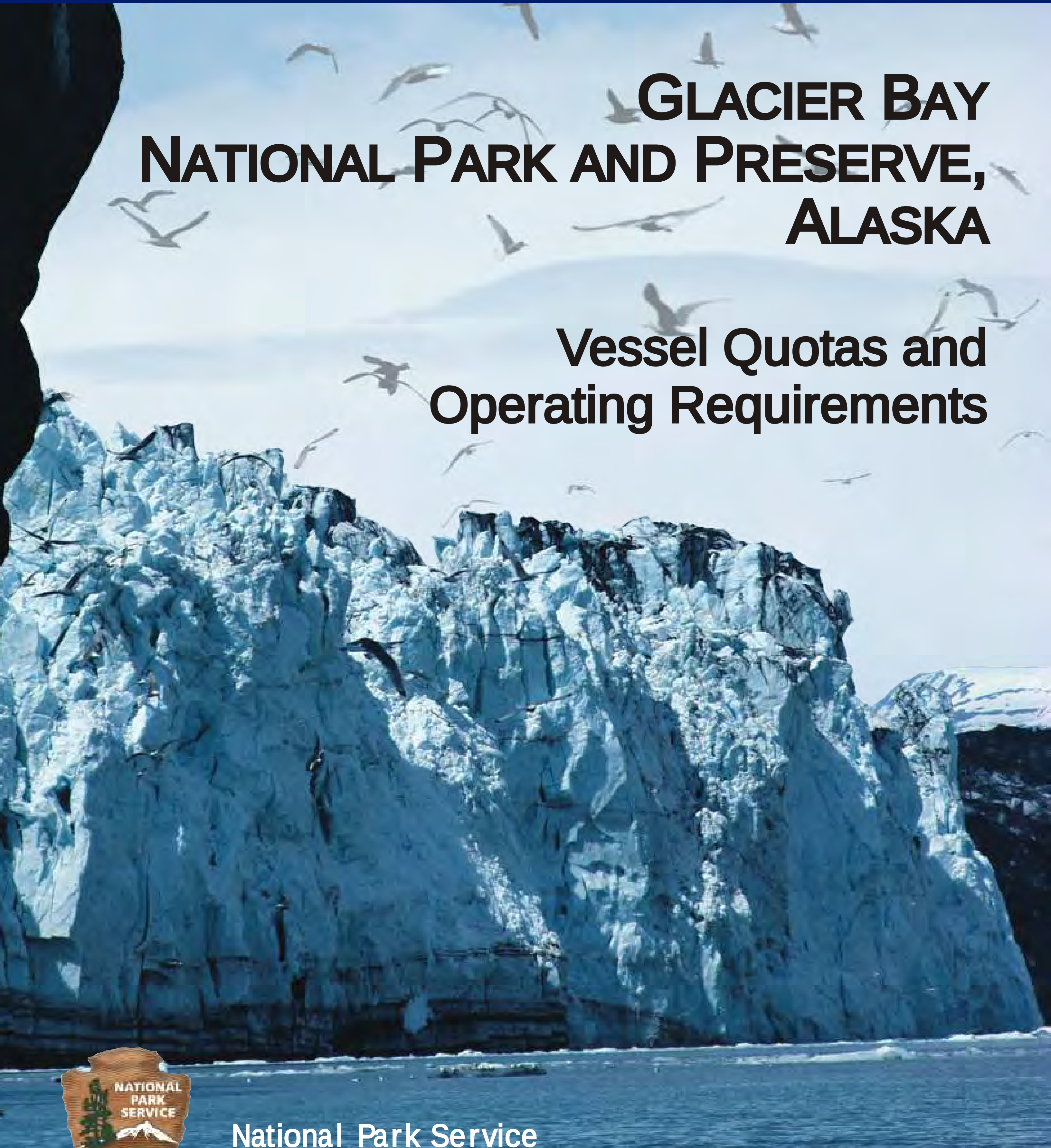
FINAL ENVIRONMENTAL IMPACT STATEMENT VOLUME I OF II

GLACIER BAY NATIONAL PARK AND PRESERVE, ALASKA

Vessel Quotas and Operating Requirements



National Park Service

Glacier Bay National Park and Preserve, Alaska
United States Department of the Interior

Front Cover Photograph by Mark Kelley • *www.markkelley.com*
Back Cover, Tufted Puffin Photograph by Shiway Wang

United States Department of the Interior

NATIONAL PARK SERVICE
Glacier Bay National Park and Preserve
P.O. Box 140
Gustavus, Alaska 99826-0140

IN REPLY REFER TO:

Tel: 907-697-2230
Fax: 907-697-2654

October 3, 2003

Dear Reader:

Enclosed is the *Final Environmental Impact Statement (FEIS) for Vessel Quotas and Operating Requirements in Glacier Bay National Park and Preserve*. If you were one of the 1,267 people who commented on the draft EIS (DEIS) last spring at public meetings, by letter or email, or via our website, thank you very much. We have read and considered each comment and have made numerous revisions and corrections to the DEIS based on what we learned from you. Appendix M of this FEIS contains a record of public comments and includes copies of the substantive comments submitted during the public comment period, with accompanying National Park Service (NPS, also "the Park Service") responses.

This FEIS contains a new alternative, alternative 6, which is the NPS preferred alternative. Many commenters on the DEIS requested that some or all of the operating requirements identified in the environmentally preferred alternative (alternative 4) be included in the preferred alternative. Alternative 6 represents a combination of the alternatives presented and evaluated in the DEIS. It shares one important element with alternative 3 in that it provides for a potential increase in cruise ship seasonal-use days during the June through August summer season. In addition, it shares many of the operating requirements considered in alternatives 4 and 5. The operating requirements for these alternatives reflect the experience and knowledge gained during the past several years. They would provide additional resource protection while also simplifying the vessel management system. The effects of alternative 6 are within the range of those evaluated in the DEIS.

The FEIS also includes a record of consultation with the National Oceanic and Atmospheric Administration (NOAA) Fisheries, including a biological opinion. The biological opinion (appendix K), which documents NPS compliance with the Endangered Species Act for the preferred alternative, concludes with a no jeopardy finding for the endangered humpback whale and Steller sea lion. It also includes several conservation recommendations. NOAA Fisheries also issued a concurrence of no-effect on essential fish habitat (appendix L) based on an assessment provided by the Park Service.

A 30-day no-action period follows the release of this FEIS. The NPS decision, including any mitigation measures and the rationale for the decision, will occur after this time and will be documented in a record of decision scheduled for release in late November 2003.

Thank you again for participating in this important planning effort for Glacier Bay National Park and Preserve.

Sincerely,

Tomie Patrick Lee

Tomie Patrick Lee
Superintendent

Glacier Bay National Park and Preserve, Alaska
Vessel Quotas and Operating Requirements
Final Environmental Impact Statement

National Park Service, Alaska Region
United States Department of the Interior

October 2003

Final Environmental Impact Statement
Glacier Bay National Park and Preserve, Alaska
Vessel Quotas and Operating Requirements

Lead Agency: National Park Service

This final environmental impact statement (FEIS) considers six alternatives to establish new or keep existing quotas (limits) and operating requirements for four types of motorized vessels – cruise ships and tour, charter, and private vessels – within Glacier Bay proper and/or Dundas Bay in Glacier Bay National Park and Preserve.

Glacier Bay National Park and Preserve is located in Southeast Alaska, approximately 65 miles (105 kilometers) west of Juneau. Accessible by boat and airplane, it is a popular destination due to its spectacular scenery, tidewater glaciers, wilderness, and wildlife. Vessel quotas and operating requirements have been in effect since 1979. The need for the actions considered in this FEIS stems from legislation enacted in 2001, wherein the U.S. Congress directed the Park Service to identify and analyze the possible effects of the 1996 increases in the number of vessel entries issued for Glacier Bay National Park and Preserve and set the maximum level of vessel entries, consistent with the purposes and values of the park. In this FEIS, the Park Service is addressing the continuing demand for vessel access into the park in a manner that assures continuing protection of park resources and values, while providing for a range of high-quality opportunities for visitors to the park.

The six alternatives evaluated in this FEIS include five action alternatives and a no-action alternative. Daily quotas, seasonal entries, seasonal-use days, quota season, and/or operating requirements differ among the alternatives. Alternatives 1, 2, and 3 would set vessel quotas and operating requirements for Glacier Bay. Alternatives 4, 5, and 6 would set quotas and operating requirements for Dundas Bay as well. In all alternatives there would be a year-round daily quota for cruise ships and tour vessels.

- **Alternative 1**, the no-action alternative, would maintain the current vessel quotas, quota season (June 1 - August 31), and operating requirements for Glacier Bay.
- **Alternative 2** would set vessel quotas for Glacier Bay in accordance with the quotas in place in 1995, maintain the current vessel quota season, and maintain current operating requirements.
- **Alternative 3** would maintain the current vessel quotas and quota season for Glacier Bay with one exception: it would include a provision to increase the number of cruise ships during the quota season, based on scientific and other information and applicable authorities. It would maintain the current vessel operating requirements.
- **Alternative 4**, the environmentally preferred alternative, would maintain the current daily quota for cruise ships and decrease the daily vessel quotas for tour, charter, and private vessels in Glacier Bay. Seasonal entry quotas would not apply. It would decrease the number of seasonal-use days for cruise ships and tour and charter vessels and increase the number of seasonal-use days for private vessels in Glacier Bay. The quota season would be May 1 through September 30. Vessel quotas would be initiated for charter vessels for Dundas Bay during a May 1 through September 30 quota season. Neither cruise ships nor tour vessels would be permitted in Dundas Bay. No quotas would be set for private vessels in Dundas Bay. Operating requirements would be modified.
- **Alternative 5** would maintain the current daily quotas and quota season for all four vessel types in Glacier Bay. Seasonal entry quotas would not apply. It would maintain the number of seasonal-use days for cruise ships, tour vessels, and charter vessels in Glacier Bay during the current June 1 through August 31 quota season, but decrease the number of seasonal-use days for cruise ships during May and September. It would increase the number of seasonal-use days for private vessels during the June through August quota season. Quotas would be initiated for tour and charter vessels in Dundas Bay, and the quota season would be June 1 through August 31. Cruise ships would not be permitted in Dundas Bay and tour vessels would not be permitted in the upper Bay (wilderness waters) on a year-round basis. No quotas would be set for private vessels in Dundas Bay. Operating requirements would be modified.
- **Alternative 6**, the NPS preferred alternative, would maintain the current daily vessel quotas for Glacier Bay. Seasonal entry quotas would not apply. It would maintain the current seasonal-use day quota for cruise ships during the current quota season (June-August), but provide for possible increases, based on the results of scientific and other information and applicable authorities. It would establish a seasonal-use day quota for cruise ships for May and September, with a provision to increase the number of seasonal-use days, based on the results of studies and monitoring. It would maintain the current number of seasonal-use days for tour and charter vessels and increase the number of seasonal-use days for private vessels during the current quota season. Quotas would be initiated for tour and charter vessels in Dundas Bay, and the quota season would be June 1 through August 31. Cruise ships would not be permitted in Dundas Bay and tour vessels would not be permitted in the upper Bay (wilderness waters) on a year-round basis. No quotas would be set for private vessels in Dundas Bay. Operating requirements would be modified.

Under all of the alternatives, motorized vessels would emit air and water pollutants, disturb some marine birds and mammals (including the endangered humpback whale), and diminish experiences for some visitors. Positive effects in some of the alternatives include increased opportunity for some visitors and simplification of vessel regulations.

This FEIS can be viewed online at http://www.nps.gov/glba.

U.S. Department of the Interior, National Park Service — Glacier Bay National Park and Preserve

CHANGES BETWEEN THE DRAFT AND FINAL ENVIRONMENTAL IMPACT STATEMENT

This final environmental impact statement (FEIS) was revised from the draft EIS (DEIS) based on responses to public comments and on internal discussions within the National Park Service. Per the National Environmental Policy Act (NEPA) section 1503.4, regarding responses to comments, agencies preparing final environmental impact statements can respond to comments in a number of ways. These ways are listed below, along with some of the major areas where comments resulted in changes in the FEIS.

MODIFY ALTERNATIVES INCLUDING THE PROPOSED ACTION OR DEVELOP AND EVALUATE ALTERNATIVES NOT PREVIOUSLY GIVEN SERIOUS CONSIDERATION BY THE AGENCY

The FEIS includes a new alternative, alternative 6, which the National Park Service has now identified as its preferred alternative (as opposed to alternative 3, identified as the preferred alternative in the DEIS). Many public comments requested that some or all of the operating requirements identified in the environmentally preferred alternative (alternative 4) be included in the preferred alternative. Alternative 6 includes many of these. Alternative 6 includes the following:

- Cruise ship quotas would be the same as alternative 3 except that the seasonal-use days for May and September would be 92 and potentially increase up to 122;
- Tour, charter, and private vessel quotas would be the same as alternative 5;
- Speed restrictions would be same as alternative 5 *except* speed would be measured “through the water” rather than “over the ground” and the 10 knots for temporary whale waters would be changed to 13 knots; and
- Whale water locations and restrictions of the use of Dundas Bay would be the same as alternative 5.

This alternative is described in detail in section 2.9. Chapter 4 was revised to include an analysis of the environmental consequences of implementing alternative 6 for each of the environmental topics evaluated in the DEIS. This alternative does not present any vessel quotas and operating requirements not already analyzed in the DEIS. It is qualitatively within the spectrum of alternatives discussed in the DEIS.

SUPPLEMENT, IMPROVE, OR MODIFY EIS ANALYSES

Each impact topic was reviewed and revised as necessary to ensure that each action being considered was evaluated adequately. In addition, many sections were edited to improve clarity and remove unnecessary or repetitive text. The most effort was placed on “Chapter 4. Environmental Consequences,” since this section contains the analytical basis for conclusions critical to NEPA compliance.

Several subsections, including soundscape, threatened and endangered species, marine mammals, marine fish, visitor experience, and socioeconomics were revised to improve logic and clarity. Based on public comments and additional agency consideration, the effects conclusions for both threatened and endangered species and marine mammals were shifted from “minor” to “moderate” based on the fact that disturbances would occur regularly and over the long term. The DEIS concluded that effects would be mostly minor because each disturbance incident would be short term. However, this conclusion did not consider the repeated nature of effects and, therefore, the conclusion was revised to “moderate.” In addition, both subsections were supplemented with new studies that were not available when the DEIS was prepared.

The biological opinion issued by NOAA Fisheries, based on the DEIS and subsequent interagency consultations, is also included in the FEIS as appendix K. The biological opinion documents NPS compliance with the Endangered Species Act for protection of the humpback whale and the Steller sea lion. The opinion makes a no jeopardy finding for both species. It includes several conservation recommendations, all addressing needed studies and monitoring.

The marine fish subsection was revised to better explain the actual effects on fish, to improve logic, and to reduce repetition. Also, a NOAA Fisheries evaluation on essential fish habitat and concurrence of no-effect on such habitat is included in the FEIS.

The soundscape analysis was revised to consider the effects on soundscape only. The soundscape analysis in the DEIS included an analysis of the effects of noise on wildlife and visitors. This was also addressed under “Biological Environment” and under “Visitor Experience.” Therefore, the duplication in soundscape was eliminated.

The visitor experience analysis was modified by expanding considerations of visitor enjoyment and the quality of experiences. The DEIS focused mainly on opportunities and access.

The socioeconomic analysis was modified by generalizing the analysis regarding effects of Glacier Bay cruise ship quotas on ports of call and on the Alaska tourism industry. Specific economic effects on the Alaska tourism industry cannot be predicted because too many variables exist, including future demand, the response of hundreds of commercial operators, and the responses of thousands (an over the years, millions) of visitors and potential visitors.

MAKE FACTUAL CORRECTIONS

Several public comments noted factual errors in the DEIS. These were evaluated and, where necessary, the text was revised for accuracy.

With the addition of a new alternative, the analysis of the effects of the new alternative has been added to each resource section. Other significant changes that have been made as this planning process moved from draft to final are listed below according to section.

OTHER CHANGES BETWEEN THE DEIS AND FEIS

Consultation and Coordination

This section has been updated to include descriptions of the public meetings that occurred after the DEIS was published and to include additional descriptions of the consultation process.

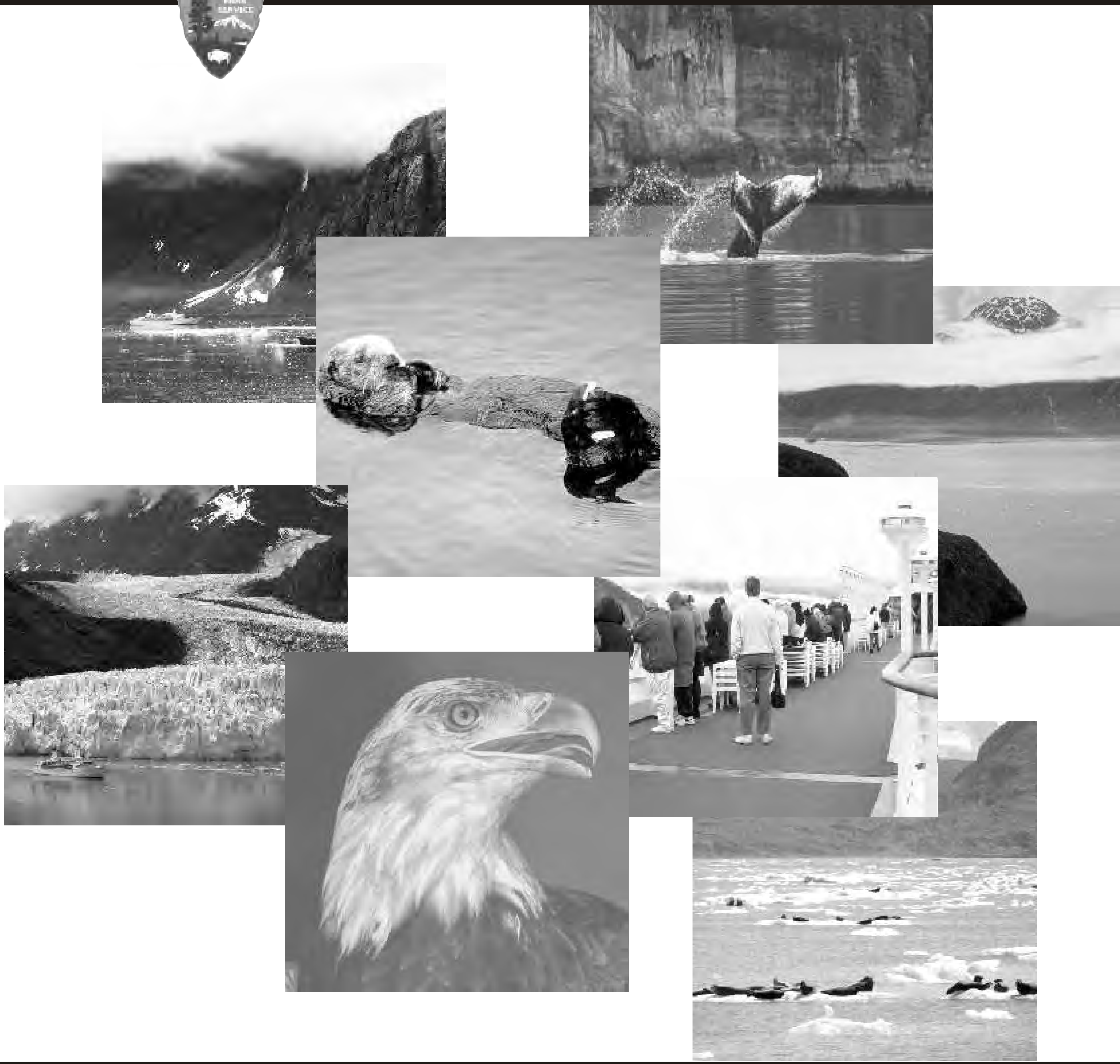
Appendices

“Appendix D. Air Emissions Calculation Methodology” has been updated to include tables that were missing from the DEIS that detail the emissions calculations for each alternative. The emissions calculations for alternative 6 also have been added.

Appendix J includes NOAA Fisheries letters for Endangered Species Act and essential fisheries habitat consultations.

Appendix M has been added. This appendix includes public comments and response to comments.

SUMMARY



GLACIER BAY

NATIONAL PARK AND PRESERVE, ALASKA

VESSEL QUOTAS AND OPERATING REQUIREMENTS • FINAL ENVIRONMENTAL IMPACT STATEMENT

SUMMARY

The National Park Service (NPS, also "the Park Service") proposes to establish new or keep existing quotas (limits) and operating requirements for four types of motorized watercraft – cruise ships, and tour, charter, and private vessels – within Glacier Bay and Dundas Bay in Glacier Bay National Park and Preserve. This final environmental impact statement (FEIS) was prepared, as required, under the National Environmental Policy Act (NEPA) of 1969 and regulations of the Council of Environmental Quality (CEQ; 40 Code of Federal Regulations [CFR] 1500). It describes a reasonable range of alternatives and the existing conditions and contains a detailed analysis of environmental consequences of the alternatives.

PURPOSE AND NEED FOR ACTION

The purpose for the action is to address the continuing demand for motorized watercraft access into Glacier Bay and Dundas Bay in a manner that ensures continuing protection of park resources and values while providing for a range of high-quality opportunities for visitors. The Park Service seeks to develop a system of vessel quotas and operating requirements for the park and preserve that will guide management of vessel traffic in the park.

The need for action stems from legislation enacted in 2001, wherein the U.S. Congress directed the Park Service to set the maximum level of motorized vessel entries based on the analysis in this EIS. Reevaluation of vessel quotas and operating requirements is required to address the continuing demand for vessel entries and park visitation. The Park Service desires, through this planning process and this EIS, to comprehensively address issues and concerns associated with vessel management and the park's marine environment.

THE ALTERNATIVES

Introduction

The National Park Service is considering six alternatives for achieving the objectives and needs described in the previous section. Each alternative defines vessel quotas (limits) and/or operating requirements for cruise ships, tour vessels, charter vessels, and private vessels. The alternatives considered share one common action; the daily vessel quota for cruise ships would be the same across alternatives (two per day).

Alternatives 1, 2, and 3 differ only in the number of vessels permitted to enter Glacier Bay. These three alternatives share the same operating requirements (i.e., the current regulations would apply). Alternative 1 (also called the "no action" alternative) would maintain the current quotas. Alternative 2 would decrease vessel quotas at those levels in effect in 1995, and alternative 3 is the current quota, plus an allowance for additional cruise ships (totaling up to two per day, every day, from June through August).

Alternative 4 (the environmentally preferred alternative) prescribes vessel quota numbers that were in effect prior to 1985, plus revised operating requirements, while alternative 5 prescribes existing vessel quota numbers with revised operating requirements; and alternative 6 (the NPS preferred alternative) is the current quota, plus an allowance for additional cruise ships (totaling up to two per day, every day from May through September) with revised operating requirements. Alternatives 4, 5, and 6 would establish vessel quotas for tour and/or charter vessels in Dundas Bay.

Operating requirements for alternative 4 differ slightly from those in alternatives 5 and 6, and the operating requirements for alternatives 5 and 6 are nearly identical. All three alternatives include:

- new closed waters for cruise ships and tour vessels.
- increased protection for harbor seal haul-out areas in Johns Hopkins Inlet.
- a revision of designated whale waters to more accurately reflect current whale use.
- a reduction in speed for large vessels that would be in effect year-round throughout Glacier Bay.

Alternative 1: No Action

Alternative 1 is the no-action alternative. The current quotas, quota season, and operating requirements for all vessel types would remain in effect for Glacier Bay under this alternative. Table S-1 lists the specific vessel quotas.

TABLE S-1: SUMMARY OF VESSEL QUOTAS FOR GLACIER BAY UNDER ALTERNATIVE 1, JUNE 1 - AUGUST 31[a]

Vessel Class	Daily Entries	Seasonal Entries	Seasonal-Use Days
Cruise ship[a]	2	139	139
Tour vessel[a]	3	276	276
Charter vessel	6	312	552
Private vessel	25	468	1,971

a. Cruise ships and tour vessels are limited to a maximum of two per day and three per day, respectively, year-round.

Alternative 2

Under alternative 2, vessel quotas would be those authorized in 1985 for Glacier Bay. The current quota season and operating requirements would remain in effect (see table S-2).

TABLE S-2: SUMMARY OF VESSEL QUOTAS FOR GLACIER BAY UNDER ALTERNATIVE 2, JUNE 1 - AUGUST 31[a]

Vessel Class	Daily Entries	Seasonal Entries	Seasonal-Use Days
Cruise ship[a]	2	107	107
Tour vessel[a]	3	276	276
Charter vessel	6	271	511
Private vessel	25	407	1,714

a. Cruise ships and tour vessels are limited to a maximum of two per day and three per day, respectively, year-round.

Alternative 3

Alternative 3 is identical to alternative 1 with one exception: it would include a provision to increase seasonal quotas for cruise ships, from 139 to 184, during June 1 through August 31, based on the results of studies and monitoring (see table S-3). This alternative would allow for two cruise ships per day every day between June 1 and August 31.

TABLE S-3: SUMMARY OF VESSEL QUOTAS FOR GLACIER BAY UNDER ALTERNATIVE 3, JUNE 1 - AUGUST 31[a]

Vessel Class	Daily Entries	Seasonal Entries	Seasonal-Use Days
Cruise ship[a]	2	139 (potentially up to 184)	139 (potentially up to 184)
Tour vessel[a]	3	276	276
Charter vessel	6	312	552
Private vessel	25	468	1,971

a. Cruise ships and tour vessels are limited to a maximum of two per day and three per day, respectively, year-round.

Alternative 4: Environmentally Preferred Alternative

Alternative 4, for Glacier Bay, would reduce the daily vessel quota across all vessel classes, eliminate the use of seasonal entries, reduce seasonal-use days for cruise ships and tour and charter vessels, and establish a quota season for May and September for all vessel classes. It would revise operating requirements for Glacier Bay. This alternative would initiate quotas for charter vessels for Dundas Bay. Cruise ships and tour vessels would not be allowed. Private vessels would not be subject to quotas in Dundas Bay. Tables S-4 and S-5 summarize vessel quotas for Glacier Bay and Dundas Bay respectively, under alternative 4.

TABLE S-4: SUMMARY OF VESSEL QUOTAS FOR GLACIER BAY UNDER ALTERNATIVE 4, MAY 1 – SEPTEMBER 30[a]

Vessel Class	Daily Vessel Quota		Seasonal Entries	Seasonal-Use Days	
	June - Aug	May and Sept		June – Aug	May and Sept
Cruise ship[a]	2	2	NA	92	61
Tour vessel[a]	2	2	NA	184	122
Charter vessel	5	5	NA	460	305
Private vessel	22	22	NA	2,024	1,342

a. Cruise ships and tour vessels are limited to daily vessel quota year-round.

NA = not applicable

TABLE S-5: SUMMARY OF VESSEL QUOTAS FOR DUNDAS BAY UNDER ALTERNATIVE 4, MAY 1 – SEPTEMBER 30[a]

Vessel Class	Daily Vessel Quota	Seasonal Entries	Seasonal-Use Days
Cruise ship[a]	Not permitted	NA	NA
Tour vessel[a]	Not permitted	NA	NA
Charter vessel	3	NA	459
Private vessel	No limit	No limit	No limit

a. Cruise ships and tour vessels are not allowed on a year-round basis.

NA = not applicable

Alternative 5

Alternative 5 would maintain the current daily vessel quotas for all vessel types in Glacier Bay, eliminate the use of seasonal entries, and maintain the current seasonal-use day quotas for cruise ships and tour and charter vessels during the current June 1 through August 31 quota season. It would increase slightly the seasonal-use day quota for private vessels during the June through August quota season and set a seasonal-use day quota for cruise ships, in May and September. It would revise operating requirements for Glacier Bay. This alternative would initiate quotas for tour and charter vessels for Dundas Bay during a June 1 through August 31 quota season. Cruise ships would not be allowed in Dundas Bay. Private vessels would not be subject to quotas in Dundas Bay. Tables S-6 and S-7 summarize vessel quotas for Glacier Bay and Dundas Bay, respectively, under alternative 5.

TABLE S-6: SUMMARY OF VESSEL QUOTAS FOR GLACIER BAY UNDER ALTERNATIVE 5, MAY 1- SEPTEMBER 30[a]

Vessel Class	Daily Vessel Quota		Seasonal Entries	Seasonal-Use Days	
	June - Aug	May and Sept		June - Aug	May and Sept
Cruise ship[a]	2	2	NA	139	92
Tour vessel[a]	3	3	NA	276	183
Charter vessel	6	No limit	NA	552	No limit
Private vessel	25	No limit	NA	2,300	No limit

a. Cruise ships and tour vessels are limited to daily vessel quota year-round.

NA = not applicable

TABLE S-7: SUMMARY OF VESSEL QUOTAS FOR DUNDAS BAY UNDER ALTERNATIVE 5, JUNE 1 – AUGUST 31[a]

Vessel Class	Daily Vessel Quota	Seasonal Entries	Seasonal-Use Days
Cruise ship[a]	Not permitted	NA	NA
Tour vessel[a]	1 in non-wilderness waters[b]	NA	92 in non-wilderness waters[b]
Charter vessel	No limit	NA	276
Private vessel	No limit	No limit	No limit

a. Cruise ships are not allowed on a year-round basis. Tour vessels are not allowed in wilderness waters on a year-round basis.
b. Upper Dundas Bay is wilderness waters; the lower Bay is non-wilderness waters.

NA = not applicable

Alternative 6: NPS Preferred Alternative

Alternative 6 would maintain the current daily vessel quotas for Glacier Bay. Seasonal entry quotas would not apply. It would maintain the current seasonal-use day quota for cruise ships during the current quota season (June-August), but provide for possible increases, based on the results of scientific and other information and applicable authorities. It would establish a seasonal-use day quota for cruise ships for May and September, with a provision to increase the number of seasonal-use days, based on the results of studies and monitoring. It would maintain the current number of seasonal-use days for tour and charter vessels and increase the number of seasonal-use days for private vessels during the current quota season. Quotas would be initiated for tour and charter vessels in Dundas Bay, and the quota season would be June 1 through August 31. Cruise ships would not be permitted in Dundas Bay and tour vessels would not be permitted in the upper Bay (wilderness waters) on a year-round basis. No quotas would be set for private vessels in Dundas Bay. Operating requirements would be modified. Tables S-8 and S-9 summarize vessel quotas for Glacier Bay and Dundas, respectively, under alternative 6.

TABLE S-8: SUMMARY OF VESSEL QUOTAS FOR GLACIER BAY UNDER ALTERNATIVE 6, MAY 1- SEPTEMBER 30[a]

Vessel Class	Daily Vessel Quota		Seasonal Entries	Seasonal-Use Days	
	June - Aug	May and Sept		June - Aug	May and Sept
Cruise ship[a]	2	2	NA	139 (potentially up to 184)	92 (potentially up to 122)
Tour vessel[a]	3	3	NA	276	183
Charter vessel	6	No limit	NA	552	No limit
Private vessel	25	No limit	NA	2,300	No limit

a. Cruise ships and tour vessels are limited to daily vessel quota year-round.

NA = not applicable

TABLE S-9: SUMMARY OF VESSEL QUOTAS FOR DUNDAS BAY UNDER ALTERNATIVE 6, JUNE 1 – AUGUST 31[a]

Vessel Class	Daily Vessel Quota	Seasonal Entries	Seasonal-Use Days
Cruise ship[a]	Not permitted	NA	NA
Tour vessel[a]	1 in non-wilderness waters[b]	NA	92 in non-wilderness waters[b]
Charter vessel	No limit	NA	276
Private vessel	No limit	No limit	No limit

a. Cruise ships are not allowed on a year-round basis. Tour vessels would not be allowed in wilderness waters.
b. Upper Dundas Bay is wilderness waters; the lower Bay is non-wilderness waters.

NA = not applicable

AFFECTED ENVIRONMENT

The topics addressed in the affected environment section were selected based on federal law, regulations, executive orders, NPS management policies, National Park Service subject-matter expertise, and concerns expressed by other agencies or members of the public during scoping and comment periods.

Physical Environment

Fjord Dynamics and Oceanographic Processes. The most significant physical aspect of Glacier Bay is that it is a recently deglaciated fjord in southeast Alaska. The north end of the Bay's main body divides into two fjord systems known as the East and West Arms. Muir Inlet is included in the East Arm.

Soundscape. The park's soundscape includes both naturally occurring and human-made sounds. When evaluated against the natural soundscape in a park, human-caused sound is considered "noise." At present, much of the human-generated sounds in the park originate from motorized vessels and, therefore, these sounds are most prevalent over the water, under the water, and along the shoreline.

Air Quality. Air emission sources within the park include emissions from fuel combustion during vessel operations, fuel combustion for heating of buildings at Bartlett Cove, fuel use by vehicles in Bartlett Cove, and occasional campfires. The greatest source of emissions within Glacier Bay and Dundas Bay is marine vessel traffic, and includes nitrogen oxides, sulfur oxides, and particulate matter.

Water Quality. Glacier Bay water quality is affected by a number of factors, including run-off, sedimentation, tidal variations, large-scale mixing and up-welling zones, the overall complex topography of the area, and motorized vessels. The consensus among researchers is that water quality in the Bay is generally good. Potential pollution sources in the Bay include motorized vessels and runoff from developed areas adjacent to the Bay.

Biological Environment

Threatened and Endangered Species. Two threatened and endangered species listed under the Endangered Species Act are present in Glacier Bay and Dundas Bay. The central North Pacific stock of humpback whales is listed as endangered. Also present, is the eastern and western stock of Steller sea lions, which are listed as threatened and endangered, respectively.

Marine Mammals. Marine mammals that inhabit the park seasonally or year-round other than the two marine mammals listed as threatened or endangered include: minke whale, harbor porpoise, killer whale, harbor seal, and sea otters.

Marine Birds and Raptors. The bird community of Glacier Bay and Dundas Bay is typical of southeastern Alaska. Marine birds (birds that spend most or all of their life near and in marine areas) are the most common type of bird in the planning area. Of these, the most sensitive to vessel traffic are colonial nesting marine birds, murrelets, molting waterfowl, raptors, shorebirds, and seaducks. Marbled murrelets are present throughout the park and although not listed in Alaska are listed as threatened in California, Oregon, and Washington. Kittlitz's murrelets are also present in the park in great numbers and are currently under review as a potential candidate for listing under the Endangered Species Act.

Marine Fishes. Four pelagic fish species, including capelin, walleye pollock, Pacific herring, and northern lampfish, account for approximately 90 percent of the total number of identified fish in the park. The demersal fishes (bottomfish) found in the park are members of the skates, sculpins, and flatfishes. Five species of salmon and steelhead trout occur in the waters of Glacier Bay and Dundas Bay.

Coastal/Shoreline Environments and Biological Communities. Glacier Bay's southern portions have more fine grain beaches than the northern reaches because shorelines in these southern areas are more mature. Farther north, the shoreline structure is less mature with more cobble/boulder beaches, exposed bedrock, and little vegetation. The shoreline vegetation found in the middle and northern portions of Glacier Bay comprises those species that colonize areas after a disturbance. At the terminus of the glaciers, exposed bedrock overlain by fine sediment is prevalent due recent glacial activity. The vegetation is sparse and includes hardy pioneer species. Water temperature, salinity, amount of suspended sediment, and ice scour are key factors controlling biological community development and all of these variables are directly related to the proximity of the site to tidewater glaciers. In general, community diversity in rocky intertidal communities close to tidewater glaciers is very low.

Shoreline environments and biological communities in Dundas Bay are more mature than Glacier Bay because the most recent glacial advance did not affect this area.

Human Environment

Cultural resources.

Archaeological resources — Archaeological resources that have been found, or can be expected to occur, in the park are diverse and include: petroglyphs and petrographs, culturally modified trees, rock shelters, villages, forts, fishing sites and weirs, hunting and gathering sites, stone cairn formations, mining camps, canneries, trading posts, log cabins, trails, horticulture sites, buried sites, major/multi-component sites, cemeteries or burials, and intertidal and wet zones.

Ethnographic resources — A Park Service preliminary assessment of Glacier Bay and Dundas Bay has identified approximately 15 sites that may qualify as traditional cultural properties.

Cultural (or ethnographic) landscape — The Park Service has compiled two Cultural Landscapes Inventories in the park at Bartlett Cove and Dundas Bay. Both areas may be eligible for listing in the National Register for Historic Places. They are components of a larger ethnographic landscape that encompasses the entire park and preserve.

Visitor Experience. For this environmental impact statement, five major visitor groups are defined: 1) cruise ship passengers; 2) tour vessel passengers; 3) charter vessel passengers; 4) private vessel visitors; and 5) backcountry visitors. In 2001, nearly 383,000 visitors traveled through Glacier Bay aboard cruise ships, tour vessels, charter vessels or private vessels and other modes. Eighty-five percent of park visitors are cruise ship passengers.

Vessel Use and Safety.

Vessel traffic — Cruise ships in Glacier Bay generally follow a predictable pattern after they enter the park. Cruise ships arrive into Glacier Bay both from the west through Cross Sound and east through Icy Strait. They generally follow a predictable pattern after they enter the park, traveling into the West Arm of the Glacier Bay. Most leave Glacier Bay between 4:00 and 8:00 p.m. each evening.

Tour, charter, and private vessels are capable of entering remote inlets and harbors within Glacier Bay and Dundas Bay, although they also tend to follow typical routes. The primary anchorages for tour, charter, and private boats within Glacier Bay are: North and South Sandy Cove, Blue Mouse Cove, Reid Inlet, Berg Bay, Geikie Inlet, Tidal Inlet, Russell Island Passage, Johnson Cove, Goose Cove, Adams Inlet, Sebree Cove, and North and South Fingers Bay.

There is a legislated provision for a daily passenger ferry from Juneau to Bartlett Cove.

Vessel safety — Since the Vessel Management Plan was implemented in 1996, no cruise ships have been involved in collisions or groundings. A crab boat, fishing in the winter, sank, and two tour vessels have grounded and released some fuel into the environment. In a separate incident, another tour vessel struck an iceberg in Tarr Inlet and suffered hull damage. There was no oil spill associated with this incident. Twenty-one other vessels (mostly private vessels) have grounded, but with only minor damage reported. Other types of accidents commonly reported include vessels going adrift or dragging anchor, and minor collisions.

Wilderness Resources. Approximately 2,658,186 acres of Glacier Bay National Park's total of 3,283,168 acres are designated as part of the National Wilderness Preservation System. These wilderness resources include most of the land in the park above the mean high tide line and five marine wilderness waterways: the Beardslee Islands, upper Dundas Bay, the Hugh Miller/Scidmore Complex, Adams Inlet, and Rendu Inlet. The Glacier Bay Wilderness offers some of the most unique resources in all of the National Wilderness Preservation System. Calving tidewater glaciers, temperate rainforest, plant diversity, and terrestrial and marine wildlife including threatened and endangered species, provides an unparalleled intact ecosystem.

Local and Regional Socioeconomics. Communities neighboring Glacier Bay and Dundas Bay include relatively small villages, native communities, and larger towns that rely on tourism; federal, state, and local government; and the fishing, forest products, and mining industries as a basis for their economies. The nearest community to the park in Gustavus, which is unincorporated. The Gustavus economy is supported by federal employment associated with Glacier Bay National Park and Preserve, commercial fishing, tourism, and state government. Other nearby communities include: Elfin Cove, a vital service center for recreational and commercial vessels, primarily supported by charter fishing and tourism; Hoonah a predominantly Alaska Native community, supported by commercial fishing, timber, government, and emerging tourism; Pelican, supported by commercial fishing; Haines, a center for commercial fishing, construction, tourism, and government; Yakutat, a predominantly Alaska Native community dependent on commercial fishing, fish processing, sport fishing, and tourism; Juneau, the capital of Alaska and the service, supply, and transportation hub for northern Southeast Alaska; Skagway, a vital transportation and tourism center; and Sitka, supported by commercial fishing, tourism, and government.

ENVIRONMENTAL CONSEQUENCES

The environmental impact statement evaluates the environmental consequences of the six alternatives in Glacier Bay and Dundas Bay by considering direct, indirect, and cumulative effects:

- **Direct effects** are those that result from the action and occur at the same time and place. Dispersion of air pollutants from a vessel stack into the atmosphere is an example of a direct effect.
- **Indirect effects** are those reasonably foreseeable effects that are caused by the action but that may occur later and not at the location of the direct effect. For example, an indirect effect of reducing vessel traffic in Glacier and Dundas Bays may be an increase in demand for use of other areas.
- **Cumulative effects** are the incremental effect of the proposed action when added to the effects of past, other present, or reasonably foreseeable future actions. Cumulative effects can result from individually minor, but collectively significant, actions taking place over time.

Effects of each "action" alternative were evaluated against the "no-action" alternative, so references to "increases" or "decreases" of effects relate to the increase or decrease as compared to alternative 1, the no-action alternative.

Effects Thresholds

Thresholds help establish the basis for understanding the severity and magnitude of the effects. Under each element of the environment, effects thresholds are defined using four categories of significance:

negligible, *minor*, *moderate*, and *major*.

An overview of the environmental consequences of the six alternatives for each environmental resource/topic area is provided below.

Physical Environment

Soundscape – The "natural soundscape" is what the Park Service calls natural sounds in the absence of human-caused sound. The Park Service considers the natural soundscape as a resource similar to air or water. Director's Order 47, Sound Preservation and Noise Management (NPS 2001c), directs all NPS units to protect, maintain, or restore the natural soundscape resource.

Under any of the alternatives, noise from cruise ships and tour, charter, and private vessels would continue to be common both on the surface and underwater and would frequently intrude over broad areas, such as inlets and bays. More data is needed to determine the actual extent of vessel noise. Vessel noise under all alternatives is considered moderate because noise would regularly intrude upon the natural soundscape over broad areas.

Under Alternative 1, human made sound would be present in the surface soundscape in most areas of the Glacier Bay and Dundas Bay. Human made sound would be dominant near the Bartlett Cove Dock and campground at all times and would be expected to be dominant during certain times of the day in other areas at popular stops along the route to upper Glacier Bay and the tidewater glaciers. These areas include:

- Sitakaday Narrows
- Gloomy Knob
- South Marble Island
- North Sandy Cove
- McBride Inlet
- Tarr, Johns Hopkins, and Reid Inlets

Because sound can travel long distances over water, human made sounds could also be heard within the non-motorized waters of Glacier Bay from vessels transiting outside of these areas. Under all alternatives, surface noise from cruise ships, including public address systems, would regularly intrude across broad areas.

However, because human made sounds would be present periodically throughout the day, natural sounds would still dominate in most areas of Glacier Bay and Dundas Bay.

On-going underwater sound monitoring conducted off-shore near Bartlett Cove (NSWC 2002) shows that vessel noise is pervasive underwater in Glacier Bay. Underwater noise from motor vessels is expected to be present throughout all waters open to motorized vessels and also within most non-motorized waters, since sound travels well underwater. The extent of this noise proliferation is expected to be within the moderate range.

While no studies have been conducted in Dundas Bay, vessel noise is expected to be a regular element of the underwater soundscape there as well. Current human-caused surface sounds in Dundas Bay include tour, charter, and private vessels within the wilderness waters of the upper Bay.

Cruise ship related noise could increase in May and September when there is no seasonal use day quota and 2 cruise ships per day, every day may enter Glacier Bay.

Alternative 2 would have the second lowest vessel noise among the alternatives. This is because reduced cruise ship and charter and private vessel numbers would reduce the overall generation of vessel noise from June through August. This alternative includes the lowest seasonal use day quota for private vessels. This, in turn could mean a reduction in the amount of man made sound near the shoreline where many private vessels tend to travel.

Alternative 3 would generate the most sound among the alternatives. It would have similar effects to alternative 1, but with the potential to increase cruise ships; this could result in daily exposure of noise from two cruise ships per day.

Alternative 4 would result in the lowest level of vessel-related noise among the alternatives, due to reduced quotas for all vessel classes, speed restrictions on cruise ships (which could greatly reduce the magnitude of underwater sound) and the elimination of cruise ships and tour vessels form a portion of the East Arm, Beardslee Entrance, and Fingers and Berg Bays. Under alternative 4, the soundscape in Dundas Bay would improve because of the daily limit and seasonal quota on charter vessel use and the closing of the Dundas Bay to cruise ships and tour vessels.

Alternative 5 and 6 would be roughly in the middle range of noise generation among the alternatives. Alternative 5 and 6 would reduce current effects on soundscape by reducing cruise ship speeds, extending the seasonal-use day quota for cruise ships to include May and September, and prohibiting tour vessels in the wilderness waters of Dundas Bay, the entrance to Adams Inlet, and the Beardslee Entrance.

Air quality — The two primary concerns related to air quality are the amount of pollutants emitted into the air and the potential from emissions for vessels to leave a visible plumes and/or create haze.

Emissions under all alternatives would be within the moderate range. All alternatives would emit nitrogen oxides in Glacier Bay above the 250-tons-per-year threshold and, except for alternative 4, emissions of sulfur dioxide above the 100 ton per year threshold. However, based on the large amount of the area over which emission would occur, the limited number of other significant emission sources, and using Juneau’s air quality for comparison, it is unlikely that these emissions would result in ambient air concentrations that are greater than 80% of the National Ambient Air Quality Standards.

Visible haze from stack emissions are known to occur under current conditions, although the frequency, magnitude, and duration of such events is unknown. Reduced vessels under alternative 2 would reduce the magnitude and, because alternative 2 would allow the fewest number of private vessels, nearshore – short-term reductions of air quality would be the lowest. Alternative 3 would increase the frequency of visible haze, should cruise ships be increased. The frequency cannot be predicted, although the NPS is undertaking an air quality monitoring program that would help predict the frequency, magnitude, and duration.

Alternative 4 would produce the lowest amount of emissions into the air due to the lowest numbers of vessels and speed restrictions for cruise ships. Eliminating tour vessels and limiting charter vessels in Dundas Bay would improve air quality there, although there is no evidence that air quality is currently a problem. Alternative 5 would also reduce emissions by limiting cruise ship speeds, by applying seasonal restrictions for cruise ships in May and September, and by eliminating tour vessels from the wilderness waters of Glacier Bay. These same measures would reduce emissions under alternative 6. Alternative 6 would result in increased emissions and visible haze due to the increase in cruise ships. Alternatives 5 and 6 would allow for the highest level of short-term emissions near shorelines due to the increase in private vessels.

Water quality - While the emissions of small amounts of fuel, oil, and wastewater would vary with the vessel quotas under each alternative, effects on water quality under any of the alternatives are expected to be minor, with the exception of fuel spills in Bartlett Cove, which could cause moderate level effects. A catastrophic oil spill in not an expected outcome of any of the alternatives. Cruise ships carry sufficient fuel into Glacier Bay to cause a major spill, however, such a spill is unlikely because cruise ships have a good worldwide safety record, are built to very high safety standards, tend to travel mostly in open waters away from navigational hazards, have highly trained and knowledgeable operators, and while in Glacier Bay carry licensed pilots on board the vessel. Tour vessels, on the other hand, have the highest potential for impacts, since they carry relatively large amounts of fuel and tend travel closer to the shoreline and more remote areas of Glacier and Dundas Bay than cruise ships. Alternative 4, 5, and 6 would prohibit cruise ships and tour vessels in Dundas Bay wilderness waters, which could reduce the potential for groundings and possible resulting spills in this area and where groundings have already occurred.

Biological Environment.

Threatened and endangered species —Populations of both humpback whales and Steller sea lions are recovering from historic lows. A biological opinion, issued by NOAA Fisheries, documents that alternative 6 would not jeopardize the continued existence of the North Pacific humpback whale population or Steller sea lion populations present in Southeast Alaska and would comply with the Endangered Species Act.

Under all alternatives, vessel traffic could regularly disturb humpback whales and Steller sea lions. Animals located near highly traveled vessel areas could be disturbed several times per day during summer. The amount of predicted disturbance varies among alternatives generally in proportion to vessel numbers and in relation to cruise ship speeds. The traffic is not expected to cause animals to leave Glacier or Dundas Bays, but it could cause some animals to leave particular areas to avoid vessel traffic, which in turn, can reduce foraging, survival and reproduction. The ultimate effect of this disturbance could be reduced energy intake (e.g., feeding) and/or increased energy expenditure (e.g. vessel avoidance behavior). Most wild animals operate under an extremely tight energy budget. Such energy budgets can become critical during high-energy demands, such as breeding, pregnancy, caring for young, or during bouts of extreme weather. Animals subject to repeated disturbances might have lower energy reserves and consequentially lower reproduction and/or survival.

The effect level is expected to be within the moderate range for all alternatives. Even though disturbance could occur regularly it is not expected to reduce overall abundance of either humpback whales or Steller sea lions.

Humpback whales are vulnerable to being struck by vessels, although an average of only about one mortality is reported each year for the entire North Pacific stock. Still, a humpback whale was struck and killed by a cruise ship in park waters in 1999. Smaller vessels also strike whales, but such strikes are typically not lethal. Based on the best available information, reducing cruise ships speed limits to 13 knots would reduce the risk of fatal vessel/whale collisions. This speed limit would be required throughout Glacier Bay in alternatives 4, 5, and 6.

Underwater noise from vessels is expected to interfere with humpback whale foraging and communication. Cruise ships generate more underwater noise than any other vessel type in Glacier Bay. Based on the analysis, a cruise ship traveling at near 20 knots is probably audible to humpback whales up to 25 miles (40 kilometers) away and would be sufficiently loud to provoke a response from a humpback whale over 6 miles (9 kilometers) away.

Sound levels under alternatives 1, 2, and 3 would commonly be at these levels or higher (with the exception of waters where 10-knot speed limits have been put in place to protect whales). Reduced speed limits (13 knots) for cruise ships under alternatives 4, 5, and 6 would greatly reduce underwater noise and its associated effects.

Steller sea lions may be disturbed by vessel noise as well. However, the primary vessel disturbance factor in Glacier Bay is vessels approaching the sea lions hauled out at South Marble Island. Based on recent research, the 100-yard (90-meter) buffer at this area may not be sufficient and increasing the buffer to up to 200 yards (180 kilometers) might reduce disturbance to Steller sea lions.

Listed from the highest to lowest levels of disturbance are:

- Alternative 3, which has highest cruise ship numbers and does not include speed limits for cruise ships outside of designated and temporary whale waters;
- Alternative 1, the no-action alternative, which would not change vessel numbers from those presently in place and does not include speed limits for cruise ships outside of designated and temporary whale waters;
- Alternative 6, the NPS preferred, has the potential to increase cruise ship numbers would restrict cruise ship speeds to 13-knots throughout Glacier Bay and eliminate cruise ships from Dundas Bay.
- Alternative 5, which reduces cruise ship numbers in May and September, restricts cruise ship speeds to 13 knots or less throughout Glacier Bay, and eliminates cruise ships from Dundas Bay.
- Alternative 2, which contains the lowest vessel numbers but does not include speed limits for cruise ships outside of designated and temporary whale waters;.
- Alternative 4, the environmentally preferred alternative, which contains the lowest numbers of vessels, includes speed restrictions for cruise ships to 13 knots or less throughout Glacier Bay, and would eliminate cruise ships and tour vessels from Dundas Bay.

Marine mammals – Vessel traffic under each of the alternatives would regularly disturb marine mammals in Glacier Bay and Dundas Bay. The overall effect is considered moderate because vessels would regularly disturb individual animals, however numbers are expected to remain within historic levels.

The ultimate effect of this disturbance could be reduced energy intake (e.g., feeding) and/or increased energy expenditure (e.g. vessel avoidance behavior). Most wild animals operate under an extremely tight energy budget. Such energy budgets can become critical during high-energy demands, such as breeding, pregnancy, caring for young, molting, or during bouts of extreme weather. Animals subject to repeated disturbances might have lower energy reserves and consequentially lower reproduction and/or survival. Existing regulations for Glacier Bay National Park and Preserve (36 CFR 13.65) specify buffers in haul-outs and approach distance requirements that provide protection from motor vessel activities.

The amount of predicted disturbance varies among alternatives generally in proportion to vessel numbers. Alternatives 5 and 6 allow the most private vessels among the alternatives, and private vessels are expected to cause some of the greatest disturbances because they tend to travel closer to the shoreline then the other vessel classes where marine mammals are predominant.

The greatest concern for marine mammals is potential additive effect on harbor seals from vessel traffic when combined with the other factors that may be causing harbor seals to decline in Glacier Bay and Southeast Alaska. Glacier Bay supports one of the largest concentrations of harbor seals in Alaska, yet populations have declined dramatically over the last 10 years. The reasons are not known, but declines have occurred throughout the species range and reasons are expected to include factors other than vessel traffic.

Under all alternatives, the upper portions of Johns Hopkins Inlet would be closed to all vessels from May 1 through June 30 to protect harbor seals when they are pupping. Alternatives 1, 2, and 3 would require that vessels remain at least 0.25 mile away from harbor seas hauled out on ice in July and August. This would reduce disturbance to harbor seals when they are molting and especially sensitive to disturbance.

Alternatives 4, 5, and 6 would extend the requirement that vessels remain a minimum of 0.25 mile away from harbor seals hauled out on ice to year round. This would reduce vessel disturbance to harbor seals after August 30, when Johns Hopkins Inlet is open to all vessel types, including cruise ships.

Marine birds and raptors — All of the alternatives would result in moderate level effects on marine birds and raptors. The most notable effects would be disturbance of concentration areas of brood-rearing harlequin ducks, molting waterfowl, and foraging marbled and Kittlitz's murrelets. These species are particularly sensitive to vessel traffic and are expected to experience potential local population declines if continually disturbed by vessels. Existing regulations which specify approach limits in certain sensitive areas, would continue to provide protection to seabird colonies.

The level of disturbance is related to vessel numbers. The ultimate effect of this disturbance could be reduced energy intake (e.g., feeding) and/or increased energy expenditure (e.g. vessel avoidance behavior). Most wild animals operate under an extremely tight energy budget. Such energy budgets can become critical during high-energy demands, such as breeding, pregnancy, caring for young, molting, or during bouts of extreme weather. Animals subject to repeated disturbances might have lower energy reserves and consequentially lower reproduction and/or survival. Private vessels are the most likely to disturb marine birds, since these vessels travel widely throughout Glacier Bay, tend to travel closer to the shoreline than other vessel types, and are the most numerous. Alternatives 5 and 6 would allow the most private vessels and associated effects. This effect is still considered within the moderate range.

Marine Fishes – Effects on marine fish are expected to be minor for all alternatives. Vessel traffic under any of the alternatives would generate underwater noise and vibration that temporarily displace or disturb fish. The degree of displacement or disturbance would depend on the volume of vessel traffic. Implementation of alternatives 2 and 4 would decrease the overall vessel traffic relative to alternative 1 and therefore the disturbance of fish would decrease. Alternative 3 and 6 would increase the number of cruise ship entries could result in an increased displacement or disruption of fish.

The increases in private vessel seasonal-use days under alternatives 4, 5, 6 could result in more sport fishing and therefore increased fish catch and reducing local abundance of species such as halibut.

Coastal/Shoreline Environment and Biological Communities – While some shoreline erosion may occur, the overall effect of vessel traffic on shorelines was found to be minor across all alternatives, with no real difference in the amount of expected effect between alternatives in Glacier Bay and Dundas Bay.

Human Environment.

Cultural resources — None of the alternatives would damage archaeological or historic resources because (a) they are exceedingly rare in Glacier Bay since glaciers have recently scoured the entire Bay and (b) the few that are present are located well away from shorelines and the effects of vessels.

Effects to ethnographic resources relate to the integrity of traditional cultural properties, including cultural landscapes: namely the Ancestral Homeland of the Huna Tlingit. The effects, which include perceptions of the Huna Tlingit, relate closely to vessel numbers. Therefore, Alternative 3 and 6 would have the greatest effect and alternative 4 the lowest. This effect is considered to be within the moderate range because it is expected that there would be a perceived degradation of cultural landscapes but not to the point of creating a disconnection of peoples from an Ancestral Homeland.

Visitor experience — One of the important purposes of vessel quotas and operating requirements is to provide a range of enjoyable visitor experiences.

Under all alternatives, the sights and sounds of other visitors and their motorized vessels would detract from the enjoyment of some visitors. Backcountry visitors can be sensitive to this disturbance because they generally travel by non-motorized methods (e.g., kayaks or on foot), which does not mask the sound of vessels, and are more likely to be seeking natural quiet and solitude. However, the sound of other motorized vessels can also impact visitors in motorized vessels when their vessels are drifting without the motor engaged or at anchor.

Alternative 1 would maintain the current level of disturbance, which is considered within the moderate range for backcountry users. Alternative 2 would reduce vessel numbers and associated disturbances to visitors, but would also restrict access by reducing quotas. Alternative 3 would increase opportunities for people to visit Glacier Bay via cruise ship, but would detract from the experiences of other visitors due to the sights, and sounds of and visible haze from cruise ships. Alternative 4 would have the lowest amount of disturbance, but would also greatly reduce available permits for people wishing to visit Glacier Bay and/or Dundas Bay. Alternative 4 would improve enjoyment for visitors aboard charter and private vessels and backcountry users by closing all or a portion of the East Arm of Glacier Bay, the Beardslee Entrance, Fingers and Berg Bays, and Dundas Bay to cruise ships and tour vessels. This, however, would also reduce opportunities for people wishing to tour Glacier Bay or Dundas Bay in a cruise ship or tour vessel. Alternatives 5 and 6 would close to cruise ships and tour vessels the entrance Adams Inlet, Beardslee Entrance, and the wilderness waters of Dundas Bay. This would improve conditions for charter and private vessel users and backcountry users in these areas and would still keep the East Arm available for cruise ship and tour vessel passengers. Alternatives 5 and 6 would increase nearshore disturbances caused by private vessels but would also reduce vessel-related disturbance in the wilderness waters of Dundas Bay by eliminating tour vessels there.

Under alternatives 1, 2, and 3, “seasonal entries” would still be used to measure quotas for all vessel classes. This could result in some private vessel visitors being denied entry during the peak visitation period of mid-summer. Under alternatives 4, 5, and 6, three changes in the way vessel quotas are measured would improve opportunities for private vessel visitors. The ‘based in Bartlett Cove’ exemption would be eliminated, short-notice permits for private vessel would be available, and the use of ‘seasonal entries’ would be eliminated. These actions would simplify the regulations, reduce frustration of visitors in private vessels, and provide increased opportunity for private vessel visitors to experience Glacier Bay during the peak summer months. These alternatives also would simplify whale water designations to make them easier to follow and more reflective of actual conditions.

Alternatives 4 would increase wilderness and solitude in the wilderness waters of Dundas Bay and the East Arm of Glacier Bay north of Muir Point by prohibiting cruise ships and tour vessels. Alternatives 5 and 6 would restrict tour vessels and cruise ships from the wilderness waters of Dundas Bay and the entrance to Adams Inlet and Beardslee Entrance in Glacier Bay. These actions would increase opportunities for solitude and to experience wilderness in these areas for other charter and private vessel visitors and backcountry visitors.

A 13-knot speed limit would be set for cruise ships under alternatives 4, 5, and 6. This would add about 3 hours to the amount of time visitors on cruise ships would remain in Glacier Bay. This additional time could either enhance or detract from the cruise ship passengers visit. Some visitors may enjoy and appreciate the extra time spent in Glacier Bay observing the scenery and wildlife. For other visitors this additional time may appear to be an annoyance and delay them from their future itinerary. The increased time cruise ships spend in Glacier Bay could also increase the exposure other visitors have to the sights and sounds of cruise ships.

Vessel use and safety — The effects to vessel safety and use are summarized below according to vessel safety and traffic and the risk of major vessel accidents. Vessel safety and traffic reflects the number of vessels in Glacier and Dundas Bays and the speed at which the vessels travel. Alternative 1 reflects existing conditions and projected increases to fill vessel quotas. Given that there have been no major accidents since this management strategy was implemented and a good safety record from 1994-2001, the effect on vessel safety due to the implementation of alternative 1 would be negligible.

The relative change in vessel safety between alternatives 1, 2, and 3 would be reflected in the number of vessels in Glacier Bay at any one time. The decrease in vessels in alternative 2 could increase the relative level of vessel safety and the increase in vessels in alternative 3 could decrease the relative level of safety compared to alternative 1.

Alternatives 4, 5, and 6 have vessel quotas for Dundas Bay as well as Glacier Bay and revised operating requirements. The decrease in the number of vessels, the designated vessel routes, and the speed limits included in alternative 4 could increase vessel safety by decreasing and controlling vessel traffic Glacier Bay. Restricting cruise ships and tour vessels from Dundas Bay in alternative 4 could reduce vessel congestion in that area and prevent groundings. Dundas Bay is poorly charted and contains many navigational hazards and shallow areas that could pose safety hazards to cruise ships and tour vessels.

The vessel quotas in alternatives 5 and 6 are comparable to current high use days; therefore, their effects are similar to alternative 1. However, alternative 5 measures vessel speed over the ground whereas alternative 6 would measure vessel speed through the water. The measurement of vessel speed over the ground could decrease vessel safety under alternative 5 because vessel maneuverability can be, at times, compromised when vessels try to maintain their speed over the ground and travel with currents. Under alternative 5 and 6 the restriction of cruise ships and tour vessels from Dundas Bay wilderness waters could increase vessel safety compared to alternative 1.

The risk of a major vessel accident is similar among all the alternatives. The history of vessel incidents shows that there have been no major accidents, however, the potential still exists. The worst case accident scenario for Glacier Bay would be a major fuel spill in ice-filled waters. Therefore, the risk of an accident increases with an increase in the number of vessels that can enter ice-filled water. Under alternative 1, the risk of such an accident is low and classified as minor. Because of the decreased number of total vessels under alternatives 2 and 4, the risk of an accident in ice filled waters would be reduced to extremely low. The increases in the number of vessels per season in alternatives 3, 5, and 6 incrementally increases the probability of accident to minor effect.

However, under alternatives 1, 2, and 3 all vessels would be able to travel at unlimited speeds throughout Glacier Bay and Dundas Bay with the exception of designated and temporary whale waters and those areas closed to motorized vessels. Under alternative 4, 5, and 6 all tour, charter, and private vessels would be able to travel at unlimited speeds in the same areas. The ability to travel at unlimited speeds could increase the potential for a vessel accident in the areas mentioned above. By reducing cruise ships to 13 knots or less under alternatives 4, 5, and 6 the potential for a vessel accident or grounding could be reduced.

One vessel accident involving a tour vessel has already occurred within the wilderness waters of Dundas Bay. Eliminating cruise ships and tour vessels from the wilderness waters of Dundas Bay under alternatives 4, 5, and 6 would reduce the risk of a vessel accident in this area to extremely low.

Wilderness resources — Under all alternatives, vessel traffic would reduce wilderness values along the terrestrial shoreline of Glacier Bay and Dundas Bay. Alternative 4 would have the lowest effect on wilderness values because of the lower vessel numbers and the elimination of cruise ships and tour vessels in all of Dundas Bay, East Arm of Glacier Bay, Beardslee Entrance, and Fingers and Berg Bays. Alternative 5 and 6 would eliminate cruise ships and tour vessels from the entrance to Adams inlet, Beardslee Entrance, and the wilderness waters of Dundas Bay, improving wilderness conditions there. Alternatives 3 and 6 would increase the potential for visible haze, noise, and naturalness in wilderness due to the increase in cruise ships.

Local and regional socioeconomics — In general, effects from changes in cruise ship and tour vessel quotas could occur at the tourism-industry level, while changes in charter and private vessels could occur at the local level, including the many small communities in the Icy Strait area.

TABLE OF CONTENTS

GLACIER BAY

NATIONAL PARK AND PRESERVE, ALASKA

VESSEL QUOTAS AND OPERATING REQUIREMENTS • FINAL ENVIRONMENTAL IMPACT STATEMENT

TABLE OF CONTENTS

CHAPTER 3. AFFECTED ENVIRONMENT

CHAPTER 4. ENVIRONMENTAL CONSEQUENCES

CHAPTER 6. REFERENCES

APPENDICES

LIST OF TABLES

LIST OF ILLUSTRATIONS

PURPOSE AND NEED

GLACIER BAY

NATIONAL PARK AND PRESERVE, ALASKA

VESSEL QUOTAS AND OPERATING REQUIREMENTS • FINAL ENVIRONMENTAL IMPACT STATEMENT

CHAPTER 1. PURPOSE AND NEED

1.1 INTRODUCTION

The National Park Service (NPS, also "the Park Service") proposes to establish new or keep existing quotas (limits) and operating requirements for four types of motorized watercraft — cruise ships, and tour, charter, and private vessels — within Glacier Bay and Dundas Bay in Glacier Bay National Park and Preserve (see figure 1-1; see subsection 1.1.3). This final environmental impact statement (FEIS) was prepared, as required, under the National Environmental Policy Act (NEPA) of 1969 and regulations of the Council on Environmental Quality (CEQ; 40 Code of Federal Regulations [CFR] 1500). It describes a reasonable range of alternatives and the existing conditions and contains a detailed analysis of the environmental consequences of the alternatives. This chapter describes the underlying purpose and need for the action; presents background information related to the history of vessel management; presents an overview of applicable regulations; and summarizes issues identified by the Park Service, government agencies, organizations, businesses, and the public.

1.1.1 Purpose

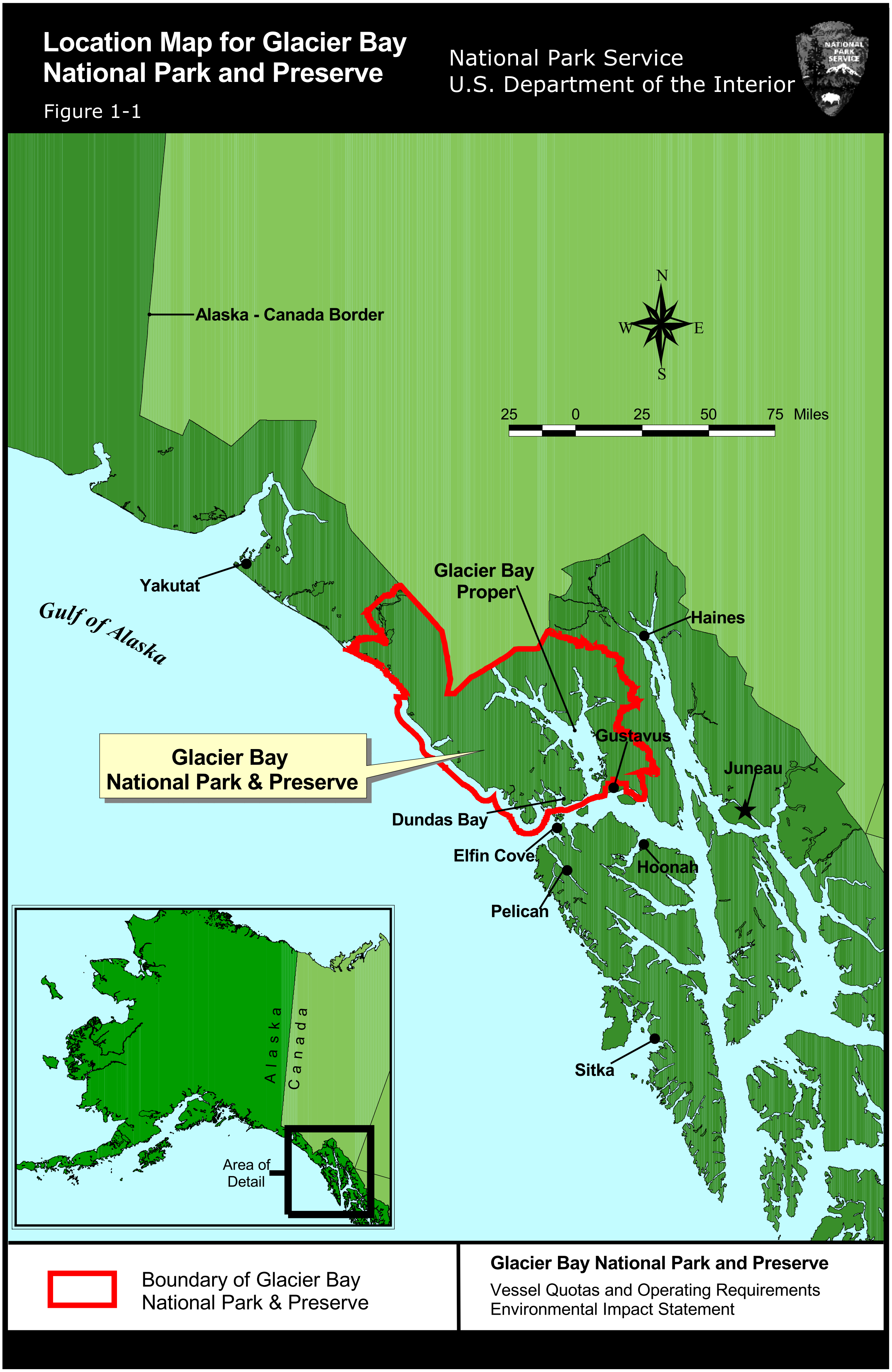
The purpose for the action is to address the continuing demand for motorized watercraft access into Glacier Bay and Dundas Bay in a manner that ensures continuing protection of park resources and values while providing for a range of high-quality recreational opportunities for visitors. The Park Service seeks to develop a system of vessel quotas and operating requirements for the park and preserve that would guide management of vessel traffic in the park and clarify regulations. Implementation of new vessel quotas and/or operating requirements would require promulgation of regulations, revising 36 CFR 13.65.

1.1.2 Need

The need for action stems from legislation enacted in 2001, wherein the U.S. Congress directed the Park Service to set the maximum level of motorized vessel entries based on the analysis in this environmental impact statement. Measures to address vessel traffic were implemented in 1979. Temporary regulations went into effect in 1980 and permanent regulations were promulgated in 1985 to respond to concerns about the effects motor vessels have on the endangered humpback whale *(Megaptera novaeangliae)*. Since then, concerns have broadened to encompass potential effects on other biota, the physical environment, and the visitor experience. Reevaluation of vessel quotas and operating requirements is required to address the continuing demand for vessel entries and park visitation. The Park Service desires, through this planning process and this environmental impact statement, to comprehensively address issues and concerns associated with vessel management and the park's marine environment.

1.1.3 Geographic Area

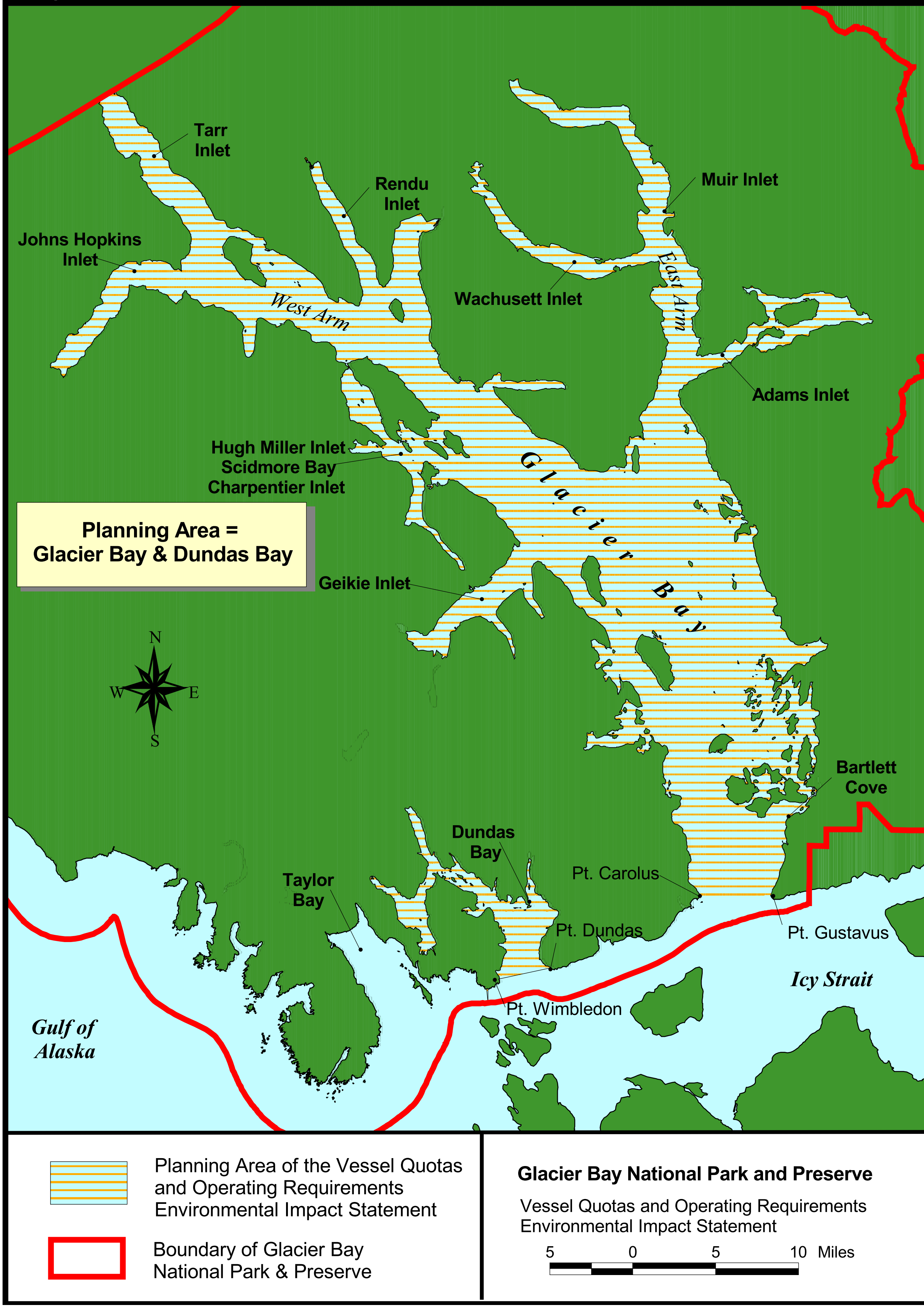
Collectively, Glacier Bay and Dundas Bay comprise the planning area in this environmental impact statement. Glacier Bay is defined as all contiguous marine waters lying north of an imaginary line between Point Gustavus and Point Carolus. Dundas Bay is defined as all contiguous marine waters north of an imaginary line between Point Dundas and Point Wimbledon (see figure 1-2).


Location Map for Glacier Bay National Park and Preserve
Figure 1-1
National Park Service
U.S. Department of the Interior
Alaska - Canada Border
N
W
E
S
25 0 25 50 75 Miles
Glacier Bay Proper
Haines
Yakutat
Gulf of Alaska
Gustavus
Juneau
Glacier Bay National Park & Preserve
Dundas Bay
Elfin Cove
Hoonah
Pelican
Sitka
Alaska
Canada
Area of Detail
Boundary of Glacier Bay National Park & Preserve
Glacier Bay National Park and Preserve
Vessel Quotas and Operating Requirements
Environmental Impact Statement

Planning Area of the Vessel Quotas and Operating Requirements Environmental Impact Statement

Figure 1-2

National Park Service
U.S. Department of the Interior



1.2 HISTORY OF VESSEL MANAGEMENT IN GLACIER BAY NATIONAL PARK AND PRESERVE

The Park Service has managed motorized recreational vessels in Glacier Bay for more than 20 years. Serious efforts to manage motorized vessels in Glacier Bay began in the mid-1970s in response to concerns regarding humpback whale populations. Since that time, many decisions and plans have been made setting vessel quotas and operating requirements. To understand the current proposed action and the purpose and need for this action, it is important to understand the major milestones of vessel management at the park and preserve.

The following subsections summarize these major milestones. For a more detailed perspective on the history of vessel management at the park, see Catton (1995). Much of the following historical overview is based on Catton (1995) and on the 1995 vessel management plan and environmental assessment (NPS 1995a; described in subsection 1.2.6), and the 1996 revised environmental assessment and finding of no significant impact (NPS 1996).

1.2.1 The 1979 Biological Opinion

At the request of the Park Service, consultation under section 7 of the Endangered Species Act (ESA) began in 1979 because vessel traffic in Glacier Bay was implicated when several humpback whales departed from the Bay. The National Marine Fisheries Service (NMFS; now called the National Oceanic and Atmospheric Administration [NOAA] Fisheries) issued a biological opinion (NMFS 1979) concerning the effects of actions proposed by the Park Service to control vessel activity in Glacier Bay National Monument. The National Marine Fisheries Service concluded that uncontrolled increase of vessel traffic, particularly of erratically traveling charter/pleasure craft, probably had altered the behavior of humpback whales in Glacier Bay and, thus, may be implicated in their departure from the Bay during 1978 and 1979. Therefore, a continued increase in the amount of vessel traffic, particularly charter/pleasure craft, in Glacier Bay would likely jeopardize the continued existence of the humpback whale population frequenting Southeast Alaska (NMFS 1979).

In response to the 1979 jeopardy opinion and the reasonable and prudent alternatives the National Marine Fisheries Service recommended, the Park Service limited vessel traffic to approximately the 1976 level and established restrictions on vessel routing and maneuvering. Vessels were divided into categories based on their size and purpose for being in the Bay. Research was initiated on humpback whale behavioral response to vessels, humpback whale prey type and density, and underwater acoustic conditions.

1.2.2 The 1983 Biological Opinion

The Park Service reinitiated consultation with the National Marine Fisheries Service in 1983 by requesting a determination on whether vessel traffic could be increased, and if so, to what extent. In the 1983 opinion, the National Marine Fisheries Service stated again that "if the amount of vessel traffic in Glacier Bay was allowed to increase without limit or if the existing restrictions on the operation of vessels within the bay were removed, the associated disturbance would be likely to jeopardize the continued existence of the Southeast Alaska humpback whale stock." The National Marine Fisheries Service addressed the question of increasing vessel traffic by stating that "an initial increase of no more than 20% (above the 1976 level) for the large ship and small vessel categories would be prudent." The National Marine Fisheries Service also recommended that any vessel increases be contingent on monitoring studies of whale presence, noise levels, and prey showing no adverse affects. The opinion stated "a minimum of two years should be allowed for monitoring and evaluating the effects of such an increase before additional increases are proposed." The opinion also allowed for subsequent increases, as long as whale numbers did not fall below the 1982 level (22 whales).

1.2.3 Increases in Vessel Quotas through the Mid- and Late-1980s

The Park Service promulgated new regulations in May 1985. These regulations allowed for up to a 20% increase in vessel quotas above the 1976 level for all vessel classes. The Park Service implemented increases in two increments, and the 20% increase was reached in 1988.

1.2.4 Final Recovery Plan for Humpback Whales

In 1991, the National Marine Fisheries Service published the *Final Recovery Plan for the Humpback Whale*. In this document a long-term numerical recovery goal was set for humpback whales, along with objectives for achieving the recovery goal. The long-term numerical goal is to increase humpback whale populations to at least 60% of the number existing before commercial exploitation or of current environmental carrying capacity. Both of those levels remain to be determined. In the meantime, the interim goal is a doubling of populations within the next 20 years.

The recovery plan further states that the primary means to an increased population is to "optimize natural fecundity by providing natural feeding opportunities, and reducing death and injury by human activities." Objectives in the humpback whale recovery plan that are applicable to vessel management include:

1. maintain and enhance current or historical habitats used by humpback whales by reducing disturbance from human-produced underwater noise in important habitats when humpback whales are present and encourage government entities at all levels to correct existing impacts on the habitat of humpback whales;
2. identify and reduce direct human-related injury and mortality through an evaluation of the effects of humpback whales from collisions with ships or boats; and
3. measure and monitor key humpback whale population parameters.

1.2.5 The 1993 Biological Opinion

In 1993, the National Marine Fisheries Service issued a biological opinion based on a 1992 internal Park Service draft proposal for quotas and operating requirements. The biological opinion analyzed the potential effects on the Steller sea lion *(Eumetopias jubatus)*, gray whale *(Eschrichtius robustus)*, and humpback whale. The biological opinion was based on the following level of proposed vessel activity: cruise ships at the rate of 2 per day for a seasonal total of up to 184, tour vessels at the rate of 3 per day for a seasonal total of 276, charter vessels at the rate of 6 per day for a seasonal total of 552, and private vessels at the rate of 25 per day for a seasonal total of 2,300. The National Marine Fisheries Service recommended continued monitoring and study of humpback whale movement, distribution, abundance, and feeding ecology, and study of how vessel presence alters the behavior and/or distribution of humpback whales. The National Marine Fisheries Service concluded that the Park Service's draft management plan would not adversely affect the Steller sea lion population, gray whales, or the central North Pacific humpback whale population. Further, the agency concluded that the level of vessel activity described in the plan would not jeopardize the continued existence and recovery of these species. The opinion applied to the 1995 vessel management plan and environmental assessment, since the vessel management levels in the plan were equivalent to or less than those described above (see the discussion about this plan in subsection 1.2.6).

1.2.6 The 1996 Vessel Management Plan and Environmental Assessment Finding of No Significant Impact (NPS 1996)

In 1991, the Park Service began the development of the first comprehensive vessel management plan, considering the effects on park resources and visitor experience. The 1996 finding of no significant impact provided for increases in cruise ships, charter vessels, and private vessels. It provided for an incremental increase in cruise ships up to 184 over the June through August season (up to 2 cruise ships per day, every day, over those three months). Any increase would be contingent upon the completion of studies demonstrating that such increases would be consistent with park resources and values. Daily limits of 3 tour vessels, 6 charter vessels, and 25 private vessels would not be changed. Current restrictions on seasonal entries and use days for charter and private vessels were modified to provide an 8% increase in seasonal-use days for charter vessels and a 15% increase for private vessels. The environmental assessment acknowledged that uncertainties existed regarding the environmental consequences of increasing vessel quotas in Glacier Bay.

Based on the environmental assessment, the Park Service concluded there would be no significant impacts as a result of the proposed action and issued a finding of no significant impact in March 1996. The Park Service concluded that an EIS was not required, and the modified vessel management alternative was implemented, with regulations effective in May 1996.

Research and monitoring programs were initiated to better understand the effects of park vessel traffic on resources and values. Research and monitoring programs initiated since the 1995 environmental assessment include:

- reaction of Steller sea lions to vessels – completed in 2000
- disturbance of harbor seals by motorized vessels in Johns Hopkins Inlet – completed in 2001
- monitoring underwater noise in Glacier Bay National Park and Preserve – ongoing
- disturbance of harbor seals at a terrestrial haul-out in Glacier Bay National Park and Preserve – ongoing
- population characteristics of humpback whales in Glacier Bay and adjacent waters – ongoing
- opportunistic sightings of marine mammals in Glacier Bay National Park – ongoing
- humpback whale song recording in Glacier Bay: their frequency and occurrence – ongoing
- humpback whale forage study – completed in 2002
- coastal resources inventory and mapping project – ongoing
- development of coastal monitoring protocols and process-based studies – completed in 2001
- ecology of selected marine communities in Glacier Bay – completed in 2003
- distribution and abundance of small schooling fish in near shore communities – completed in 2003
- marine predator studies in Glacier Bay National Park and Preserve – ongoing
- sea otter distribution, relative abundance, prey analysis, and impact on benthic communities – ongoing
- fjord oceanographic processes in Glacier Bay – ongoing
- mapping the benthic habitat in Glacier Bay – completed in 2001
- abundance and distribution of forage fish and plankton – completed in 1999

1.2.7 Omnibus Parks and Public Lands Management Act of 1996 (Public Law 104-333)

This act limited the ability of the Park Service to regulate air and water quality, as well as noise generation. Key provisions of the act are as follows:

> *The Park Service may not impose any additional permittee operating conditions in the areas of air, water, and oil pollution beyond those determined and enforced by other appropriate agencies.*
>
> *When competitively awarding permits to enter Glacier Bay, the Park Service may take into account the relative impact particular permittees will have on park values and resources, provided that no operating conditions or limitations relating to noise abatement shall be imposed unless the secretary determines, based on the weight of the evidence from all available studies including verifiable scientific information from the investigations provided for in this subsection, that such limitations or conditions are necessary to protect park values and resources.*

1.2.8 2001 Decision – U.S. Court of Appeals for the Ninth Circuit

In a May 1997 complaint filed in the U.S. District Court, the National Parks Conservation Association challenged the validity of the Park Service's 1996 finding of no significant impact that authorized the increased entry levels. The U.S. District Court upheld the decision made by the Park Service. Following an appeal, the U.S. Court of Appeals for the Ninth Circuit reviewed the evidence and ruled in February 2001 that the portion of the vessel management plan and environmental assessment and the implementing regulations that authorized an increase in vessels into Glacier Bay violated NEPA because an environmental impact statement was not prepared. The court determined that uncertainty about the potential effects of increased vessel quotas, as outlined in the environmental assessment (see subsection 1.2.5), was itself an indicator of significant impacts as defined under NEPA. Furthermore, the court determined that the project involved controversy, which is another measure of significance under the act.

The court prohibited vessel traffic above the pre-1996 levels unless an EIS was prepared. The court decision went into effect in late summer 2001.

1.2.9 Fiscal Year 2002 U.S. Department of the Interior Appropriations Bill (Public Law 107-63, 105th Congress)

Following the Ninth Circuit Court of Appeals' decision, the U.S. Congress, as part of the U.S. Department of the Interior (USDI) Appropriations Act of 2002 (section 130 of Public Law 107-63 [155 Statute 414]), changed the requirements established in the court decision and required the Park Service to:

- prepare and complete an environmental impact statement by January 1, 2004, to identify and analyze the effects of the increased vessel use established in 1996.
- set the maximum levels of vessels (motorized watercraft) that enter Glacier Bay based on the environmental impact statement.

Congress set the numbers of allowable vessel entries to the levels in effect during the 2000 calendar year, which were 139 cruise ships, 276 tour vessels, 312 charter vessels, and 468 private vessels for the June through August season. On January 18, 2002, the U.S. District Court modified the previous injunction. This current level of seasonal entries forms the basis for the no-action alternative (alternative 1) of this environmental impact statement.

1.2.10 The 2003 Biological Opinion

The National Park Service initiated formal consultation with NOAA Fisheries under section 7 of the Endangered Species Act on March 17, 2003, regarding the direct and indirect effects of possible increases in vessel quotas and operating requirements. NOAA Fisheries assessed the potential effects of the action using information presented in the draft environmental impact statement completed by the Park Service in March 2003; information provided by NPS since the DEIS was issued; and on discussions among NPS and NOAA Fisheries.

The biological opinion, issued August 5, 2003, focused on the NPS preferred alternative in this FEIS, but determined that the effects of any of the alternatives are not likely to jeopardize the continued existence of any, nor would they destroy or adversely modify, designated critical habitat of the three species analyzed: (i) Western stock of Steller sea lions, listed as endangered on May 5, 1997 (62 FR 30772), critical habitat designated on August 27, 1993 (58 FR 45269); (ii) Eastern stock of Steller sea lions, listed as threatened on November 26, 1990 (55 FR 40204), critical habitat designated on August 27, 1993 (58 FR 45269); and (iii) central North Pacific humpback whales listed as endangered upon passage of the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.).

Although NOAA Fisheries concluded that “we can state with certainty that these effects will not jeopardize the continued existence of the central North Pacific population of humpback whales,” they raised concern that the potential of mortality due to collisions, and the effects of increased noise levels, may adversely affect humpback whales and, moreover, that the takes from the proposed actions cannot be quantified at this time.

NOAA Fisheries viewed the greatest potential for take for Steller sea lions to be disturbance at haul-outs in the action area. While individuals from the endangered western population of Steller sea lions occur in the action area, the numbers of individuals present is believed to be low enough that NOAA Fisheries found that the proposed action could only result in a minimal number of potential takes. Takes from the western population would be at a level that could only have a minimal effect on this population. NOAA Fisheries has no reason to believe that the NPS preferred alternative (alternative 6), as proposed, would jeopardize the continued existence of the western population of Steller sea lions in the future.

NOAA Fisheries made four conservation recommendations pursuant to the above concerns:

1. The Park Service should continue to monitor the levels of disturbance from vessels and vessel noise in Glacier Bay National Park and Preserve waters to determine the extent of take of Steller sea lions and humpback whales that would occur under the decision. Upon determination of appropriate take levels, and issuance of regulations or authorizations under section 101(a)(5) of the Marine Mammal Protection Act and/or its 1994 amendments, NOAA Fisheries will amend the opinion to include an ESA incidental take statement for listed species in the action area. No increases in cruise ship entries into Glacier Bay from the 2003 levels should occur until these determinations have been made.

2. NOAA Fisheries expressed concern about the potential for collisions to occur that result in serious injury or mortality to the whale, especially because as numbers of whales and vessels increase the probability of collision will likely increase. The Park Service continues to monitor the occurrence of whales in nearshore waters to determine if maximizing private vessel use in Glacier Bay, by increasing the number of seasonal-use days for private vessels, would result in increased disturbances to marine mammals including sea lions on rocks, or foraging whales.

3. Given that vessel length and speed are an important factor in the severity of whale-vessel collisions, and that NOAA Fisheries included waters immediately adjacent to the park

entrance in Icy Strait and at Point Adolphus as part of the action area they evaluated, and that the large whale concentration at Point Adolphus, a popular whale watching location for vessels entering and exiting NPS waters, is not protected by vessel speed limits NOAA Fisheries made the following recommendation: The NPS should work with NOAA Fisheries, the U.S. Coast Guard and the State of Alaska to implement vessel speed limits, or exclusion zones in the nearshore waters of Icy Strait (i.e, within 1 mile of Point Adolphus) adjacent to park waters that contain known concentrations of whales, or establish agreements with cruise ship and tour vessel concessioners whereby vessel speed and course restrictions are adopted beyond the NPS boundaries in these areas where whales are known to forage and occur in large numbers.

4. And finally, NOAA Fisheries concluded that the proposed increases in vessel traffic are occurring in an area where disturbance and collision risk are already a concern, and in the absence of a quantitative determination of Endangered Species Act and the Marine Mammal Protection Act of 1972 take levels. It is NOAA Fisheries recommendation, therefore, that the Park Service should monitor and evaluate its vessel operating requirements to determine if they are effective at protecting whales in these nearshore waters. Two essential elements of this recommendation are measurements of compliance and effectiveness of regulations.

1.3 LEGAL MANDATES, POLICIES, AND PLANS

The following subsections summarize the most important directives that guide development of this plan.

1.3.1 NPS Organic Act and Redwood Amendment

The Organic Act of 1916 and the 1978 amendment of the NPS General Authorities Act of 1970 provide the overall mandate for management of the national parks. The Organic Act specifies the core NPS mission, including establishing regulations to protect the environment. The act states the responsibilities of the Park Service:

> *The (National Park) service . . . shall promote and regulate the use of the Federal areas known as national parks . . . to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.*

The Organic Act gives the Park Service a mandate to protect resources of national parks and to make conservation of the environment the leading priority when making management decisions regarding national parks. The act also states that one of the fundamental purposes of all parks includes the enjoyment of park resources and values. In situations where a conflict exists between Park Service efforts to conserve resources and values versus those providing for enjoyment of them, conservation takes precedence.

Supplements to the Organic Act of 1916. Congress supplemented provisions of the Organic Act by the General Authorities Act in 1970, and through enactment of a 1978 amendment to that law, the Redwood Amendment. Congress strengthened the ability of the U.S. Secretary of the Interior to protect park resources. The Redwood Amendment states:

> *Congress further reaffirms, declares, and directs that the promotion and regulation of the various areas of the National Park System . . . shall be consistent with and founded in the purpose established by section 1 of this title [the Organic Act provision quoted on page 1], to the common benefit of all the people of the United*

> *States. The authorization of activities shall be construed and the protection, management, and administration of these areas shall be conducted in light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress.*

Section 1.4 of the Park Service's *2001 Management Policies* (NPS 2001b), described further in subsection 1.3.3, formally adopts a single interpretation of the key statutory provisions under the Redwood amendment. This interpretation limits ambiguity to ensure consistency in decision making to show the courts that decisions made by the Park Service are logical and reasonable, and thoroughly thought through in accordance with the Organic Act. Section 1.4 of the NPS management policies states that the no-impairment term of the Organic Act and the no-derogation term of the Redwood amendment define a single standard for management of the National Park System, and the terms can be used interchangeably (NPS 2001b).

1.3.2 Protection of Park Resources and Values

The NPS Organic Act and the General Authorities Act prohibit impairment of park resources and values. The NPS management policies use the terms "resources" and "values" to mean the full spectrum of tangible and intangible attributes for which the park is established and are managed, including the Organic Act's fundamental purpose and any additional purposes as stated in the park's establishing legislation. The impairment of park resources and values may not be allowed unless directly and specifically provided by statute. The primary responsibility of the National Park Service is to ensure that park resources and values will continue to exist in a condition that will allow U.S. citizens to have present and future opportunities for enjoyment of them.

The evaluation of whether impacts of a proposed action would lead to impairment of park resources and values is included in this environmental impact statement. Impairment is more likely when there are potential impacts to a resource or value whose conservation:

- is necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park.
- is key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park.
- is identified as a goal in the park's general management plan (NPS 1984) or other relevant NPS planning documents.

This environmental impact statement includes an evaluation of the potential for each alternative to result in impairment. The Park Service will base its final decision regarding the proposed action's potential to impair park resources on this evaluation.

An impairment evaluation is presented in "Chapter 4. Environmental Consequences" for each topic contained within the physical and biological environment sections and for two topics within the human environment section — wilderness resources and cultural resources.

1.3.3 Pertinent NPS Director's Orders

Director's orders are part of the NPS directives system, as are NPS management policies. Director's orders provide legal references, operating policies, standards, and procedures for particular aspects of park planning. Director's Order 12 (NPS 2001a) is most relevant because it provides the guidance necessary to prepare an NPS EIS in compliance with NEPA.

Two other director's orders are particularly pertinent to vessel management in Glacier and Dundas Bays. "Director's Order 47, Sound Preservation and Noise Management" (NPS 2001c) is important because it provides guidance for regulating noise in the park. This director's order articulates NPS policies that require, to the fullest extent practicable, the protection, maintenance, or restoration of the natural soundscape resource in a condition unimpaired by inappropriate or excessive noise sources. "Director's Order 41, Wilderness Preservation and Management" (NPS 1999a) provides accountability, consistency, and continuity to the Park Service's wilderness management program, and otherwise guides service-wide efforts in meeting the letter and spirit of the 1964 Wilderness Act. This director's order clarifies, where necessary, specific provisions of the Park Service's management policies (NPS 2001b), and establishes specific instructions and requirements concerning the management of all NPS wilderness areas.

1.3.4 Glacier Bay National Park and Preserve Enabling Legislation

Glacier Bay was designated as a national monument by presidential proclamation in 1925. The presidential proclamations of 1925 and 1939 established and expanded Glacier Bay National Monument; the Alaska National Interest Lands Conservation Act (ANILCA) of 1980 redesignated the monument as a park and preserve and further expanded it; the NPS Organic Act of 1916, and amendments applicable to all national park areas, and the Omnibus Consolidated and Emergency Supplemental Appropriations Act of 1999 (Public Law 105-277), as amended, provide specific statutory requirements for management of the park and preserve. These mandates include:

- "conserv[ing] the scenery and the natural and historic objects and wildlife therein and . . . provid[ing] for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (NPS Organic Act).
- preserving and protecting the area's tidewater glaciers, vegetation, unique opportunities for scientific study of glaciers and related flora and fauna changes over time, and historic value associated with early explorers and scientists (proclamation).
- preserving lands and waters containing nationally significant natural, scenic, historic, archeological, geological, scientific, wilderness, cultural, recreational, and wildlife values (Alaska National Interest Lands Conservation Act).
- preserving the unrivaled scenic and geological values associated with natural landscapes (Alaska National Interest Lands Conservation Act).
- maintaining sound populations of, and habitat for, wildlife species of inestimable value to the citizens (Alaska National Interest Lands Conservation Act).
- preserving the natural, unaltered state of the coastal rain forest ecosystem (Alaska National Interest Lands Conservation Act).
- preserving wilderness resources and related recreational opportunities (Alaska National Interest Lands Conservation Act).
- maintaining opportunities for scientific research and undisturbed ecosystems (Alaska National Interest Lands Conservation Act).
- allowing the park to remain "[a] large sanctuary where fish and wildlife may roam free, developing their social structure and evolving over long periods of time as nearly as possible without the changes that extensive human activities would cause" (Alaska National Interest Lands Conservation Act).

1.3.5 Park Purposes

Based on the enabling legislation presented in subsection 1.3.4, the purpose of the park is to preserve its accessible tidewater glaciers, superlative scenic grandeur, historic value, unique opportunities for the study of glaciers and associated plant and animal community succession processes, fish and wildlife populations and their habitats, unaltered and undisturbed ecosystems and opportunities for scientific research, and wilderness resource values and related recreational opportunities (NPS 2000a).

1.3.6 International Biosphere Reserve and World Heritage Site Designations

In 1986, the park and preserve was designated as an International Biosphere Reserve by the United Nations Educational, Scientific, and Cultural Organization under its Man and the Biosphere Program. Biosphere reserves are protected areas that are internationally recognized. They are established to conserve species and natural communities and to discover ways to use environments without degrading them. The program emphasizes research, resource monitoring, and education.

In December 1992, the United Nations Educational, Scientific, and Cultural Organization also designated the park as a World Heritage Site, a natural site of outstanding universal value to mankind. World Heritage Site designation recognizes the world's most significant natural and cultural areas. The park and preserve is a part of the Kluane/Wrangell-St. Elias/Glacier Bay/Tatshenshini-Alsek World Heritage Site.

1.3.7 Park Management

Title 36 CFR 13.65 (see appendix A) and the *Glacier Bay National Park and Preserve 2003 Compendium* (NPS 2003; see appendix B) stipulate park rules and regulations, including current vessel quotas and operating requirements (as amended by the U.S. Congress). The park compendium outlines many NPS regulations that provide the superintendent with discretionary authority to make designations or impose public use restrictions or conditions. The regulations in 36 CFR 13.65 and the park compendium encompass all aspects of park management. The compendium is reviewed and revised annually.

1.3.8 Omnibus Consolidated and Emergency Supplemental Appropriations Act, 1999 (Public Law 105-277, 1998)

The Omnibus Consolidated and Emergency Supplemental Appropriations Act, passed in October 1998 and amended in May 1999, specifically addressed commercial fishing activities in the marine waters of the park. This legislation restated closure of wilderness waters to commercial fishing, closed additional non-wilderness areas within Glacier Bay to commercial fishing, and required a phase-out (in progress) of all commercial fishing within Glacier Bay. The law allows existing commercial fisheries to continue in the marine waters of the park outside Glacier Bay under a cooperative NPS / State of Alaska fisheries management plan consistent with park purposes and values.

1.3.9 Pertinent Park Plans and Their Relationship to This Plan

General Management Plan. The park and preserve's *General Management Plan* (NPS 1984) sets the overall direction for management of natural and cultural resources, visitor use, land protection, and facility development. The following general management plan objectives pertain to vessel quotas and operating requirements:

1. *Protection of park resources:* Allow ecological processes to continue unimpaired by visitor use. Protect marine and terrestrial wildlife and vegetation from adverse effects of visitor use. Identify marine areas that have special sensitivities for wildlife, solitude, or other values, and develop methods for protecting these special sensitivities.
2. *Provision for visitor use:* Continue recognition of Glacier Bay's waterways as primary access corridors to the area. Ensure visitors have a wide variety of quality and environmentally sound alternatives for experiencing the Glacier Bay story, employing a wide variety of vessel types. Establish vessel operating requirements and limits on the number of vessel entries necessary to protect park purposes and resources.

Wilderness Visitor Use Management Plan. In July 1989, the park adopted the *Wilderness Visitor Use Management Plan* (NPS 1989). The plan establishes wilderness visitor management zones and requirements for access, group size, length of use, and commercial activities. Recreational use associated with vessel traffic, such as tour vessel drop-off points for wilderness visitors, or numbers of commercial sea kayaking trips, is addressed in the plan. This plan was considered in the development of this environmental impact statement.

Backcountry Management Plan and Environmental Impact Statement. The National Park Service is amending the park general management plan with a backcountry management plan and accompanying EIS. A Notice of Intent to prepare an EIS was published in the *Federal Register* in September 2002. The Plan is to provide comprehensive management direction for the next 15 to 20 years for the backcountry of Glacier Bay National Park and Preserve. Specific topics to be addressed in the backcountry plan include, but are not limited to: backcountry hiking, mountaineering, aviation, non-motorized boating (such as kayaking), commercial services, administrative and research activities, and the various facilities related to these activities.

Commercial Fishing Compensation Program. Commercial fishing is being phased out of Glacier Bay, but will continue until all the current permit holders cease to fish.

1.3.10 Environmental Regulatory Requirements

In addition to NPS mandates, policies, and plans, the Park Service also must evaluate its proposed action against several federal laws intended to protect the environment. These laws are described in "Chapter 4. Environmental Consequences."

1.4 THE NEPA PROCESS

1.4.1 Scoping

NEPA is the basic national charter for protection of the environment. NEPA procedures ensure that relevant environmental information is available to government officials and the public before decisions are made and before actions are taken. To achieve these objectives, the NEPA process for "major federal actions" includes scoping, preparation of draft and final environmental impact statements, and development of a record of decision. These elements of the NEPA process for the Glacier Bay proposed action are described in detail below.

The Council on Environmental Quality defines scoping as "an early and open process for determining the scope of issues to be addressed in an EIS and for identifying the significant issues related to the proposed action" (40 CFR 1501.7). The intent of scoping is to avoid overlooking important issues that should be analyzed and to de-emphasize less important issues. Comments from any interested persons; affected federal, state, and local government agencies; any affected Native groups; and private industry are invited.

The scoping period began on February 22, 2002, with publication of the notice of intent (NOI) to prepare an environmental impact statement. The notice of intent is published in the *Federal Register* and invites industry, government agencies, environmental groups, and the general public to comment on areas of interest or concerns related to the action being proposed. The notice of intent announces the scoping process followed for the environmental impact statement. The notice requested that all comments be received by the Park Service by June 7, 2002. During the scoping period, the Park Service published a brochure inviting the public to participate in the scoping process and providing basic information about the NEPA process, the actions and alternatives under consideration, and how the public could participate in the process. The brochure included a comment form, and the Park Service provided electronic versions of both on the park website.

The Park Service hosted public meetings from May 20 through May 30, 2002, in the Alaska communities of Hoonah, Gustavus, Pelican, Elfin Cove, Anchorage, and Juneau, as well as in Seattle, Washington. Meeting participants could review displays, maps, and literature, and speak directly with members of the EIS project team. The team provided an overview of the project at each meeting, followed by an opportunity for the public to make comments and ask questions. The project team recorded the comments received at each meeting. Following the meetings, the Park Service mailed a brochure summarizing the comments received and the anticipated EIS schedule to the individuals who attended the public meetings and others known to be interested in the process.

The Park Service conducted internal scoping meetings at park headquarters on April 19 and May 9, 2002. In addition, the EIS project team met with representatives from the U.S. Geological Survey (USGS) and the USGS Alaska Science Center on May 9, 2002; with representatives from several Alaska State agencies on May 15 and May 28, 2002; and with a representative from the National Marine Fisheries Service on May 29, 2002.

Based on the information gained through the scoping process — which included NPS staff evaluations and input — major issues, alternatives to the proposed action, and measures that could mitigate the effects of the proposed action were identified for analysis in this environmental impact statement. The issues are presented in section 1.5.

1.4.2 Draft Environmental Impact Statement

As required by section 102(2)(C) of NEPA, an environmental impact statement is prepared for any major federal action significantly affecting the quality of the human environment. The draft EIS (DEIS) describes the proposal, the alternatives, and the potentially affected marine and onshore environments; presents an analysis of potential adverse effects on the environment; describes potential mitigating measures to reduce the adverse effects; and presents a record of consultation and coordination with others during EIS preparation.

The document is filed with the U.S. Environmental Protection Agency (EPA), and its availability is announced in the *Federal Register*. Preparation of the DEIS began in June 2002 and the notice of availability for the DEIS was published in March 2003. Comments on this DEIS were submitted to the Park Service during the public review period.

The public comment period began with the issuance of the DEIS and publication of the Notice of Availability in the *Federal Register* (*Federal Register, volume 68, number 55*, March 21, 2003) and ended on May 14, 2003. During the comment period, the Park Service conducted seven open houses/public hearings to receive verbal comments on the DEIS in Hoonah, Alaska (April 14, 2003); Gustavus, Alaska (April 15, 2003); Pelican, Alaska (April 16, 2003); Elfin Cove, Alaska (April 17, 2003); Juneau, Alaska (April 23, 2003); Anchorage, Alaska (April 24, 2003); and Seattle, Washington (April 29, 2003). A total of 79 persons attended these open houses/public hearings. The Park Service received comments during these public hearings as well as more than 1,000 electronic mail messages, postcards, comment letters, and web-based comments from organizations and private citizens.

1.4.3 Final Environmental Impact Statement

Oral and written comments on the adequacy of the DEIS were obtained through the public review process and are responded to in this FEIS. Comments and responses are provided in appendix M. As specified in the response to comments, some comments resulted in revisions to the text of the environmental impact statement. The FEIS is filed with the U.S. Environmental Protection Agency and made available to the public. The availability of the FEIS is announced in the *Federal Register* and the notice of availability was published in October 2003.

1.4.4 Record of Decision

When an environmental impact statement is prepared, the ultimate choice of an alternative, mitigation measures, and the decision rationale are documented in the record of decision. Publication of the record of decision will follow a 30-day no-action period after release of the FEIS.

1.5 ISSUES OF CONCERN RAISED DURING SCOPING

1.5.1 Summary of Issues and Topics Evaluated in This Environmental Impact Statement

Issues and impact topics identified during the scoping process form the basis for environmental analysis in this document. A brief description is provided for each issue and impact topic. Issues and topics considered, but not addressed in this document, also are identified. “Chapter 5. Consultation and Coordination” provides more details regarding NPS and public scoping meetings and consultation with other federal and state agencies. The issues of concern raised during scoping regarding topics to be addressed in this environmental impact statement include the following:

Soundscape.

- Vessel noise could unacceptably alter the natural soundscape of the park.

Air Quality.

- Increases in vessel quotas could increase the particulate and pollutant load entering the air column and have a detrimental effect on air quality by increasing, thus changing the air quality, visibility, and the presence of haze.
- Increases in vessel quotas could increase the stack emissions and could result in detrimental effects to human health and the environment.

Water Quality.

- Increases in vessel quotas increases the potential for unauthorized releases of marine debris, petroleum, graywater, sewage, oil, ballast, photographic chemicals, dry cleaning solutions, and cleaning solvents. The unauthorized release of marine debris and other contaminants may degrade water quality.
- Increasing the vessel quota increases the potential of small and large oil spills. Current technology is inadequate to clean up oil spills in ice-filled waters.

- Vessels other than large cruise ships may not have the capacity to hold and treat waste. Possible increases in these types of vessels in park waters could result in increased discharges of waste, resulting in degradation of the marine environment.
- The park's zero discharge policy for cruise ships means that the ships are dumping waste outside the park, resulting in possibly more degradation of the marine environment outside the park than otherwise might occur.

Threatened and Endangered Species.

- The sight and noise of vessel traffic alter marine mammal behavior; therefore, any increase in the number of vessels would further disrupt marine mammal behavior.
- Vessel wakes could cause onshore waves that startle sleeping humpback whales.
- Varying vessel speeds need to be evaluated to determine the appropriate speed to protect whales and minimize the effects on threatened and endangered species.
- Increases in vessel traffic could result in increased whale/vessel collisions, and whale mortality or injury could result from such collisions.
- Humpback whales feeding in Bartlett Cove could be disrupted by vessels operating in this area. Vessel requirements should be evaluated to determine if they are effective in protecting whales.

Marine Mammals.

- The sight and noise of vessel traffic alter marine mammal behavior; therefore, any increase in the number of vessels would further disrupt their behavior.
- Varying vessel speeds need to be evaluated to determine the appropriate speed to protect and minimize the effects on whales in non-whale waters.
- Increases in vessel traffic could result in increased whale/vessel collisions, and whale mortality or injury could result from such collisions.
- Whales feeding in Bartlett Cove could be disrupted by vessels operating in this area. Vessel operating requirements should be evaluated to determine if they are effective in protecting whales.

Marine Birds and Raptors.

- The presence of vessels in the marine environment can alter marine bird behavior. Harlequin ducks in Dundas Bay could be disturbed by vessel traffic.
- Waves from vessel wakes could swamp marine bird nests that are in low-lying areas, thus reducing reproductive success and altering marine bird feeding behavior.
- Private and charter vessels that offload visitors onshore could disturb bird colonies, specifically at McBride Glacier, as well as nesting arctic terns and mew gulls in other breeding locations, thus reducing reproductive success.

Marine Fishes.

- Airborne contaminants from ship stacks could be deposited in the marine environment and enter the marine food chains, causing fish mortality through ingestion or dermal contact.
- The presence of artificial light from vessels could alter behavior of marine fish.
- Waves generated by wakes and prop wash could increase turbidity and degrade fish habitat.

- Invasive species on hulls of ships or in unauthorized releases of ballast water could be introduced into the marine environment of the park and could displace native marine fishes.

Coastal/Shoreline Environment and Biological Communities.

- Vessel wakes could erode portions of the shoreline.
- Traffic at popular drop-off locations could be changed, resulting in increased physical disturbances and disturbance of intertidal communities.
- Waves could alter the behavior of terrestrial mammals that feed, roam, or sleep on the shoreline.
- Invasive species on hulls of ships or in unauthorized releases of ballast water could be introduced into the marine environment of the park, which could displace native species and alter ecological functioning.

Cultural Resources.

- Air and water pollution could defile elements of Glacier Bay sacred to the Huna Tlingit, including the glaciers, mountain goats, and harbor seals.
- Waves generated from vessels could erode portions of the shoreline, thus changing the geological composition of the shoreline, and possibly exposing anthropological and archeological resources present in interstadial geologic layers, including preglacial forests.
- Increase in traffic at popular drop-off locations could increase physical disturbances and potential vandalism of anthropological resources.

Visitor Experience.

- The presence of large cruise ships could diminish the experience of visitors from smaller vessels because of the visual effects and loss of wilderness experience.
- Vessel noise could intrude on visitor solitude in Glacier Bay.
- The presence of vessels may provide a backcountry user with a greater sense of security knowing that help is nearby if an emergency occurs.
- The presence of vessels may scare wildlife and thereby diminish the experience of visitors expecting to see wildlife.

Vessel Use and Safety.

- Increasing vessels or vessel speed could increase the risk of vessel-vessel and vessel-marine mammal collisions.
- A 10-knot vessel speed restriction could decrease the maneuverability of large vessels, causing an increased risk to the ship and to visitor safety.
- Smaller vessels are more maneuverable than larger vessels and should be allowed to travel at faster speeds because they could avoid most potential hazards.
- Waves generated from larger vessels could swamp kayaks or small vessels on the water and cause serious injury to the occupants.
- Increasing the user-friendliness of the operating requirements could increase the possibility that vessel operators would adhere to the rules and decrease the possibility of accidents and/or violations of regulations.

- Cruise ships and tour vessels should have strict protocols and routes to minimize the risk of vessel groundings that could cause resource damage or risks to visitor safety.

Wilderness Resources.

- An increase in vessel quotas could allow more people to experience a wilderness area intimately. In addition, the wilderness would be more accessible.
- An increase in vessel quotas could diminish the value of the wilderness by increasing the sense of crowdedness.
- The presence of large vessels could diminish the wilderness values.
- Increases in off-vessel activity could result in more trash and degradation of the terrestrial environment.

Local and Regional Socioeconomics.

- Increasing the vessel quota for private and charter vessels and providing access to Dundas and Taylor Bays could improve local economies and lifestyles. Revenues generated from local wildlife viewing and sightseeing charter and tour vessels could replace loss of livelihood resulting from the Glacier Bay commercial fishing phase-out.
- Increasing the number of permits allocated to local owners and operators could benefit the local economy.
- Increasing the vessel quota for tour vessels could benefit the economy of local communities by providing additional entries to local operators. Increased restrictions on local resident access could have detrimental effects to local economies.
- Increasing the vessel quota for private, locally based vessels would benefit inn and lodge operators by increasing their access to Glacier and Dundas Bays for their guests.
- Some people perceive that tourism in Southeast Alaska is leveling out and fewer independent travelers are coming to the park. These conditions, if true, may alter demand and the type of visitor experience preferred.
- The number of charter vessel operators is increasing, which could result in increased demand for permits.

Cumulative Effects. NEPA mandates that agencies consider all potential effects, including those considered cumulative, as defined in CEQ NEPA regulation 40 CFR 1508.7. A cumulative effect is the effect on the environment that results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions. Existing actions/projects and reasonably foreseeable actions that may contribute to cumulative effects are described in chapter 4.

1.5.2 Issues Considered but Eliminated from Detailed Analysis in This Environmental Impact Statement

The scope of this environmental impact statement is necessarily focused on motorized vessel use. Comments related to management of the following resources and topics are considered outside the scope of this document:

- **Land-based activities.**
- **Allocation of cruise ship or tour or charter vessel permits.** This will be addressed in accordance with NPS regulations and policy.
- **Deep benthic environments in Glacier Bay and Dundas Bay.** The deep benthic environments within this area are not likely to be affected by cruise ships or other vessel

activities addressed in this environmental impact statement. These habitats occur well below the depth at which they might be affected by vessel wakes, oil spills, or other activities related to vessel traffic. While vessel noise likely would reach these habitats, most deep benthic animals have no known sensory apparatus for hearing. Additionally, attenuation of the vessel noise with depth is likely to decrease noise levels to below the level at which crabs or other deep benthic animals are affected.

- **Restrictions to the backcountry or to providing access into the backcountry (i.e., off-vessel areas).** The park's backcountry management plan will address where vessels may land and where they may offload passengers.
- **Kayak quotas and operating requirements.** This environmental impact statement addresses only motorized vessels. Kayak quotas and operating requirements will be addressed in the park's backcountry management plan.
- **Commercial fishing.** Issues concerning commercial fishing are addressed in the commercial fishing compensation plan and the commercial fishing environmental assessment (NPS 1998). Vessel use associated with commercial fishing is evaluated in the cumulative effects sections of this document.
- **Administrative vessel use.** Administrative vessel use is not within the scope of this environmental impact statement. Administrative vessel use is determined by the superintendent, as necessary, to ensure visitor safety; respond to emergency situations; and otherwise implement the park's mission, purposes, and values.
- **Invasive species.** At this time, no marine invasive species are known to have colonized the waters of Glacier Bay National Park and Preserve, but little data has been collected within Glacier Bay, so the actual extent of invasive species is unknown. Still, the potential for major introductions of invasive species into Glacier or Dundas Bays appears to be low. The Alaska Department of Fish and Game, in a recent publication (Fay 2002), listed the invasive species they consider the greatest threats to Alaska. The only two species that might be carried on cruise ships and/or other vessels are the European green crab *(Carcinus maenas)* and the Chinese mitten crab *(Eriocheir sinensis)*. Both make some use of marine waters, but are primarily estuarine or freshwater species. Both crabs could possibly reach Glacier Bay or Dundas Bay as larvae on the hulls of cruise ships, but the most likely method of transport is north-moving oceanographic currents. None of the cruise ships or other vessels entering Glacier Bay or Dundas Bay discharge ballast water to the environment, unless during a catastrophic event; therefore, ballast water is not a likely source of invasive species. Compliance with U.S. Coast Guard discharge regulations of bilge water is likely to keep this potential source of invasive species from being introduced into Glacier and Dundas Bays.

1.6 FEDERAL PERMITS, LICENSES, AND ENTITLEMENT NECESSARY TO IMPLEMENT THE ACTION

No permits are required for the Park Service preferred alternative (alternative 6). Implementation of a vessel quota and operating requirement alternative would require the Park Service to promulgate regulations, revising 36 CFR 13.65.

ALTERNATIVES

GLACIER BAY

NATIONAL PARK AND PRESERVE, ALASKA

VESSEL QUOTAS AND OPERATING REQUIREMENTS • FINAL ENVIRONMENTAL IMPACT STATEMENT

CHAPTER 2. ALTERNATIVES

2.1 INTRODUCTION

This chapter identifies, describes, and compares six alternatives for achieving the purpose and need for the action described in chapter 1. These alternatives are the result of discussions with representatives of federal, state, and local agencies; the Hoonah Indian Association, which is a federally recognized tribal government; interested civic groups; businesses; and the public, as well as discussions among NPS staff. Alternative 6 was developed as a result of public comment on the DEIS and additional NPS consideration. It represents a combination of vessel quotas and operating requirements presented in other alternatives evaluated in the DEIS. The elements and effects of this alternative are within the scope of what was presented and analyzed in the DEIS.

2.2 TERMINOLOGY AND DEFINITIONS

Table 2-1 provides a comparison of the terms and definitions used in the alternatives' discussion in the FEIS.

2.3 ACTION COMMON TO ALL ALTERNATIVES

The daily vessel quota for cruise ships would be two per day year-round for all of the alternatives.

2.4 ALTERNATIVE 1: NO ACTION

Alternative 1 is the no-action alternative or the status quo. Vessel quotas and operating requirements considered under this alternative pertain to Glacier Bay. Vessel classes would continue to be defined under the existing regulations. The current quotas, quota season, and operating requirements for cruise ships and tour, charter, and private vessels would remain in effect under this alternative. The current vessel quotas were set by Congress (Public Law 107-63) in November 2001 at the level in effect in the 2000 calendar year and the "modified alternative 5" of the NPS 1996 *Vessel Management Plan and Environmental Assessment* finding of no significant impact (NPS 1996).

2.4.1 Alternative 1 — Vessel Quotas

This alternative would maintain existing visitor-use opportunities in Glacier Bay by continuing the vessel quotas for cruise ships and tour, charter, and private vessels, set by Congress in 2001. Table 2-2 lists the quotas for each vessel class. The current quota season of June 1 through August 31 would remain in effect.

TABLE 2-1: COMPARISON OF DEFINITIONS FOR ALTERNATIVES 1 THROUGH 6

Term	Alternatives 1, 2, and 3 **Current regulations apply, and current regulatory language is shown below.**	Alternative 4 **Adjustments to the current regulations are shown below; other definitions in the current regulations would continue to apply.**	Alternative 5 **Adjustments to the current regulations are shown below; other definitions in the current regulations would continue to apply.**	Alternative 6 **Adjustments to the current regulations are shown below; other definitions in the current regulations would continue to apply.**
Adams Inlet (wilderness boundary)	East of the wilderness boundary at the mouth of the inlet.	Same as alternatives 1, 2, and 3.	Same as alternatives 1, 2, and 3.	Same as alternatives 1, 2, and 3.
Administrative Use	Not specifically defined in the current regulations, but managed as a motor vessel engaged in official business for the state or federal government. See 13.65(b)(2)(iii). Exceptions from entry permit requirement.	Any motor vessel engaged in official government business.	Same as alternative 4.	Same as alternative 4.
Administrative Vessel	Not defined in the current regulations, but managed as any vessel involved in administrative use.	Any vessel involved in administrative use.	Same as alternative 4.	Same as alternative 4.
Bartlett Cove Passenger Ferry[b]	Any motor vessel engaged in the transport of passengers for hire, with sole purpose of accessing park or other authorized visitor services or facilities at, or originating from, the public dock area at Bartlett Cove, as provided in Public Law 105-83, Title I, section 27.	A motor vessel of less than 100 tons gross (U.S. System) or 2,000 tons gross (International Convention System) permitted by the superintendent to engage in the transport of passengers for hire into Bartlett Cove from Juneau with sole purpose of accessing park or other authorized visitor services or facilities at, or originating from, the public dock area at Bartlett Cove.	Same as alternative 4.	Same as alternative 4.
Beardslee Entrance (wilderness boundary)	East of the wilderness boundary at the Beardslee Entrance and south of the wilderness boundary extending from Sita Reef to Beartrack Cove.	Same as alternatives 1, 2, and 3.	Same as alternatives 1, 2, and 3.	Same as alternatives 1, 2, and 3.

Table 2-1: Comparison of Definitions for Alternatives 1 Through 6

Term	Alternatives 1, 2, and 3 Current regulations apply, and current regulatory language is shown below.	Alternative 4 Adjustments to the current regulations are shown below; other definitions in the current regulations would continue to apply.	Alternative 5 Adjustments to the current regulations are shown below; other definitions in the current regulations would continue to apply.	Alternative 6 Adjustments to the current regulations are shown below; other definitions in the current regulations would continue to apply.
Charter Vessel	Any motor vessel under 100 tons gross (U.S. System) of 2,000 tons gross (International Convention System) that is rated to carry up to 49 passengers, and is available for hire on an unscheduled basis, except a charter vessel used to provide a scheduled camper or kayak drop-off service.	Any motor vessel of less than 100 tons gross (U.S. System) or 2,000 tons gross (International Convention System) engaged in transport of passengers for hire and rated to carry up to 12 passengers overnight or up to 49 passengers for daytime use, except when operating as an administrative vessel. Charter vessels also include any uninspected vessel of less than 200 tons gross (U.S. Simplified Measurement System) and not more than 24 meters (79 feet) in length engaged in transport of passengers for hire, except when operating as an administrative vessel.	Same as alternative 4.	Same as alternative 4.
Cruise Ship	Any motor vessel at or more than 100 tons gross (U.S. System) or 2,000 tons gross (International Convention System) carrying passengers for hire.	Any motor vessel of at least 100 tons gross (U.S. System) or 2,000 tons gross (International Convention System) carrying more than 12 passengers for hire, except when operating as an administrative vessel (administrative vessels are those engaged in official government business, including research).	Same as alternative 4.	Same as alternative 4.
Daily Vessel Quota	Not defined in current regulations, but managed as the number of vessel-use days allowed in an area on any one calendar day.	The number of vessel-use days allowed in an area on any one calendar day.	Same as alternative 4.	Same as alternative 4.

TABLE 2-1: COMPARISON OF DEFINITIONS FOR ALTERNATIVES 1 THROUGH 6

Term	Alternatives 1, 2, and 3 Current regulations apply, and current regulatory language is shown below.	Alternative 4 Adjustments to the current regulations are shown below; other definitions in the current regulations would continue to apply.	Alternative 5 Adjustments to the current regulations are shown below; other definitions in the current regulations would continue to apply.	Alternative 6 Adjustments to the current regulations are shown below; other definitions in the current regulations would continue to apply.
Dundas Bay	All waters inside a line drawn between Point Dundas and Point Wimbledon.	Same as alternatives 1, 2, and 3.	Same as alternatives 1, 2, and 3.	Same as alternatives 1, 2, and 3.
Entry	Each time a motor vessel passes the mouth of Glacier Bay into the Bay; each time a private vessel activates or extends a permit; each time a motor vessel based at or launched from Barlett Cove leaves the dock area on the way into Glacier Bay, except a private vessel based at Barlett Cove that is gaining access or egress to or from outside Glacier Bay; the first time a local private vessel uses a day of the seven-use day permit; or each time a motor vessel singularly launched from a permitted motor vessel and operated only while the permitted vessel remains at anchor, or a motor vessel launched and operated from a permitted motor vessel while that vessel is not under way and in accordance with a concession agreement.	NA	NA	NA
Glacier Bay	All marine waters inside a line drawn between Point Gustavus and Point Carolus.	Same as alternatives 1, 2, and 3.	Same as alternatives 1, 2, and 3.	Same as alternatives 1, 2, and 3.

TABLE 2-1: COMPARISON OF DEFINITIONS FOR ALTERNATIVES 1 THROUGH 6

Term	Alternatives 1, 2, and 3 Current regulations apply, and current regulatory language is shown below.	Alternative 4 Adjustments to the current regulations are shown below; other definitions in the current regulations would continue to apply.	Alternative 5 Adjustments to the current regulations are shown below; other definitions in the current regulations would continue to apply.	Alternative 6 Adjustments to the current regulations are shown below; other definitions in the current regulations would continue to apply.
Private Vessel	Any motor vessel used for recreation that is not engaged in commercial transport of passengers, commercial fishing, or official government business.	Same as alternatives 1, 2, and 3.	Same as alternatives 1, 2, and 3.	Same as alternatives 1, 2, and 3.
Seasonal-Use Days	Not defined in current regulations, but managed as the number of vessel-use days allowed during a specific seasonal period.	The number of vessel-use days allowed during a specific seasonal period.	Same as alternative 4.	Same as alternative 4.
Short-Notice Private Vessel Permits	NA	Permits available to private vessels on short notice. Private vessel operators could obtain one of these permits by making a reservation within 48 hours of when they desire to enter Glacier Bay.	Same as alternative 4.	Same as alternative 4.
Speed Over the Ground	NA[a]	NA	Speed measured in relation to a fixed point on the earth.	NA
Speed Through the Water	The speed at which a vessel moves through the water (which itself may be moving), as distinguished from "speed over the ground."	Same as alternatives 1, 2, and 3.	NA	Same as alternatives 1, 2, and 3.
Tour Vessel	Any motor vessel under 100 tons gross (U.S. System) or 2,000 tons gross (International Convention System) that is rated to carry more than 49 passengers, or any smaller vessel that conducts tours or provides transportation at regularly scheduled times along a regularly scheduled route.	Any motor vessel of less than 100 tons gross (U.S. System) or 2,000 tons gross (International Convention System) engaged in transport of passengers for hire and rated to carry more than 12 passengers overnight or greater than 49 passengers for daytime use, except when operating as an administrative vessel.	Same as alternative 4.	Same as alternative 4.

TABLE 2-1: COMPARISON OF DEFINITIONS FOR ALTERNATIVES 1 THROUGH 6

	Alternatives 1, 2, and 3	Alternative 4	Alternative 5	Alternative 6
Term	**Current regulations apply, and current regulatory language is shown below.**	**Adjustments to the current regulations are shown below; other definitions in the current regulations would continue to apply.**	**Adjustments to the current regulations are shown below; other definitions in the current regulations would continue to apply.**	**Adjustments to the current regulations are shown below; other definitions in the current regulations would continue to apply.**
Vessel-Use Days	Any continuous period of time in which a motor vessel is in Glacier Bay from 12 midnight on one day to 12 midnight the next day.	When a motor vessel is in Glacier Bay or Dundas Bay operating under its permit for that calendar day.	Same as alternative 4.	Same as alternative 4.
Whale Waters	Any portion of Glacier Bay, designated by the superintendent, having a high probability of whale occupancy, based upon recent sighting or past patterns of occurrence.	Same as alternative 1, 2, and 3.	Same as alternatives 1, 2, and 3.	Same as alternatives 1, 2, and 3.

a. The term "speed over ground" is referenced in the current regulations, but no definition is provided. It is presumed to be speed measured in relation to a fixed point on the earth.

b. See Title I, section 127, of the Department of the Interior and Related Agencies Appropriations Act of 1988 (Public Law 105-83), which authorizes one entry per day for a passenger ferry into Bartlett Cove from Juneau.

NA = Not applicable.

CFR = Code of Federal Regulations.

TABLE 2-2: SUMMARY OF VESSEL QUOTAS FOR GLACIER BAY UNDER ALTERNATIVE 1, JUNE 1–AUGUST 31 [a]

Vessel Class	Daily Entries	Seasonal Entries	Seasonal-Use Days
Cruise ship [a]	2	139	139
Tour vessel [a]	3	276	276
Charter vessel	6	312	552
Private vessel	25	468	1,971

[a] Cruise ships and tour vessels are limited to a maximum of two per day and three per day, respectively, year-round.
See table 2-1 for an explanation of terms.

As indicated in the table above, a maximum of two cruise ships per day would be allowed entry to Glacier Bay; however, the seasonal limit of 139 cruise ship entries would ensure that some days during the season would have fewer than two cruise ship entries. Current exceptions would be maintained, including the exception of administrative traffic and private vessels based at Bartlett Cove. No permit would be required for private vessels based at Bartlett Cove transiting between Bartlett Cove and waters outside Glacier Bay, or private vessels operating in Bartlett Cove in waters bounded by the public and administrative docks.

2.4.2 Alternative 1 — Vessel Operating Requirements

Under alternative 1, vessel operating requirements would follow the existing regulations (see appendix A) and the park compendium (see appendix B). The park compendium is a written compilation of designations, closures, permit requirements, and other restrictions imposed by the superintendent under the discretionary authority found in the Code of Federal Regulations.

Vessel Speed. Under alternative 1, vessels would continue to be required to operate at speeds of 20 knots or less in the designated lower Bay whale waters. (The superintendent may designate a 10-knot limit in any area because of whale concentrations.) Vessel speed is measured “through the water,” or the speed at which a vessel moves through the water (which itself may be moving), as distinguished from speed “over the ground.” Under alternative 1, vessel speed limits in designated whale waters would be in effect from May 15 through August 31.

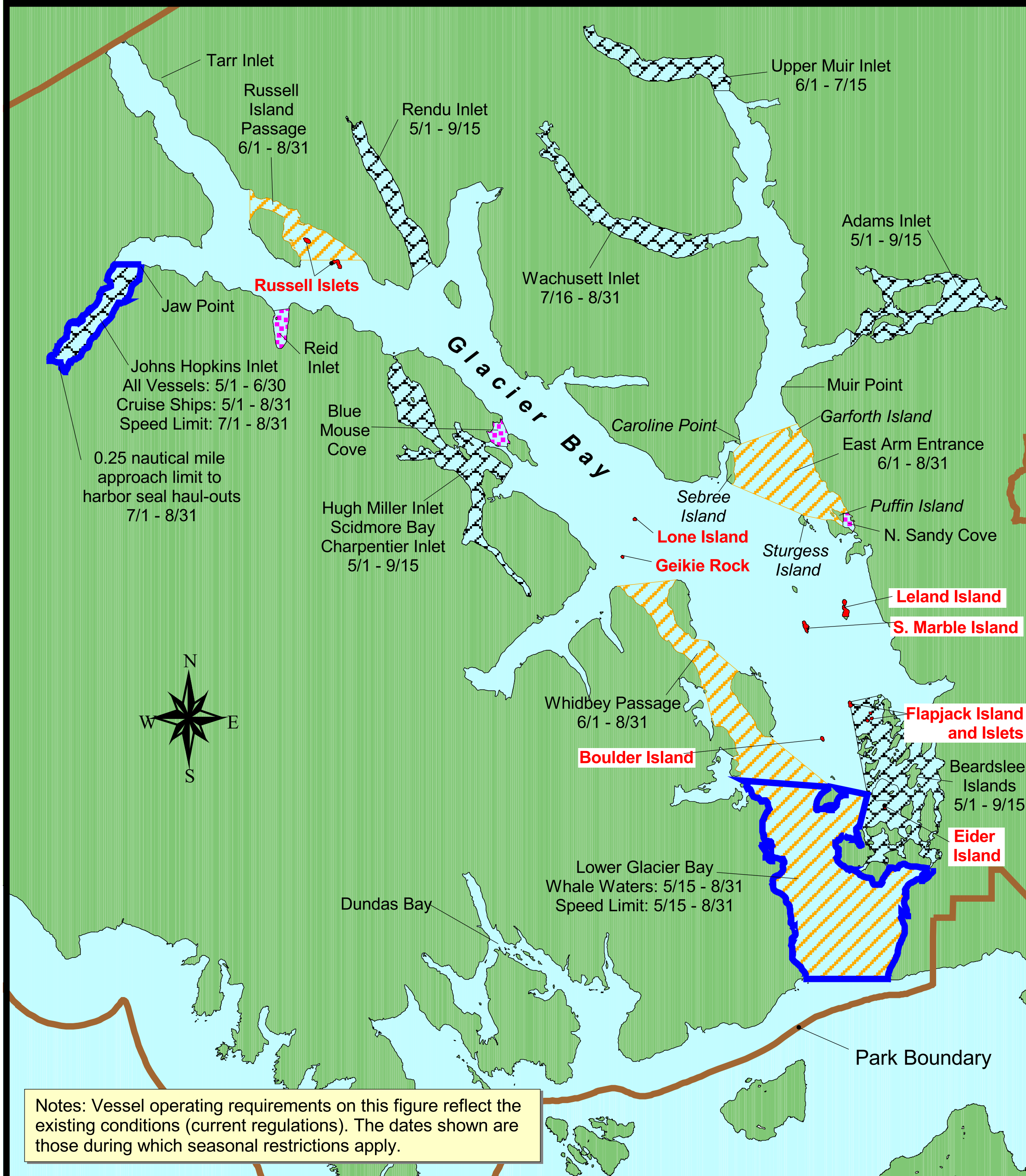
Whale Waters. Whale waters are any portion of Glacier Bay designated by the superintendent as having a high probability of whale occupancy, based upon recent sightings or past patterns of occurrence. From May 15 through August 31, the lower Bay, defined in 36 CFR 13.65 (see appendix A) and shown in figure 2-1, would be designated whale waters. From June 1 through August 31, Whidbey Passage, East Arm entrance waters, and Russell Island Passage waters would also be designated whale waters (see appendix A and figure 2-1). Current regulations specify that, except for vessels actually fishing or otherwise authorized or vessels operating solely under sail, while in transit, operators of motor vessels over 18 feet long must maintain a distance of at least one nautical mile from shore in designated whale waters and in narrower areas must navigate in mid-channel.

Vessel Routes and Destinations. Under alternative 1, vessel routes are not defined although cruise ships generally follow the mid-channel of Glacier Bay. Closed waters are identified in figure 2-1 and defined in 36 CFR 13.65 (see appendix A). Many of the waters around rocks and islands are closed for protection of sensitive wildlife species. In addition, for the protection of harbor seals, Johns Hopkins Inlet is closed to cruise ships from May 1 through August 31 and to all vessels from May 1 through June 30. From July 1 through August 31, in Johns Hopkins Inlet, all vessels are required to stay 0.25 nautical mile (0.4 kilometer) from seals hauled out on ice.

Vessel Operating Requirments Under Alternatives 1, 2, & 3

Figure 2-1

National Park Service
U.S. Department of the Interior



Islands with Protective Buffers
(Islands' names shown in red)

Seasonal Non-Motorized Waters

Seasonal Whale Waters

Seasonal Speed Restricted Areas

Seasonal Noise Restricted Area
(10 pm - 6 am, 6/1 - 8/31)

Glacier Bay National Park and Preserve

Vessel Quotas and Operating Requirements
Environmental Impact Statement

5 0 5 10 Miles

The areas currently closed to motor vessels from May 1 through September 15 to protect sensitive resources and provide non-motorized backcountry experiences include most of Adams Inlet, Rendu Inlet, the Hugh Miller complex, and waters within the Beardslee Island group. Muir Inlet, beginning approximately one nautical mile north of McBride Glacier (June 1 through July 15), and Wachusett Inlet are closed to motor vessels (July 16 through August 31; see figure 2-1). These areas are defined in appendix A.

2.5 ALTERNATIVE 2

Under alternative 2, vessel quotas would be set to those authorized in 1985 and in effect in 1996. Vessel classes would continue to be defined under the existing regulations as shown in table 2-1. Vessel operating requirements and the quota season would remain the same as those under the no-action alternative. Vessel quotas and operating requirements considered under this alternative pertain to Glacier Bay.

2.5.1 Alternative 2 — Vessel Quotas

Vessel quotas would be in effect in Glacier Bay from June 1 through August 31 (see table 2-3). Current exceptions would be maintained, including the exception of administrative vessels and private vessels based at Bartlett Cove.

TABLE 2-3: SUMMARY OF VESSEL QUOTAS FOR GLACIER BAY UNDER ALTERNATIVE 2, JUNE 1–AUGUST 31[a]

Vessel Class	Daily Entries	Seasonal Entries	Seasonal-Use Days
Cruise ship[a]	2	107	107
Tour vessel[a]	3	276	276
Charter vessel	6	271	511
Private vessel	25	407	1,714

a. Cruise ships and tour vessels are limited to a maximum of two per day and three per day, respectively, year-round.
See table 2-1 for an explanation of terms.

2.5.2 Alternative 2 — Vessel Operating Requirements

As with alternative 1, vessel operating requirements would follow the existing regulations (see appendix A) and the park compendium (see appendix B). See the description of operating requirements under alternative 1.

2.6 ALTERNATIVE 3

Alternative 3 represents the vessel management plan completed in 1996. Vessel quotas and operating requirements considered under this alternative pertain to Glacier Bay. Alternative 3 would continue the current vessel quotas, but would provide for potential future increases in cruise ships up to 184 during June 1 through August 31. The increases would allow up to two cruise ships per day, every day. The current quota season and operating requirements would be maintained. As with alternatives 1 and 2, the time period when seasonal entries and seasonal-use days are defined would be from June 1 through August 31. Vessel classes, seasonal-use days, and seasonal entries would continue to be defined under the existing regulations (see table 2-1).

Tour, charter, and private vessel quotas would remain the same as currently allowed. Any increase in cruise ship numbers would be based on scientific and other information and applicable authorities.

Since 1996, the Park Service has conducted research to determine whether increases are warranted, and each year the superintendent reviews the research results. To date, the research has not clearly demonstrated that further increases are warranted. Research would continue with emphasis on air quality, underwater sound, humpback whales, marine birds, soundscape, and visitor experience.

2.6.1 Alternative 3 — Vessel Quotas

This alternative would optimize visitor-use opportunities via cruise ship in Glacier Bay by potentially increasing cruise ship seasonal-entry quotas and seasonal-use days (see table 2-4). This alternative is identical to alternative 1, except that the cruise ship seasonal quota could increase from 139 per season to 184 per season, based on scientific and other information and applicable authorities. The determination whether to increase cruise ship quotas would rely on a set of criteria that define the environmental and social conditions that would need to be met before any additional entries would be approved. These yet to be determined criteria would be based on recommendations and guidance provided by studies of the impact of vessels on all park resources. Studies would be identified in a research framework developed with the assistance of a science advisory board. This research framework would identify the studies necessary to provide information on the effects of vessel traffic on the environment and develop monitoring information necessary for park management. If the cruise ship vessel quota were increased to 184, two cruise ships would be permitted to enter Glacier Bay every day from June 1 to August 31. As with alternative 1, current exceptions would be maintained, including the exceptions of administrative vessel traffic and private vessels based in Bartlett Cove.

TABLE 2-4: SUMMARY OF VESSEL QUOTAS FOR GLACIER BAY UNDER ALTERNATIVE 3, JUNE 1–AUGUST 31[a]

Vessel Class	Daily Entries	Seasonal Entries	Seasonal-Use Days
Cruise ship[a]	2	139 (potentially up to 184)	139 (potentially up to 184)
Tour vessel[a]	3	276	276
Charter vessel	6	312	552
Private vessel	25	468	1,971

a. Cruise ships and tour vessels are limited to a maximum of two per day and three per day, respectively, year-round.
See table 2-1 for an explanation of terms.

2.6.2 Alternative 3 — Vessel Operating Requirements

As with alternatives 1 and 2, vessel operating requirements would follow the existing regulations (see appendix A) and the park compendium (see appendix B). See the description of operating requirements under alternative 1.

2.7 ALTERNATIVE 4: ENVIRONMENTALLY PREFERRED ALTERNATIVE

Alternative 4 would allow the lowest level of entries across all vessel classes, except private vessels. Alternative 4 would maintain the current daily quotas for cruise ships and reduce slightly the daily quotas for the other three vessel classes. It would reduce seasonal-use days for cruise ships, tour vessels, and charter vessels and would slightly increase the number of seasonal-use days for private vessels for Glacier Bay. The quota season would be lengthened to include May and September for all vessel classes. Seasonal entry quotas would be eliminated. In Dundas Bay, cruise ships and tour vessels would not be permitted year-round and vessel quotas would be initiated for charter vessels, and a May through September quota season would apply. Operating requirements would be modified, including limited closures of certain waters to cruise ships and tour vessels and decreased vessel speed for large vessels.

2.7.1 Alternative 4 — Vessel Quotas

Glacier Bay. Under alternative 4, cruise ship quotas would be set at two per day year-round; however, because the seasonal-use days would be 92 (June through August) and 61 (May and September) cruise ships would average one per day; on some days there could be none. The daily quota for tour vessels would be set at two per day year-round, with seasonal-use day limits of 184 (June through August) and 122 (May and September). The daily quota of charter vessels in Glacier Bay would be set at five, with seasonal-use days set at 460 (June through August) and 305 (May and September). Daily quotas for private vessels would be 22. Seasonal-use days for private vessels would be 2,024, which is an additional 53 use days, compared to the current situation. Seasonal-use day limits for private vessels for May and September would be 1,342.

Dundas Bay. Alternative 4 would formalize the current cruise ship use pattern by prohibiting cruise ships in Dundas Bay. Tour vessels also would be prohibited in Dundas Bay. This alternative would establish a daily quota of three for charter vessels in Dundas Bay from May 1 through September 30. Daily vessel quotas would not be set for private vessels.

Season. Vessel quotas in Glacier Bay and Dundas Bay under alternative 4 would be in effect from May 1 through September 30.

With this alternative, seasonal entries would be eliminated. Currently, when a vessel leaves Glacier Bay, it is not permitted to return without obtaining a new permit. Under alternative 4, with the elimination of seasonal entries, a vessel could leave the Bay and enter again under one permit within a particular calendar day. Seasonal-use days would be the product of the daily vessel quota times the number of days in the season (92 for June through August; 61 for May and September).

Tables 2-5 and 2-6 summarize vessel quotas for Glacier Bay and Dundas Bay, respectively, under alternative 4.

TABLE 2-5: SUMMARY OF VESSEL QUOTAS FOR GLACIER BAY UNDER ALTERNATIVE 4, MAY 1–SEPTEMBER 30[a]

	Daily Vessel Quota		Seasonal Entries	Seasonal-Use Days	
Vessel Class	June–Aug	May and Sept		June–Aug	May and Sept
Cruise ship[a]	2	2	NA	92	61
Tour vessel[a]	2	2	NA	184	122
Charter vessel	5	5	NA	460	305
Private vessel	22	22	NA	2,024	1,342

a. Cruise ships and tour vessels are limited to the daily vessel quota year-round.

NA = Not applicable.
See table 2-1 for explanation of terms.

TABLE 2-6: SUMMARY OF VESSEL QUOTAS FOR DUNDAS BAY UNDER ALTERNATIVE 4, MAY 1–SEPTEMBER 30[a]

Vessel Class	Daily Vessel Quota	Seasonal Entries	Seasonal-Use Days
Cruise ship[a]	Not permitted	NA	NA
Tour vessel[a]	Not permitted	NA	NA
Charter vessel	3	NA	459
Private vessel	No limit	No limit	No limit

[a] Cruise ships and tour vessels are not allowed year-round.

NA = Not applicable.
See table 2-1 for explanation of terms.

Permitting Procedures. Under alternative 4, current park regulations would be changed from "Each private motor vessel must have a permit" to "Permits shall be issued to a designated individual for a specific vessel over a specific period of time." Permits would be issued to individuals rather than vessels because individuals are responsible for following park regulations.

Under current regulations, private vessels based in Bartlett Cove that enter and exit Glacier Bay do not count as a daily entry (note that traveling up-Bay from Bartlett Cove counts as an entry). The "based in Bartlett Cove" exemption would be eliminated under alternative 4. In its place, 10 private vessel permits (of the 22 daily permits allowed), called "short-notice permits," would be set aside for distribution on a short-notice basis (up to 48 hours). Any individual with a private vessel could obtain one of these permits by making a reservation within 48 hours of entrance to Glacier Bay. The number of short-notice permits could be adjusted annually by the superintendent through use of the park compendium.

2.7.2 Alternative 4 — Vessel Operating Requirements

Vessel Speed. Placing speed limits on vessels is one of the main methods the Park Service uses to reduce the risk of vessels colliding with marine life. Noise level is related to vessel speed; lower speed means less noise.

Vessel speed regulations would change in two fundamental ways under alternative 4. First, vessel speed limits would be based on vessel length; a year-round speed limit of 13 knots through the water would be placed on all vessels greater than or equal to 262 feet (80 meters) to reduce risks of vessel collisions with whales. Second, the timeframe for speed limits in whale waters (lower Glacier Bay only) would be extended to May 1 through September 30 (currently May 15 through August 31) to account for the presence of humpback whales throughout the longer period. Motorized vessels less than 262 feet (80 meters) long would be prohibited from operating at more than 20 knots through the water in lower Bay whale waters. All motor vessels would be subject to operating at no greater than 10 knots through the water when the superintendent has designated a maximum of 10 knots because of the presence of whales. The regulatory language would read:

> *From May 1 through September 30 in the designated whale waters of the lower Bay, as defined above, for vessels less than 262 feet (80 meters) in length, the following is prohibited: 1) Operating at more than 20 knots speed through the water. 2) Operating at more than 10 knots speed through the water, when the superintendent has designated a maximum speed of 10 knots (due to the presence of humpback whales in the area).*

For vessels 262 feet (80 meters) or greater in length, the following is prohibited: 1) Operating at more than 13 knots speed through the water, everywhere within Glacier Bay. 2) Operating at more than 10 knots speed through the water when the superintendent has designated a maximum speed of 10 knots (due to the presence of humpback whales in the area).

Whale Waters. Whale waters would be lower Glacier Bay waters only from May 1 through September 30 (see appendix A for a detailed description of the boundary). In addition, the superintendent also may designate any portion(s) of Glacier Bay and Dundas Bay as temporary whale waters and impose motor vessel speed restrictions in whale waters.

Vessel Routes and Destinations. Routes for cruise ships in Glacier Bay would be defined to provide more assurance of resource protection, provide a potentially improved backcountry visitor experience, better separate the various vessels in Glacier Bay, and provide an increased margin of safety for avoidance of nearshore collisions. A cruise ship route would be identified using the current typical cruise ship traffic pattern (generally in mid-channel). Non-motorized water designations and seasons would not change.

Cruise ships would be allowed to go into the West Arm, into Tarr Inlet, and up to Jaw Point in Johns Hopkins Inlet. In addition to the closed waters defined for alternatives 1, 2, and 3, cruise ships also would not be allowed into Beardslee Entrance, Dundas Bay, and the East Arm, as defined by an imaginary line drawn from southern Sebree Island to the mainland (see figure 2-2).

Tour vessels would not be allowed in the closed waters, as defined in the current regulations (see appendix A). In addition, tour vessels would not be allowed into Beardslee Entrance, Muir Inlet (the East Arm of Glacier Bay north of Muir Point), Berg Bay, and Fingers Bay in Glacier Bay or in Dundas Bay.

Johns Hopkins Inlet seasonal closure — Under alternative 4, motorized vessels would be required to maintain a 0.25-nautical-mile (0.4 kilometer) distance from harbor seals hauled out on ice in Johns Hopkins Inlet on a year-round basis.

2.8 ALTERNATIVE 5

Vessel quotas and operating requirements under alternative 5 would apply to Glacier Bay and Dundas Bay. Alternative 5 would maintain the current daily vessel quotas for all four vessel types in Glacier Bay. The seasonal-use days for cruise ships would be extended into May and September. It would maintain the number of seasonal-use days for cruise ships, tour vessels, and charter vessels during the current quota season but decrease the number of seasonal-use days for cruise ships during May and September. It would increase the number of seasonal-use days for private vessels. Seasonal entry quotas would be eliminated. Vessel quotas would be initiated for tour and charter vessels in Dundas Bay. Operating requirements would be modified, including limited closure of certain waters to cruise ships and tour vessels, decreased vessel speed for large vessels, and use of “speed over ground” as a measure of vessel speed.

2.8.1 Alternative 5 — Vessel Quotas

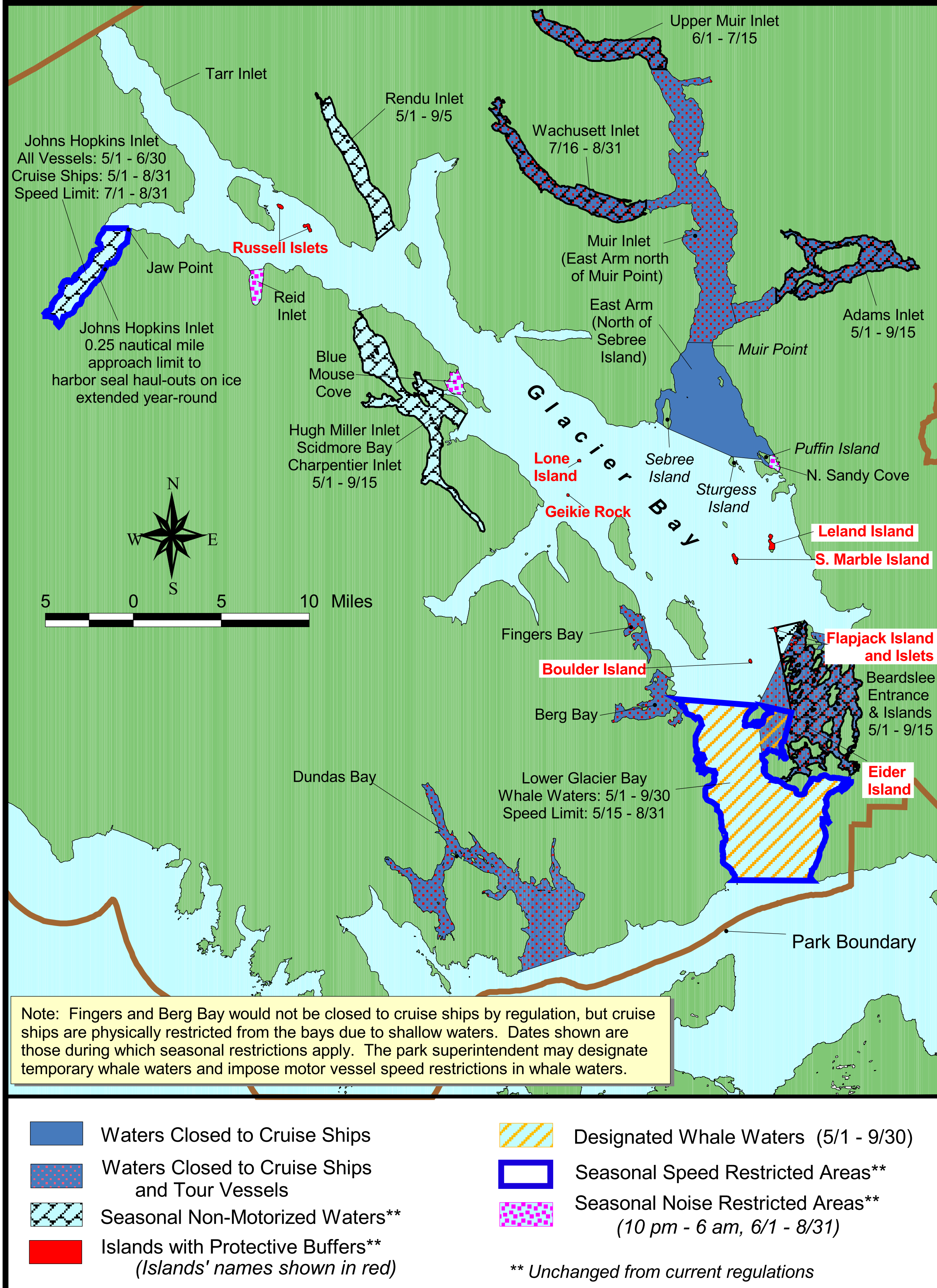
Glacier Bay. Alternative 5 would maintain current vessel numbers for Glacier Bay from June 1 to August 31 and would extend the seasonal-use day limits to May and September for cruise ships. The number of cruise ships that would be allowed in May and September represents the same proportion of use allowed at present from June through August (139 cruise ships/92 days June through August = 92 cruise ships/61 days May and September). The number of tour vessels is limited by the year-round daily quota of three per day. Charter and private vessel classes would maintain the June through August season. Entry limits lower than those allowed under existing requirements are proposed for

Vessel Operating Requirments Under Alternative 4

Figure 2-2

National Park Service
U.S. Department of the Interior

Glacier Bay National Park and Preserve
Vessel Quotas and Operating Requirements
Environmental Impact Statement



cruise ships in May and September (see table 2-7). This alternative would maximize private vessel use in Glacier Bay by increasing seasonal-use days for private vessels compared with existing conditions. As with alternative 4, seasonal entries would be eliminated with this alternative.

Dundas Bay. Cruise ships would not be allowed in Dundas Bay on a year-round basis. One tour vessel would be allowed per day in the non-wilderness waters of Dundas Bay from June 1 through August 31. Tour vessels would not be allowed within the wilderness waters year-round. Seasonal-use days for charter vessels would be 276, which represent an average of three vessels per day from June through August.

Season. As is currently the case, daily quotas for cruise ships and tour vessels would be in effect year-round in Glacier Bay. Seasonal-use days would apply from May 1 through September 30 for cruise ships. Daily quotas and seasonal-use days for charter and private vessels would apply for the existing season of June 1 through August 31, as would the seasonal-use days for tour vessels. The season for vessel quotas in Dundas Bay would be June 1 through August 31, although cruise ships would not be permitted year-round and tour vessels would not be permitted in the upper Dundas Bay wilderness waters (year-round).

Tables 2-7 and 2-8 summarize vessel quotas for Glacier Bay and Dundas Bay, respectively, under alternative 5.

TABLE 2-7: SUMMARY OF VESSEL QUOTAS FOR GLACIER BAY UNDER ALTERNATIVE 5, MAY 1–SEPTEMBER 30[a]

	Daily Vessel Quota		Seasonal Entries	Seasonal-Use Days	
Vessel Class	June–Aug	May and Sept		June–Aug	May and Sept
Cruise ship[a]	2	2	NA	139	92
Tour vessel[a]	3	3	NA	276	183
Charter vessel	6	No limit	NA	552	No limit
Private vessel	25	No limit	NA	2,300	No limit

a. Cruise ships and tour vessels are limited to the daily vessel quota year-round.

NA = Not applicable
See table 2-1 for an explanation of terms.

TABLE 2-8: SUMMARY OF VESSEL QUOTAS FOR DUNDAS BAY UNDER ALTERNATIVE 5, JUNE 1–AUGUST 31[a]

Vessel Class	Daily Vessel Quota	Seasonal Entries	Seasonal-Use Days
Cruise ship[a]	Not permitted	NA	NA
Tour vessel[a]	1 in non-wilderness waters[b]	NA	92 in non-wilderness waters[b]
Charter vessel	No limit	NA	276
Private vessel	No limit	No limit	No limit

a. Cruise ships are not allowed on a year-round basis; tour vessels are not allowed in wilderness waters.
Upper Dundas Bay is wilderness waters; the lower Bay is non-wilderness waters.

NA = Not applicable
See table 2-1 for an explanation of terms.

Permitting Procedures. Current park regulations would be changed so that permits would be issued to a designated individual for a specific vessel over a specific period of time rather than issued to a vessel. Permits would be issued to individuals rather than vessels because individuals are responsible for following park regulations.

Under alternative 5, the exemption for private vessels based in Bartlett Cove that enter and exit Glacier Bay (these are not currently counted as daily entries) would be eliminated and new “short-notice permits” would be issued. Anyone could request a short-notice permit by making a reservation within 48 hours of entrance to Glacier Bay.

2.8.2 Alternative 5 — Vessel Operating Requirements

Alternative 5 shares the revisions to operating requirements with alternative 4, with the following exceptions:

1. how vessel speed is defined;
2. the time frame during which speed restrictions are in effect;
3. the time frame during which whale waters are in effect;
4. access for cruise ships and tour vessels in the East Arm; and
5. access for tour vessels in Dundas Bay.

Vessel Speed. Vessel speed limits would be similar to those described for alternative 4. Vessel speed would be based on “over the ground” rather than “through the water” for all vessel classes. Over the ground speed does not account for water currents, but rather is based on the rate of travel in relation to a fixed point on the ground or the bottom of the water body.

Until the proliferation of Global Positioning System (GPS) units in the consumer market, most vessels measured vessel speed with a through-hull or transducer-mounted paddle-wheel device that calculated speed by water passing under the vessel; this is speed “through the water.” GPS technology uses signals from high-altitude satellites located in stationary positions over earth. By timing the signals sent by an array of satellites, and by knowing the orbital parameters of the satellites, a GPS can determine a location more accurately than was previously possible. GPS receivers can measure vessel speed in relation to fixed positions on the ground or speed “over the ground.”

Most private boaters use GPS technology and may not have electronic equipment available to measure through the water speed. As a result, alternative 5 uses a ground-based, rather than water-based, definition of vessel speed. In many situations, the actual differences are negligible; however, Glacier Bay is known for its rapid currents that measure 8 knots or more in some places. Using ground speed and traveling against such a current, a vessel’s water-based speed would be 8 knots faster than its ground speed, and moving with such a current, a vessel’s water-based speed would be 8 knots slower than ground speed.

A 13-knot speed limit, as measured over the ground, would be in effect year-round in Glacier Bay for motor vessels greater than or equal to 262 feet (80 meters). In designated whale waters (lower Glacier Bay), a speed limit of 20 knots over the ground would be in effect for motor vessels less than 262 feet (80 meters) from May 15 through September 30. In non-designated waters no speed limit would be in effect for vessels less than 262 feet (80 meters). A 10-knot speed limit over the ground would be in effect from May 15 through September 30 for motor vessels when the superintendent has designated a maximum speed of 10 knots due to the presence of whales.

Whale Waters. Whale waters would be lower Glacier Bay only from May 15 through September 30 and, again, speed would be measured over the ground (rather than through the water). In addition, the superintendent may designate any portions(s) of Glacier Bay National Park as temporary whale waters and impose motor vessel speed restrictions.

Vessel Routes and Destinations. Under alternative 5, vessel routes are not defined although cruise ships generally follow the mid-channel of Glacier Bay. Likewise, non-motorized and closed waters would be the same as currently exist with the addition of Beardslee Entrance and the entrance to

Adams Inlet which would be closed to both cruise ships and tour vessels, Dundas Bay would be closed to cruise ships, and the wilderness waters of Dundas Bay would be closed to tour vessels (see figure 2-3). As with alternative 4, the required 0.25-mile (0.4 kilometer) distance from harbor seals in Johns Hopkins Inlet would be applied year-round.

2.9 ALTERNATIVE 6: NPS PREFERRED ALTERNATIVE

Alternative 6, developed in response to public comment on the draft EIS and additional NPS consideration, combines elements of alternatives 3 and 5. This alternative does not present any vessel quotas or operating requirements not already analyzed in the draft EIS. It is qualitatively within the spectrum of alternatives discussed in the DEIS. Alternative 6 would optimize visitor use opportunities and also simplify and improve vessel operating requirements.

Vessel quotas and operating requirements under alternative 6 would apply to Glacier Bay and Dundas Bay. Alternative 6 would maintain the current daily vessel quotas for all four vessel types in Glacier Bay. Seasonal entry quotas would not apply. It would maintain the current number of seasonal-use days in Glacier Bay for cruise ships, tour vessels, and charter vessels during the current quota season (June 1 through August 31), but provide for potential increases in the seasonal-use day quota for cruise ships during this timeframe. Any increase would be based on scientific and other information and applicable authorities. Alternative 6 would establish a seasonal-use day quota for cruise ships in May and September. This would represent a decrease in the number of cruise ships from the current allowable two per day; however, the potential would exist under this alternative for the number to increase back to two per day. This alternative would increase the number of seasonal-use days for private vessels. Seasonal entry quotas would be eliminated. Vessel quotas would be initiated for tour and charter vessels in Dundas Bay and a June 1 through August 31 quota season would apply. Operating requirements would be modified, including limited closure of certain waters to cruise ships and tour vessels and decreased vessel speed for large vessels in Glacier Bay.

2.9.1 Alternative 6 — Vessel Quotas

Glacier Bay. Alternative 6 would maintain the current daily vessel quotas for all four vessel types. The daily quotas for cruise ships and tour vessels would be would be two per day and three per day, respectively, year-round. The daily quotas for charter and private vessels would be 6 per day and 25 per day, respectively, from June 1 through August 31. The seasonal-use day quotas for charter and private vessels would be 552 and 2,300, respectively, from June 1 through August 31. Seasonal-use days for cruise ships would be 139 from June through August, with the potential for increases to 184. In May and September, the seasonal-use day quota for cruise ships would be 92, with the potential for increases to 122. Any increases would be based on scientific and other information and applicable authorities. The determination of whether to increase seasonal-use day quotas for cruise ships would rely on criteria that define the environmental and social conditions that would need to be met before any additional seasonal-use days were approved. These yet to be determined criteria would be based on the results of and guidance provided through studies that examine the effects of vessels on all park resources. Studies would be identified in a research framework developed with the assistance of a science advisory board. This research framework would identify the studies necessary to provide information on the effects of vessel traffic on the environment and develop monitoring information necessary for park management.

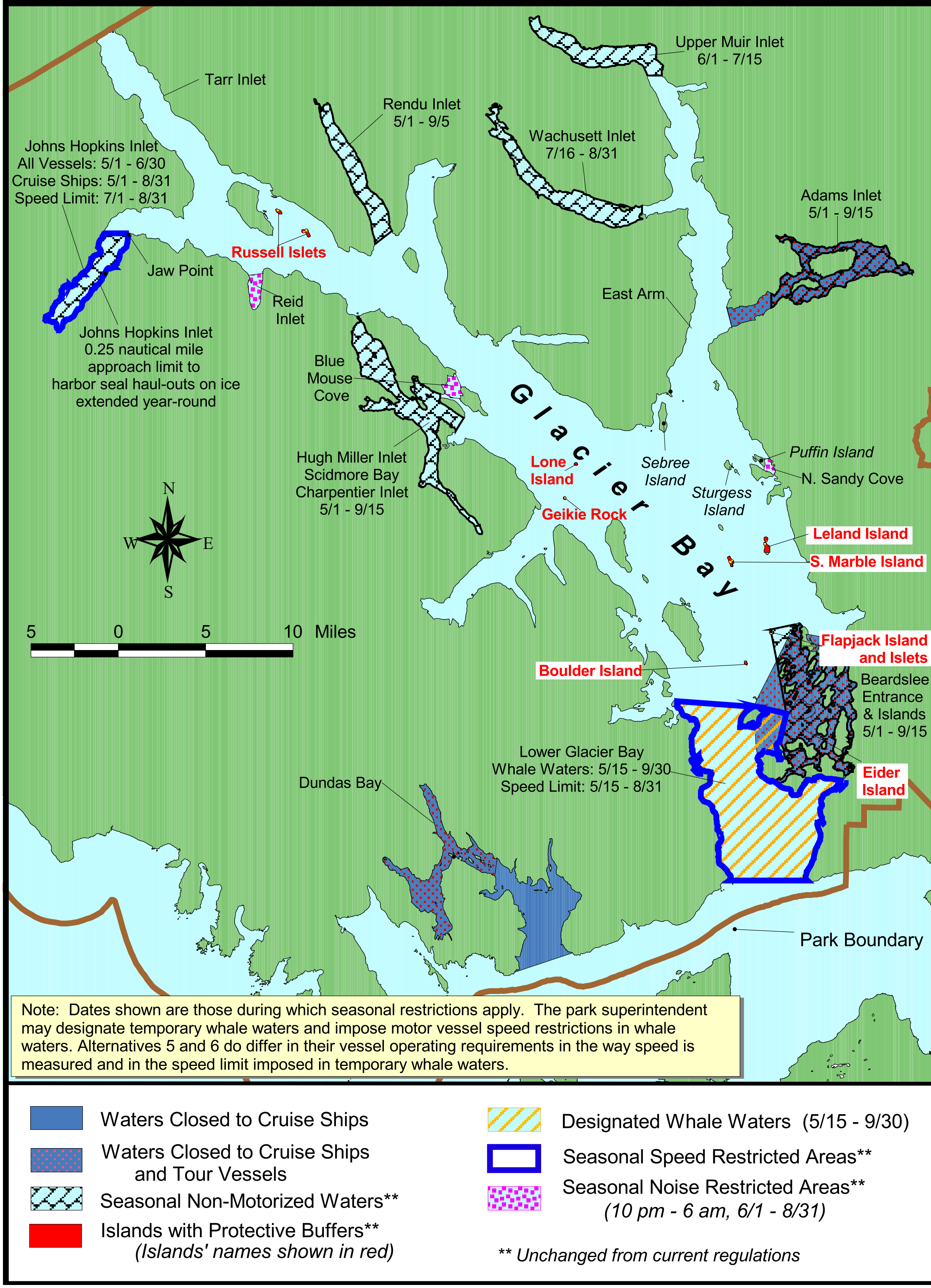
Dundas Bay. Cruise ships would not be allowed in Dundas Bay on a year-round basis. One tour vessel would be allowed per day in the non-wilderness waters of Dundas Bay from June 1 through August 31. Tour vessels would not be allowed within the wilderness waters year-round. Seasonal-use days for charter vessels would be 276, which represent an average of three vessels per day from June through August, but no daily limit for charter vessels would apply. Private vessels would not be subject to quotas in Dundas Bay.

Vessel Operating Requirments Under Alternatives 5 & 6

Figure 2-3

National Park Service
U.S. Department of the Interior

Glacier Bay National Park and Preserve
Vessel Quotas and Operating Requirements
Environmental Impact Statement



Season. As is currently the case, daily quotas for cruise ships and tour vessels would be in effect year-round in Glacier Bay. Seasonal-use days would apply from May 1 through September 30 for cruise ships. Daily quotas and seasonal-use days for charter and private vessels would apply for the existing season of June 1 through August 31, as would the seasonal-use days for tour vessels. The season for vessel quotas in Dundas Bay would be June 1 through August 31, although cruise ships would not be permitted year-round and tour vessels would not be permitted in wilderness waters (upper Dundas Bay) on a year-round basis.

Tables 2-9 and 2-10 summarize vessel quotas for Glacier Bay and Dundas Bay, respectively, under alternative 6.

TABLE 2-9: SUMMARY OF VESSEL QUOTAS FOR GLACIER BAY UNDER ALTERNATIVE 6, MAY 1–SEPTEMBER 30[a]

Vessel Class	Daily Vessel Quota		Seasonal Entries	Seasonal-Use Days	
	June–Aug	May and Sept		June–Aug	May and Sept
Cruise ship[a]	2	2	NA	139 (potentially up to 184)	92 (potentially up to 122)
Tour vessel[a]	3	3	NA	276	183
Charter vessel	6	No limit	NA	552	No limit
Private vessel	25	No limit	NA	2,300	No limit

b. Cruise ships and tour vessels are limited to the daily vessel quota year-round.

NA = Not applicable
See table 2-1 for an explanation of terms.

TABLE 2-10: SUMMARY OF VESSEL QUOTAS FOR DUNDAS BAY UNDER ALTERNATIVE 6, JUNE 1–AUGUST 31[a]

Vessel Class	Daily Vessel Quota	Seasonal Entries	Seasonal-Use Days
Cruise ship[a]	Not permitted	NA	NA
Tour vessel[a]	1 in non-wilderness waters[b]	NA	92 in non-wilderness waters[b]
Charter vessel	No limit	NA	276
Private vessel	No limit	No limit	No limit

a. Cruise ships are not allowed on a year-round basis; tour vessels are not allowed in wilderness waters.
b. Upper Dundas Bay is wilderness waters; the lower Bay is non-wilderness waters.

NA = Not applicable
See table 2-1 for an explanation of terms.

Permitting Procedures. Current park regulations would be changed so that permits would be issued to a designated individual for a specific vessel over a specific period of time rather than issued to a vessel. Permits would be issued to individuals rather than vessels, because individuals are responsible for following park regulations.

Under alternative 6, the exemption for private vessels based in Bartlett Cove that enter and exit Glacier Bay (these are not currently counted as daily entries) would be eliminated and new “short-notice permits” would be issued. Anyone could request a short-notice permit within 48 hours of entrance to Glacier Bay.

2.9.2 Alternative 6 — Vessel Operating Requirements

Alternative 6 shares the revisions to operating requirements with alternative 5, with the following exceptions:

1. how vessel speed is measured; and
2. the speed limit in temporary whale waters.

Vessel Speed. For alternative 6 speed would be based as “through the water” speed for all vessel classes.

Vessels greater than or equal to 262 feet (80 meters) would be restricted to 13 knots or less on a year-round basis within Glacier Bay. Vessels less than 262 feet (80 meters) would be restricted to 20 knots or less in the designated lower Bay whale waters from May 15 through September 30. If the presence of whales warrants it, the superintendent may impose temporary whale waters and a vessel speed limit of 13 knots. No speed limit would be imposed in areas outside of designated or temporary whale waters for vessels less than 262 feet (80 meters).

Whale Waters. Whale waters would be designated in lower Glacier Bay waters only, from May 15 through September 30. In addition, consistent with current regulations, the superintendent may designate temporary whale waters and impose motor vessel speed restrictions in any portion of Glacier Bay and Dundas Bay having a high probability of whale occupancy, based upon recent sighting and/or past patterns of occurrence.

Vessel Routes and Destinations. In Glacier Bay, two areas would be added to those already closed to cruise ships and tour vessels through existing regulations. These two additions would be the Beardslee Entrance and the entrance to Adams Inlet. Dundas Bay also would be closed to cruise ships year-round, and the wilderness waters of Dundas Bay would be closed to tour vessels year-round (see figure 2-3). The required 0.25-mile (0.4-kilometer) distance from harbor seals in Johns Hopkins Inlet would be applied year-round.

2.10 THE NPS PREFERRED ALTERNATIVE

Alternative 6 is the NPS preferred alternative for several reasons: it would provide a modified and simplified system of vessel management that would allow for increased visitor use while continuing protection of park resources and values. This alternative would maintain most of the current vessel quotas in Glacier Bay but provide increased visitor use through an increase in seasonal-use days for private vessels and a potential increase in seasonal-use days for cruise ships during the June 1 through August 31 season. Any increase in seasonal-use day numbers for cruise ships would be based on scientific and other information and applicable authorities. In addition, modifications to operating requirements proposed under this alternative take into account experience and knowledge gained over the past several years. These modifications provide for continued protection of park resources and values through such things as a year-round speed limit for large vessels throughout Glacier Bay, an extension of the quota season for cruise ships to include May and September, limiting additional areas to entry for cruise ships and/or tour vessels, an additional measure to protect harbor seals in Johns Hopkins Inlet, and initiation of vessels quotas for Dundas Bay. These modifications also would result in a simplified system, through such things as elimination of seasonal entry quotas, elimination of the ‘based in Bartlett Cove’ provision for private vessels, and initiation of a short-notice vessel permit system for private vessels. A research framework, developed with the assistance of a scientific advisory board, would help ensure that appropriate studies and monitoring would be undertaken to guide vessel management, including any decisions about possible increases in seasonal-use day numbers for cruise ships in Glacier Bay.

2.11 THE ENVIRONMENTALLY PREFERRED ALTERNATIVE

NEPA criteria for the environmentally preferred alternative includes those that:

- fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
- ensure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings;
- attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences;
- preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice;
- achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities; and
- enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Based on these criteria, alternative 4 is the environmentally preferred alternative. Alternative 4 includes closure of more area to cruise ships and tour vessels, and provides more protection of resources through revised operating requirements than the other alternatives. In addition, by allowing the fewest number of cruise ships, tour vessels, and charter vessels, alternative 4 would provide for the lowest number, intensity, and duration of adverse effects to natural resources in Glacier Bay and Dundas Bay.

2.12 ACTIONS CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS IN THIS EIS

The following describes actions raised during scoping that were considered but eliminated from detailed evaluation in this EIS.

Development of an Open-Access Vessel Corridor to the Bartlett Cove Dock. Local residents requested unlimited access between Icy Strait and the Bartlett Cove dock, without requiring an entry permit. The Gustavus dock is in disrepair, and local residents must travel across Icy Strait for fuel and other services. Providing access to Bartlett Cove would provide a convenient and, some believe, safer alternative.

Providing an open-access vessel corridor to Bartlett Cove is counter to park purposes, as well as the purpose and function of Bartlett Cove. The services at Bartlett Cove are intended to support the park's use by park visitors and are not intended to constitute a service stop for the greater Icy Strait area. In addition, the mouth of Glacier Bay is already a high-traffic area where vessels enter and leave the park. It is also an area where wildlife concentrate. Allowing this essentially unregulated use in the lower Bay could cause excessive vessel traffic in a sensitive area. In its July 2002 meeting, the Gustavus Community Association voted against formally requesting unlimited access to the Bartlett Cove dock as part of this EIS because of concerns about the effects that such a request would have on the fate of the Alaska State Dock at Gustavus.

Restricting Administrative Use. Some commenters suggested limits on administrative vessel use in Glacier Bay. Administrative vessels include research vessels, park vessels, and any other vessels on official business for the state or federal government. Use of NPS vessels is necessary to protect park resources and values.

This EIS addresses the use of commercial and private motor vessels. Administrative vessel use is determined by the superintendent to assure protection of park purposes and values, ensure visitor safety, respond to emergency situations, and otherwise implement the park's mission.

While the cumulative analysis considers the effects of administrative vessel use on park resources, restrictions on administrative use of vessels are beyond the scope of this EIS. The scope of this EIS, as defined by Congress (see subsection 1.2.8), is to identify and analyze the effects of the 1996 increases in the number of vessel entries allowed in Glacier Bay.

Administrative vessels will be managed on a case-by-case basis using a decision matrix (in appendix E). This matrix will be used on an individual basis when requests for administrative vessel use in the park are received from individuals associated with federal, state, tribal, or private organizations. Administrative vessel use is defined as any vessel use that is not classified as a cruise ship, tour vessel, charter vessel, or private vessel under the standard permit classification system (36 CFR 13.65; see appendix A), or listed as an exception under 36 CFR 13.65(iii). Exceptions to this definition are requests from individuals who have the authority to enforce state or federal regulations within the park.

Requiring Maximum Available Technology or Increasing Pollution Minimization Requirements to Control Cruise Ship Stack Emissions and Improve Air Quality. Section 703 of the November 1996 Omnibus Act (Public Law 104-333) prohibits the Park Service from imposing any vessel operating conditions related to air, water, and oil pollution beyond those enforced by other agencies on permittees. Section 703 also prohibits noise abatement unless scientific information supports a determination that such restrictions are necessary.

Increasing Cruise Ship Numbers above 1996 Levels. The previous vessel management plan and EA for Glacier Bay, completed in 1996, did not contemplate cruise ship numbers greater than two per day each day during the 92-day peak visitor season from June through August. Any increase in the number of cruise ships to be allowed into Glacier Bay was to be contingent upon studies, an annual review of study results by the superintendent, a determination by the superintendent based on that review, and approval from the NPS director. Study results to date have not provided reason to warrant increasing the limit beyond what was considered in the 1996 plan. The Park Service believes that a measured approach is in the public interest of ensuring protection of park resources. Finally, based on the results of scoping for this current planning effort, which included more than four months for interests and concerns to be voiced, no interest was expressed in increasing the daily limit beyond two per day. Thus, the Park Service believes that two cruise ships per day for each of the 92 days of the visitor season constitutes a reasonable upper limit to consider for cruise ships in the current plan.

The Environmental Impact Statement Should Consider the Widest Range of Alternatives, from Banning All Motorized Vessels and Prohibiting Further Vessel Quota Increases to Allowing Only Small Craft or Providing Unlimited Use of Glacier Bay. The Park Service believes that the alternatives identified in the EIS constitute a reasonable range of alternatives that provide access to the park, provide a range of visitor opportunities, and protect park resources. Banning all motorized vessels or allowing only small craft in Glacier Bay would not meet the Park Service’s goal of providing a wide range of opportunities for visitors. Eliminating cruise ships and tour vessels from the Bay would dramatically reduce opportunities to visit the park for most of the visiting public. Providing motorized vessels unlimited access to the Bay would jeopardize park resources and values. These alternatives would not meet the basic objectives for the park.

Eliminate Vessel Quotas and Base Vessel Operating Requirements on Safety Issues. Vessel quotas and operating requirements are essential tools that the Park Service employs to manage vessel use in the park so that mandates defined in the enabling legislation and park purposes are met. The quotas and operating requirements are established to allow visitor access to the park and to protect park resources so that they can be conserved and remain unimpaired for the enjoyment of future generations. Eliminating vessel quotas and basing vessel operating requirements only on safety issues would not provide adequate protection for resources and values for which the park was established.

Expand Whale Waters to Include the Marble Islands and Extend Whale Waters from the Southern Park Boundary to the Eastern Tip of Lemesurier Island and the Western Tip of Pleasant Island. The proposed permanent expansion of the whale waters to include the Marble Islands is unnecessary under all alternatives because the superintendent has the authority to designate temporary whale waters and impose motor vessel speed restrictions when necessary to protect whales. Permanent designation would unnecessarily limit visitor enjoyment of the park by requiring vessels of more than 18 feet (5.5 meters) to maintain a distance of 1 nautical mile (1.5 kilometers) from shore. Temporary whale waters limit the amount of time this stipulation is in force and thus restrict access to the shore only when it is necessary for the protection of humpback whales. Expanding the whale waters to the eastern tip of Lemesurier Island and the western tip of Pleasant Island, which are beyond the park boundary, is outside the NPS jurisdiction.

Establish Commercial-Free Activity Zones. By law, regulation, and policy, the Park Service limits commercial visitor services to those that are necessary and appropriate for public use and enjoyment, and that are consistent with the preservation and conservation of the resources and values of the unit to the highest practicable degree. No rationale has been provided as to why the commercial visitor services proposed in the plan would fail to meet the requirements.

Allow Self-Regulated, Traditional Use of the Park for Native Alaskans. This EIS pertains to vessel quotas and operating requirements for the four classes of motor vessels (cruise ships and tour, charter, and private vessels) entering the park in Glacier Bay and Dundas Bay. Traditional use of the park by Native Alaskans is beyond the scope of this EIS.

2.13 COMPARISON OF ALTERNATIVES

Each alternative defines quotas and/or operating requirements for cruise ships, tour vessels, charter vessels, and private vessels.

2.13.1 Comparison of Quotas

Quotas define the maximum allowable number of motorized vessels allowed in Glacier Bay and/or Dundas Bay, set by vessel class (i.e., cruise ship, tour vessel, charter vessel, and private vessel). Quotas are set by day and by season. For alternatives 1, 2, and 3, two types of seasonal quotas are used, seasonal entries and seasonal-use days (see table 2-1 for definitions). Alternatives 4, 5, and 6 only use seasonal-use days. A seasonal limit may result in daily use that is less than the maximum daily use allowed. For example, under existing conditions, a maximum of two cruise ships are allowed into Glacier Bay on any given day, year-round. However, from June through August (a 92-day period), 139 cruise ships are allowed into Glacier Bay, for a daily average of 1.5 cruise ships per day. On certain days, no cruise ships enter the Bay.

Alternative 1, the no-action alternative, would maintain the current quotas for Glacier Bay, as established by Congress.

Alternative 2 would decrease vessel quotas from current quotas, setting them at those levels in effect in 1995 (i.e., quotas authorized by 1985 vessel regulations). This would result in:

- a 23% reduction in cruise ship seasonal entries (from 139 to 107).
- a 13% reduction in charter vessel seasonal entries (from 312 to 271) and a 7% reduction in charter vessel seasonal-use days (from 552 to 511).
- a 13% reduction in private vessel seasonal entries (from 468 to 407) and a 3% decrease in seasonal-use days (from 1,971 to 1,714).

Alternative 3 would implement the 1996 Vessel Management Plan. This alternative would maintain the current vessel quotas, and include a provision to allow an incremental increase in cruise ships (totaling up to two per day, every day, from June through August), based on scientific and other information and applicable authorities. This equates to a potential increase in cruise ship use up to 32% (from 139 to 184). The increased traffic would be absorbed in early and late summer because the mid-July through mid-August period already has two cruise ships per day every day.

Alternative 4 calls for the greatest reduction in cruise ships and tour and charter vessels in Glacier Bay and regulates vessel traffic in Dundas Bay. Under alternative 4, seasonal limits would change from June through August as follows:

- a 33% reduction in cruise ship seasonal entries (from 139 to 92).
- a 33% reduction in tour vessel daily vessel quota (from 3 to 2) and a 33% reduction in seasonal-use days (from 276 to 184).
- a 17% reduction charter vessel daily vessel quota (from 6 to 5) and a 17% reduction in charter vessel seasonal-use days (552 to 460).
- a 12% reduction in private daily vessel quota (from 25 to 22) but a 3% increase in seasonal-use days (from 1,971 to 2,024).

In addition, alternative 4 would expand seasonal limits to include May and September, which would result in a 50% reduction in cruise ships and a 33% reduction in tour vessels during May and September as compared to the current situation. Daily limits for charter and private vessels also would be restricted in May and September to five and 22 vessels, respectively. Currently, no limits are set for charter or private vessels during May and September.

Under alternative 4, Dundas Bay would be closed to cruise ships and tour vessels. Charter vessels would be limited to three per day and 459 seasonal-use days May through September. No limit would be placed on private vessels.

Alternative 5 would maintain existing daily and seasonal-use day quotas from June through August, with the exception of private vessels in Glacier Bay and would regulate vessel traffic in Dundas Bay. Seasonal limits would be expanded to include May and September for cruise ships (alternative 4 expanded the season for all vessel classes). While the daily quotas for private vessels would remain the same as currently in place, seasonal-use day quotas would increase by 16% (from 1971 to 2300).

Cruise ships would be prohibited from entering Dundas Bay and one tour vessel per day only would be permitted in lower Dundas Bay (with a seasonal-use day limit of 153 June through August). No daily limit would be placed on charter vessels but there would be a seasonal-use day limit of 276 from June through August. No limit would be placed on private vessels in Dundas Bay.

Season-use days would change as follows:

Alternative 6 would maintain existing daily and seasonal-use day quotas from June through August for all vessels except private vessels. Private vessel daily quotas would remain the same as current quotas but seasonal-use days would increase. This seasonal quota increase would be offset by the elimination of the “based in Bartlett Cove” exemption (this is discussed in the following paragraph). Like alternative 5, seasonal limits would be expanded to include May and September for cruise ships. As with alternative 3, this alternative would include a provision to allow incremental increases in cruise ships (May through September) if studies support that such increases are compatible with protection of park values and purposes. This equates to a potential increase over existing cruise ship use up to 32% (from 139 to 184) during June through August and up to existing seasonal quotas for May and September (as compared to alternative 5 this would be an increase of up to 33% [from 92 to 122] during May and September).

Under alternatives 4, 5, and 6, the way vessel quotas are counted would change in several ways. First, vessel class definitions would be changed to be more consistent with other standard vessel classifications (e.g., U.S. Coast Guard definitions). Second, vessels based in Bartlett Cove would no longer be exempt from permits. This would eliminate the essentially unregulated traffic of these vessels that currently exists between Bartlett Cove and the mouth of Glacier Bay. One of the reasons this exemption was first established was to avoid the possibility of a vessel based at Bartlett Cove from being stranded outside of Glacier Bay due to the lack of sufficient permits available. This measure would no longer be necessary with the elimination of seasonal entries under alternatives 4, 5, and 6. The daily vessel quota would no longer be based on "entries" so that a vessel covered under a permit for any particular day could leave Glacier Bay and then return. Under alternatives 1 through 3, each time a vessel enters Glacier Bay it would be counted toward the daily vessel quota.

See figures 2-4 through 2-6 for a visual comparison of vessel quotas among alternatives.

Allowing vessels to enter, leave, and reenter Glacier Bay on the same day could shift more use to the lower Bay. However, eliminating the Bartlett Cove exemption would eliminate the currently unregulated traffic (which would now be counted toward the quota). Therefore, these two changes would tend to counteract each other in terms of vessel traffic.

Also, under alternatives 4, 5, and 6, ten daily permits would be made available each day to private vessels on a short-notice basis. Private vessel operators could obtain one of these permits by making a reservation within 48 hours of when they desired to enter Glacier Bay (including vessels transiting from Bartlett Cove). Adjustment to this number could be made annually by the superintendent through the park compendium.

Unlike alternatives 1, 2 and 3, alternatives 4, 5, and 6 would prohibit cruise ships from entering Dundas Bay (although cruise ships do not currently enter Dundas Bay). Alternative 4 also would prohibit tour vessels from entering Dundas Bay, while alternatives 5 and 6 would allow tour vessels in the lower Bay, but not in the upper Bay (wilderness waters). Alternative 4 would establish a daily quota of three for charter vessels in Dundas Bay from May 1 through September 30, while alternatives 5 and 6 would set no daily limit for charter vessels but would set a limit of 276 seasonal-use days from June through September (for an average of three charter vessels per day).

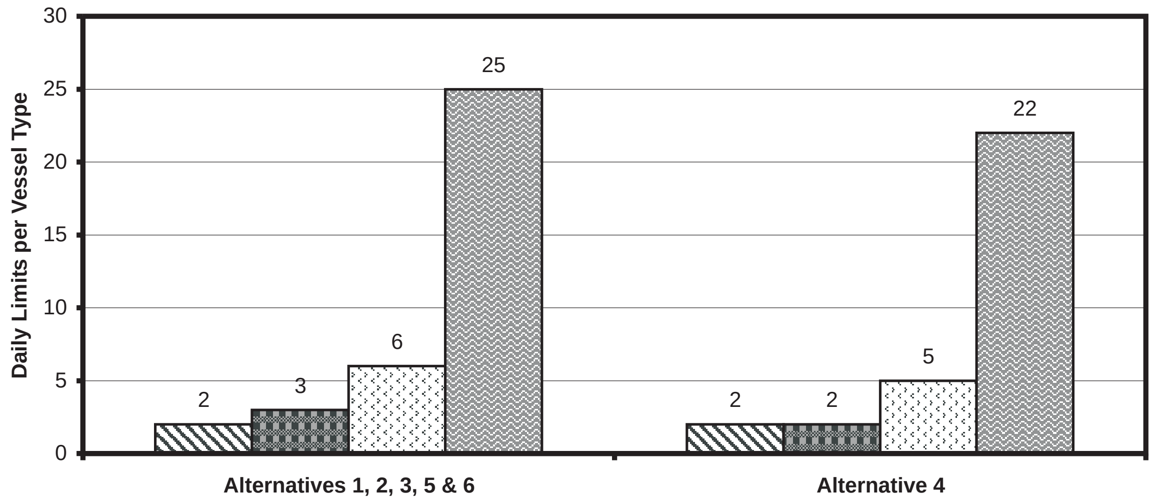
2.13.2 Comparison of Operating Requirements

The 1996 decision to increase vessel numbers also included many measures to reduce or avoid effects on the resources and values of Glacier Bay. These are defined in the form of vessel operating requirements and are in regulation (36 CFR 13.65, see appendix A).

Some measures to protect park resources and values included in the current regulations are:

- Non-motorized waters allow backcountry visitors to experience areas of the park without the presence of motorized vessels.
- Regulations protecting vessel speed and approach to humpback whales mitigate potential disturbance to whales allowing these species enhanced opportunities to forage and travel than would be the case without the regulations.
- The ability by the superintendent to establish temporary whale waters and reduced vessel speeds within Glacier Bay National Park provides protection to this endangered species.
- Islands and rocks with nesting seabirds that are closed to close vessel approaches on a year-round basis provide protection of marine bird nesting habitat from vessels and visitors.
- Steller sea lion and harbor seal haul-outs that are closed to close vessel approaches on a year-round and seasonal basis provide protection to the Steller sea lion and declining harbor seal from vessel and visitor disturbance.

FIGURE 2-4: VESSEL QUOTAS IN GLACIER BAY PROPER COMPARED AMONG THE ALTERNATIVES – DAILY VESSEL QUOTA (MAY THROUGH SEPTEMBER)



Note: The alternatives vary mostly in "seasonal-use days" rather than daily limits. With the exception of alternative 4, all alternatives share the same daily limits, but do not share the same seasonal limits. Also, note that for alternatives 1, 2, and 3, daily limits are for entry, which is the maximum number of vessels that can enter the Bay in any one day. For alternatives 4, 5, and 6, daily limits are for "daily vessel quotas," which is the maximum number of vessels allowed in the Bay during any period *between midnight of one day and midnight the next.* The daily seasonal quotas for private and charter vessels in alternatives 1, 2, 3, 5, and 6 are for June through August; during May and September no quotas are imposed. Daily quotas for charter and private vessels are in effect in May and September for alternative 4. Daily quotas for cruise ships and tour vessels are year-round for all of the alternatives.

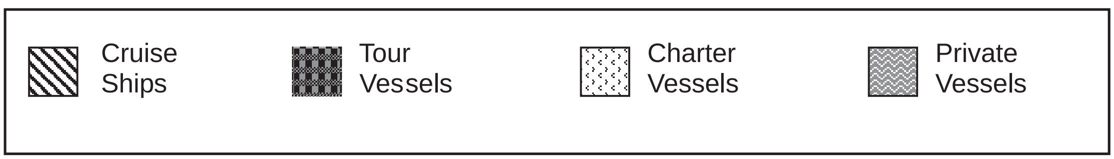


FIGURE 2-5: VESSEL QUOTAS IN GLACIER BAY PROPER COMPARED AMONG THE ALTERNATIVES – SEASONAL-USE DAYS (JUNE 1 THROUGH AUGUST 31)

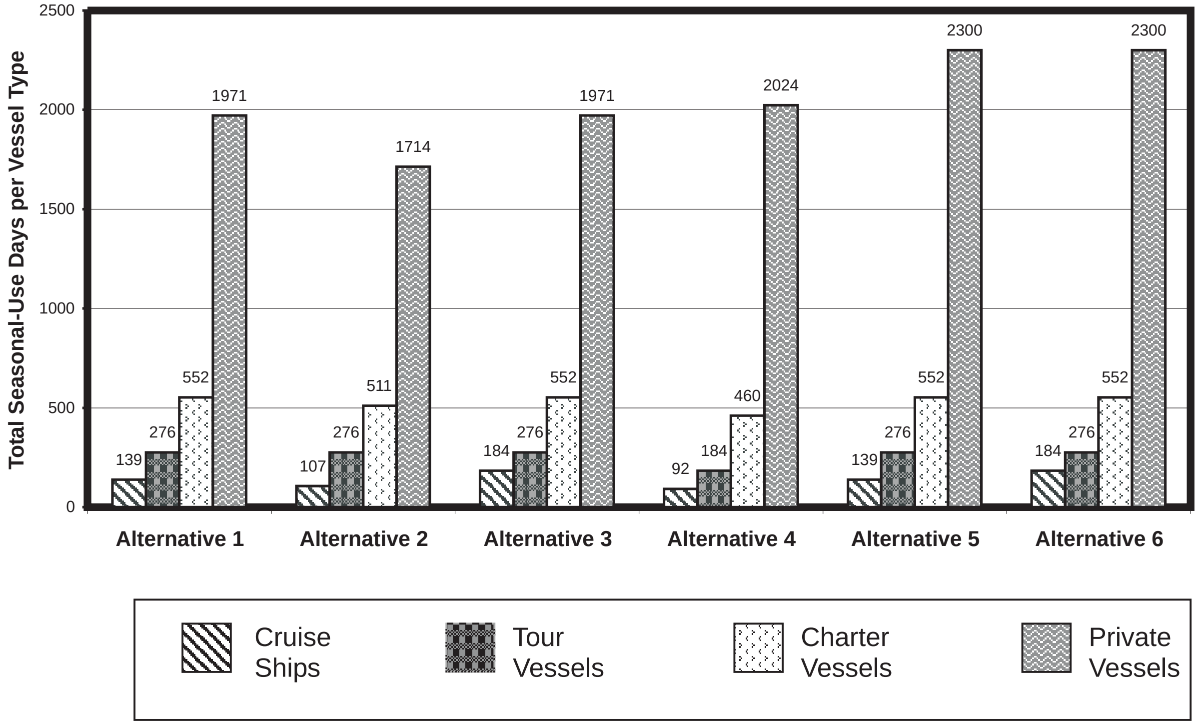
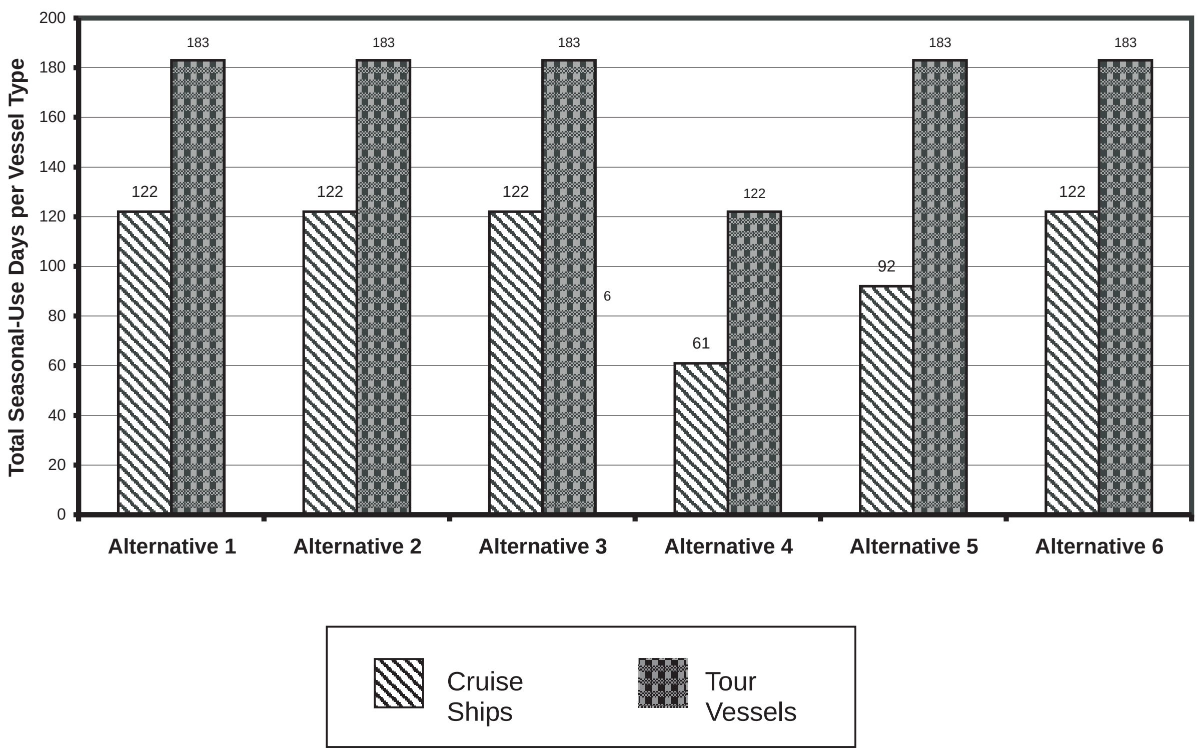


FIGURE 2-6: VESSEL QUOTAS FOR CRUISE SHIPS AND TOUR VESSELS IN GLACIER BAY PROPER COMPARED AMONG THE ALTERNATIVES – SEASONAL-USE DAYS (MAY AND SEPTEMBER)



These measures are in existing regulations (see appendix A for more details) and are not proposed for change with any of the alternatives examined in this FEIS, except for a reduction in designated whale waters in three of the six alternatives.

Temporary Whale Waters. Establishment of temporary whale waters is perhaps one of the most important and effective ways of protecting humpback whales while avoiding unnecessary restrictions on visitor use. Park Service staff monitor whale numbers and movements and report concentration areas as they develop. Whale use can be unpredictable, so this method allows for early detection and protection of areas where whales are concentrating. Based on monitoring, the superintendent can and does establish temporary whale waters to protect whales. In temporary whale waters, speed limits are restricted to 10 knots for all of the alternatives except alternative 6. For alternative 6 the speed limit would be 13 knots to take into account recent data that indicates that a 13-knot speed limit reduces the risk of a whale fatality due to collision with a large vessel. This system has proven to be an effective way to protect humpback whales while not restricting vessel use unnecessarily. Monitoring humpback whales and establishing temporary whale waters would stay in effect under all alternatives.

Speed Restrictions. Under alternatives 1, 2, and 3, speed limits would be set within designated whale waters of the lower Bay, with a limit of 20 knots measured through the water. Speed would be unrestricted elsewhere, although cruise ships and tour vessels generally travel at a slow maneuvering speed in the upper West Arm. With all of the alternatives, when whales begin to congregate in any area, temporary whale waters are established and speed is restricted to 10 knots for alternative 1 through 5, and 13 knots for alternative 6. In addition, vessels are required to slow to 10 knots (or 13 knots with alternative 6) or less whenever inadvertently being within 0.25 mile (0.4 kilometer) of a humpback whale. Under alternatives 4, 5, and 6, cruise ship speeds would be limited to 13 knots year-round, throughout the Bay, to reduce the likelihood of collisions with whales. Under alternative 5 only, vessel speeds would be changed to measure speed over the ground, rather than through the water. With speed measured through the water, vessels can move several knots faster (as measured over the ground) when going with the current, and several knots slower when going against the current.

Ferry Vessel Operating Requirements. Under all alternatives, the daily ferry from Juneau mandated by Congress is restricted to the lower Bay and Bartlett Cove. The effects of the ferry are evaluated in cumulative effects. Under alternatives 4, 5, and 6, additional restrictions are defined to prohibit the ferry from deviating from a direct course between the mouth of Glacier Bay and Bartlett Cove.

Vessel Routes**.** Under alternative 4, routes for cruise ships would be defined (typically in mid-channel) to protect coastal resources, provide an improved backcountry visitor experience, protect wilderness values, better separate the various users, and provide an increased margin of safety for avoidance of near-shore collisions. A cruise ship route would be specified using the current typical cruise ship traffic pattern. Non-motorized water designations and seasons would not change.

2.13.3 Comparison of Environmental Effects Among Alternatives

Many of the environmental effects of vessel traffic would be similar among the six alternatives, in terms of overall impact conclusions (i.e., negligible, minor, moderate, or major). In general, most adverse effects would occur in proportion to vessels numbers, speed, and distribution, including air emissions and disturbance of wildlife and visitors from vessel traffic. Increasing vessel numbers could result in some positive effects, including economic benefits related to the Alaska tourism industry and visitor opportunities to experience the Bay via a motorized vessel.

Alternatives 2 and 4 have lower vessel numbers than the other alternatives (with the exception that alternative 4 allows more private vessel use days). In most cases, the magnitude of environmental effects also would be lower than would be expected for the other alternatives. Alternative 2 would allow the fewest private vessel use days among the alternatives, while alternative 4 would allow the fewest cruise ships.

Alternatives 3 and 6, could allow an increase of up to 184 cruise ships, should studies demonstrate that such an increase could be taken consistent with park purposes and values. The analysis in Chapter 4 assumes that the 184-vessel level would be reached (alternative 1 addresses the effects of the current level of 139 vessels). Since 1996, the Park Service has conducted research to determine if increases were warranted. Each year, the superintendent reviews the results of this research. To date, the research has not clearly demonstrated that further increases are warranted. Research will continue, with particular emphasis on air quality, humpback whales, nesting birds, and visitor experience.

Alternatives 3 and 6 have the highest potential level of cruise ship use. Under either alternative, cruise ship numbers would not be increased until specific criteria are set, based on recommendations and guidance provided by impact studies. This system has worked well over the past several years, providing the opportunity for over 300,000 visitors each year in a manor consistent with park purposes and values. Providing opportunities for people to visit the park is one of the primary purposes of Glacier Bay National Park and Preserve. Alternative 3 maintains the protection measures defined in the 1996 decision while alternative 6 includes revised operating requirements to provide clarification for vessel operators and to enhance protection of park resources.

Alternative 4 would eliminate tour vessels from Dundas Bay. This would improve non-tour vessel visitor experience in this area, as well as protect wildlife. The risk of groundings would also be reduced. As with alternative 6, alternatives 4 and 5 would have new operating requirements intended to reduce environmental effects of vessel traffic. Under these alternatives, cruise ships would be required to travel at speeds no greater than 13 knots. This would greatly reduce the potential of cruise ships colliding with humpback or other whales.

Alternatives 5 and 6 would provide for the most private vessels. Since private vessels tend to be smaller and operators are freer to explore, private vessels tend to travel to the more remote waters of Glacier and Dundas Bays. Such use can disturb backcountry users, detract from the naturalness of wilderness, and disturb marine and terrestrial wildlife.

Alternative 6, the NPS preferred alternative, would combine the potential increase up to 184 (proposed in alternative 3) with new operating requirements (most of which are included in alternative 5) intended to reduce environmental effects and improve visitor understanding of requirements. Like alternative 5, private vessels seasonal quotas would be increased.

In accordance with the NEPA and its implementing regulations, this EIS considers direct, indirect, and cumulative effects:

- **Direct effects** are those that result from the action and occur at the same time and place. Dispersion of air pollutants from a vessel stack into the atmosphere is an example of a direct effect.
- **Indirect effects** are those reasonably foreseeable effects that are caused by the action but that may occur later and not at the location of the direct effect. For example, an indirect effect of reducing vessel traffic in Glacier and Dundas Bays may be an increase in demand for use of other areas.
- **Cumulative effects** are the incremental effect of the proposed action when added to the effects of past, other present, or reasonably foreseeable future actions. Cumulative effects can result from individually minor, but collectively significant, actions taking place over time.

Effects Thresholds. Thresholds help establish the basis for understanding the severity and magnitude of the effects. Under each element of the environment, effects thresholds are defined using four categories of significance: *negligible, minor, moderate,* and *major*.

An overview of the comparison of effects of each of the six alternatives for each environmental resource/topic area is provided below.

Physical Environment

Soundscape – The "natural soundscape" is what the Park Service calls natural sounds in the absence of human-caused sound. The Park Service considers the natural soundscape as a resource similar to air or water. Director's Order 47, Sound Preservation and Noise Management (NPS 2001c), directs all NPS units to protect, maintain, or restore the natural soundscape resource.

Under any of the alternatives, noise from cruise ships and tour, charter, and private vessels would continue to be common both on the surface and underwater and would frequently intrude over broad areas, such as inlets and bays. More data is needed to determine the actual extent of vessel noise. Vessel noise under all alternatives is considered moderate because noise would regularly intrude upon the natural soundscape over broad areas.

Under Alternative 1, human made sound would be present in the surface soundscape in most areas of the Glacier Bay and Dundas Bay. Human made sound would be dominant near the Bartlett Cove Dock and campground at all times and would be expected to be dominant during certain times of the day in other areas at popular stops along the route to upper Glacier Bay and the tidewater glaciers. These areas include:

- Sitakaday Narrows
- Gloomy Knob
- South Marble Island
- North Sandy Cove
- McBride Inlet
- Tarr, Johns Hopkins, and Reid Inlets

Because sound can travel long distances over water, human made sounds could also be heard within the non-motorized waters of Glacier Bay from vessels transiting outside of these areas. Under all alternatives, surface noise from cruise ships, including public address systems, would regularly intrude across broad areas.

However, because human made sounds would be present periodically throughout the day, natural sounds would still dominate in most areas of Glacier Bay and Dundas Bay.

On-going underwater sound monitoring conducted off-shore near Bartlett Cove (NSWC 2002) shows that vessel noise is pervasive underwater in Glacier Bay. Underwater noise from motor vessels is expected to be present throughout all waters open to motorized vessels and also within most non-motorized waters, since sound travels well underwater. The extent of this noise proliferation is expected to be within the moderate range; however, the localized effect in some areas of Glacier Bay could be near the major level.

While no studies have been conducted in Dundas Bay, vessel noise is expected to be a regular element of the underwater soundscape there as well. Current human-caused surface sounds in Dundas Bay include tour, charter, and private vessels within the wilderness waters of the upper Bay.

Cruise ship related noise could increase in May and September when there is no seasonal-use day quota and 2 cruise ships per day, every day may enter Glacier Bay.

Alternative 2 would have the second lowest vessel noise among the alternatives. This is because reduced cruise ship and charter and private vessel numbers would reduce the overall generation of vessel noise from June through August. This alternative includes the lowest seasonal-use day quota for private vessels. This, in turn could mean a reduction in the amount of man made sound near the shoreline where many private vessels tend to travel.

Alternative 3 would generate the most sound among the alternatives. It would have similar effects to alternative 1, but with the potential to increase cruise ships; this could result in daily exposure of noise from two cruise ships per day.

Alternative 4 would result in the lowest level of vessel-related noise among the alternatives, due to reduced quotas for all vessel classes, speed restrictions on cruise ships, which could greatly reduce the magnitude of underwater sound, and the elimination of cruise ships and tour vessels form a portion of the East Arm, Beardslee Entrance, and Fingers and Berg Bays. Under alternative 4, the soundscape in Dundas Bay would improve because of the daily limit and seasonal quota on charter vessel use and the closing of the Dundas Bay to cruise ships and tour vessels.

Alternative 5 and 6 would be roughly in the middle range of noise generation among the alternatives. Alternative 5 and 6 would reduce current effects on soundscape by reducing cruise ship speeds, extending the seasonal-use day quota for cruise ships to include May and September, and prohibiting tour vessels in the wilderness waters of Dundas Bay, the entrance to Adams Inlet, and the Beardslee Entrance.

Air quality — The two primary concerns related to air quality are the amount of pollutants emitted into the air and the potential from emissions for vessels to leave a visible plumes and/or create haze.

Emissions under all alternatives would be within the moderate range. All alternatives would emit nitrogen oxides in Glacier Bay above the 250-tons-per-year threshold and, except for alternative 4, emissions of sulfur dioxide above the 100 ton per year threshold. However, based on the large amount of the area over which emission would occur, the limited number of other significant emission sources, and using Juneau's air quality for comparison, it is unlikely that these emissions would result in ambient air concentrations that are greater than 80% of the National Ambient Air Quality Standards.

Visible haze from stack emissions are known to occur under current conditions, although the frequency, magnitude, and duration of such events is unknown. Reduced vessels under alternative 2 would reduce the magnitude and, because alternative 2 would allow the fewest number of private vessels, nearshore – short-term reductions of air quality would be the lowest. Alternative 3 would increase the frequency of visible haze, should cruise ships be increased. The frequency cannot be predicted, although the NPS is undertaking an air quality monitoring program that would help predict the frequency, magnitude, and duration.

Alternative 4 would produce the lowest amount of emissions into the air due to the lowest numbers of vessels and speed restrictions for cruise ships. Eliminating tour vessels and limiting charter vessels in Dundas Bay would improve air quality there, although there is no evidence that air quality is currently a problem. Alternative 5 would also reduce emissions by limiting cruise ship speeds, by applying seasonal restrictions for cruise ships in May and September, and by eliminating tour vessels from the wilderness waters of Glacier Bay. These same measures would reduce emissions under alternative 6. Alternative 6 would result in increased emissions and visible haze due to the increase in cruise ships. Alternative 6 would allow for the highest level of short-term emissions near shorelines due to the increase in private vessels.

Water quality - While the emissions of small amounts of fuel, oil, and wastewater would vary with the vessel quotas under each alternative, effects on water quality under any of the alternatives are expected to be minor, with the exception of fuel spills in Bartlett Cove, which could cause moderate level effects. A catastrophic oil spill in not an expected outcome of any of the alternatives. Cruise ships carry sufficient fuel into Glacier Bay to cause a major spill, however, such a spill is unlikely because cruise ships have a good worldwide safety record, are built to very high safety standards, tend to travel mostly in open waters away from navigational hazards, have highly trained and knowledgeable operators, and while in Glacier Bay carry licensed pilots on board the vessel. Tour vessels, on the other hand, have the highest potential for impacts, since they carry relatively large amounts of fuel and tend travel closer to the shoreline and more remote areas of Glacier and Dundas Bay than cruise ships. Alternative 4, 5, and 6 would prohibit cruise ships and tour vessels in Dundas Bay wilderness waters, which could reduce the potential for groundings and possible resulting spills in this area and where groundings have already occurred.

Biological Environment.

Threatened and endangered species — Populations of both humpback whales and Steller sea lions are recovering from historic lows. A biological opinion, issued by NOAA Fisheries, documents that alternative 6 would not jeopardize the continued existence of the North Pacific humpback whale population or Steller sea lion populations present in Southeast Alaska and would comply with the Endangered Species Act.

Under all alternatives, vessel traffic could regularly disturb humpback whales and Steller sea lions. The traffic is not expected to cause animals to leave Glacier or Dundas Bays, but it could cause some animals to leave particular areas to avoid vessel traffic, which in turn, can reduce foraging, survival and reproduction. The ultimate effect of this disturbance could be reduced energy intake (e.g., feeding) and/or increased energy expenditure (e.g. vessel avoidance behavior). Most wild animals operate under an extremely tight energy budget. Such energy budgets can become critical during high-energy demands, such as breeding, pregnancy, caring for young, or during bouts of extreme weather. Animals subject to repeated disturbances might have lower energy reserves and consequentially lower reproduction and/or survival.

The effect level is expected to be within the moderate range for all alternatives. Even though disturbance could occur regularly it is not expected due to overall abundance of either humpback whales or Steller sea lions. Animals located near highly traveled vessel areas could be disturbed several times per day during summer.

The amount of predicted disturbance varies among alternatives generally in proportion to vessel numbers and in relation to cruise ship speeds.

Humpback whales are vulnerable to being struck by vessels, although an average of only about one whale/vessel collision is reported each year for the entire North Pacific stock. Still, a humpback whale was struck and killed by a cruise ship in park waters in 1999. Smaller vessels also strike whales, but such strikes are typically not lethal. Based on the best available information, reducing large vessels speed limits to 13 knots would reduce the risk of fatal vessel/whale collisions. This speed limit would be required throughout Glacier Bay in alternatives 4, 5, and 6.

Underwater noise from vessels is expected to interfere with humpback whale foraging and communication. Cruise ships generate more underwater noise than any other vessel type in Glacier Bay. Based on the analysis, a cruise ship traveling at near 20 knots is probably audible to humpback whales up to 25 miles (40 kilometers) away and would be sufficiently loud to provoke a response from a humpback whale over 6 miles (9 kilometers) away.

Sound levels under alternatives 1, 2, and 3 would commonly be at these levels or higher (with the exception of waters where 10-knot speed limits have been put in place to protect whales). Reduced speed limits (13 knots) for large vessels under alternatives 4, 5, and 6 would greatly reduce underwater noise and its associated effects.

Steller sea lions may be disturbed by vessel noise as well. However, the primary vessel disturbance factor in Glacier Bay is vessels approaching the sea lions hauled out at South Marble Island. Based on recent research, the 100-yard (90-meter) buffer at this area may not be sufficient and increasing the buffer to up to 200 yards (180 kilometers) might reduce disturbance to Steller sea lions.

Listed from the highest to lowest levels of disturbance are:

- Alternative 3, which has highest cruise ship numbers and does not include speed limits for cruise ships outside of designated and temporary whale waters;
- Alternative 1, the no-action alternative, which would not change vessel numbers from those presently in place and does not include speed limits for large vessels outside of designated and temporary whale waters;
- Alternative 6, the NPS preferred, which has the potential to increase cruise ship numbers would restrict large vessels speeds to 13-knots throughout Glacier Bay and eliminate cruise ships from Dundas Bay.
- Alternative 5, which reduces cruise ship numbers in May and September, restricts large vessels speeds to 13 knots or less throughout Glacier Bay, and eliminates cruise ships from Dundas Bay.
- Alternative 2, which contains the lowest vessel numbers does not include speed limits for cruise ships outside of designated and temporary whale waters;.
- Alternative 4, the environmentally preferred alternative, which contains the lowest numbers of vessels, includes speed restrictions for large vessels to 13 knots or less throughout Glacier Bay, and would eliminate cruise ships and tour vessels from Dundas Bay.

Marine mammals — Vessel traffic under each of the alternatives would regularly disturb marine mammals in Glacier Bay and Dundas Bay. The overall effect is considered moderate because vessels would regularly disturb individual animals, however numbers are expected to remain within historic levels.

The ultimate effect of this disturbance could be reduced energy intake (e.g., feeding) and/or increased energy expenditure (e.g. vessel avoidance behavior). Most wild animals operate under an extremely tight energy budget. Such energy budgets can become critical during high-energy demands, such as breeding, pregnancy, caring for young, molting, or during bouts of extreme weather. Animals subject to repeated disturbances might have lower energy reserves and consequentially lower reproduction and/or survival. Existing regulations for Glacier Bay National Park and Preserve (36 CFR 13.65) specify buffers at haul-outs and approach distance requirements that provide protection from motor vessel activities.

The amount of predicted disturbance varies among alternatives generally in proportion to vessel numbers. Alternatives 5 and 6 allow the most private vessels among the alternatives, and private vessels are expected to cause some of the greatest disturbances because they tend to travel closer to the shoreline then the other vessel classes where marine mammals are predominant.

The greatest concern for marine mammals is potential additive effect on harbor seals from vessel traffic when combined with the other factors that may be causing harbor seals to decline in Glacier Bay and Southeast Alaska. Glacier Bay supports one of the largest concentrations of harbor seals in Alaska, yet populations have declined dramatically over the last 10 years. The reasons are not known, but declines have occurred throughout the species range and reasons are expected to include factors other than vessel traffic.

Under all alternatives, the upper portions of Johns Hopkins Inlet would be closed to all vessels from May 1 through June 30 to protect harbor seals when they are pupping. Alternatives 1, 2, and 3 would require that vessels remain at least 0.25 mile (0.4 kilometer) away from harbor seas hauled out on ice in July and August. This would reduce disturbance to harbor seals when they are molting and especially sensitive to disturbance.

Alternatives 4, 5, and 6 would extend the requirement that vessels remain a minimum of 0.25 mile (0.4 kilometer) away from harbor seals hauled out on ice to year-round. This would reduce vessel disturbance to harbor seals after August 30, when Johns Hopkins Inlet is open to all vessel types, including cruise ships.

Marine birds and raptors — All of the alternatives would result in moderate level effects on marine birds and raptors. The most notable effects would be disturbance of concentration areas of brood-rearing harlequin ducks, molting waterfowl, and foraging marbled and Kittlitz's murrelets. These species are particularly sensitive to vessel traffic and are expected to experience potential local population declines if continually disturbed by vessels. Existing regulations which specify approach limits in certain sensitive areas, would continue to provide protection to seabird colonies.

The level of disturbance is related to vessel numbers. The ultimate effect of this disturbance could be reduced energy intake (e.g., feeding) and/or increased energy expenditure (e.g. vessel avoidance behavior). Most wild animals operate under an extremely tight energy budget. Such energy budgets can become critical during high-energy demands, such as breeding, pregnancy, caring for young, molting, or during bouts of extreme weather. Animals subject to repeated disturbances might have lower energy reserves and consequentially lower reproduction and/or survival. Private vessels are the most likely to disturb marine birds, since these vessels travel widely throughout Glacier Bay, tend to travel closer to the shoreline than other vessel types, and are the most numerous. Alternatives 5 and 6 would allow the most private vessels and associated effects. This effect is still considered within the moderate range.

Marine fishes — Effects on marine fish are expected to be minor for all alternatives. Vessel traffic under any of the alternatives would generate underwater noise and vibration that temporarily displace or disturb fish. The degree of displacement or disturbance would depend on the volume of vessel traffic. Implementation of alternatives 2 and 4 would decrease the overall vessel traffic relative to alternative 1 and therefore the disturbance of fish would decrease. Alternative 3 and 6 would increase the number of cruise ship entries could result in an increased displacement or disruption of fish.

The increases in private vessel seasonal-use days under alternatives 4, 5, 6 could result in more sport fishing and therefore increased fish catch and reducing local abundance of species such as halibut.

Coastal/shoreline environment and biological communities — While some shoreline erosion may occur, the overall effect of vessel traffic on shorelines was found to be minor across all alternatives, with no real difference in the amount of expected effect between alternatives in Glacier Bay and Dundas Bay.

Human Environment.

Cultural resources — None of the alternatives would damage archaeological or historic resources because (a) they are exceedingly rare in Glacier Bay due since glaciers have recently scoured the entire Bay and (b) the few that are present are located well away from shorelines and the effects of vessels.

Effects to ethnographic resources relate to the integrity of traditional cultural properties, including cultural landscapes: namely the Ancestral Homeland of the Huna Tlingit. The effects, which include perceptions of the Huna Tlingit relate closely to vessel numbers. Therefore, Alternative 3 and 6 would have the greatest effect and alternative 4 the lowest. This effect is considered to be within the moderate range because it is expected that there would be a perceived degradation of cultural landscapes but not to the point of creating a disconnection of peoples from an Ancestral Homeland.

Visitor experience — One of the important purposes of vessel quotas and operating requirements is to provide a range of enjoyable visitor experiences.

Under all alternatives, the sights and sounds of other visitors and their motorized vessels would detract from the enjoyment of some visitors. Backcountry visitors can be sensitive to this disturbance because they generally travel by non-motorized methods (e.g., kayaks or on foot), which does not mask the sound of vessels, and are more likely to be seeking natural quiet and solitude. However, the sound of other motorized vessels can also impact visitors in motorized vessels when their vessels are drifting without the motor engaged or at anchor.

Alternative 1 would maintain the current level of disturbance, which is considered within the moderate range for backcountry users. Alternative 2 would reduce vessel numbers and associated disturbances to visitors, but would also restrict access by reducing quotas. Alternative 3 would increase opportunities for people to visit Glacier Bay via cruise ship, but would detract from the experiences of other visitors due to the sights, and sounds of and visible haze from cruise ships. Alternative 4 would have the lowest amount of disturbance, but would also greatly reduce available permits for people wishing to visit Glacier Bay and/or Dundas Bay. Alternative 4 would improve enjoyment for visitors aboard charter and private vessels and backcountry users by closing all or a portion of the East Arm of Glacier Bay, the Beardslee Entrance, Fingers and Berg Bays, and Dundas Bay to cruise ships and tour vessels. This, however, would also reduce opportunities for people wishing to tour Glacier Bay or Dundas Bay in a cruise ship or tour vessel. However, because cruise ships do currently travel into these areas, the opportunity for cruise ships passengers to experience these areas would not be diminished under this alternative. Alternatives 5 and 6 would close to cruise ships and tour vessels the entrance Adams Inlet, Beardslee Entrance, and the wilderness waters of Dundas Bay. This would improve conditions for charter and private vessel users and backcountry users in these areas and would still keep the East Arm available for cruise ship and tour vessel passengers. Alternatives 5 and 6 would also increase nearshore disturbances caused by private vessels but would also reduce vessel-related disturbance in the wilderness waters of Dundas Bay by eliminating tour vessels there.

Under alternatives 1, 2, and 3 seasonal entries would still be required for all vessel classes. This could result in some private vessel visitors being denied entry during the peak visitation period of mid-summer. Under alternatives 4, 5, and 6, three changes in the way vessel quotas are measured would improve opportunities for private vessel visitors. The ‘based in Bartlett Cove’ exemption would be eliminated, short-notice permits for private vessel would be available, and the use of ‘seasonal entries’ would be eliminated. These actions would simplify the regulations, reduce frustration of visitors in private vessels, and provide increased opportunity for private vessel visitors to experience Glacier Bay during the peak summer months. These alternatives also would simplify whale water designations to make them easier to follow and more reflective of actual conditions.

Alternatives 4 would increase wilderness and solitude in the wilderness waters of Dundas Bay and the East Arm of Glacier Bay north of Muir Point by prohibiting cruise ships and tour vessels. Alternatives 5 and 6 would restrict tour vessels and cruise ships from the wilderness waters of Dundas Bay and the entrance to Adams Inlet and Beardslee Entrance in Glacier Bay. These actions would increase opportunities for solitude and to experience wilderness in these areas for other charter and private vessel visitors and backcountry visitors.

A 13-knot speed limit would be set for cruise ships under alternatives 4, 5, and 6. This would add about 3 hours to the amount of time visitors on cruise ships would remain in Glacier Bay. This additional time could either enhance or detract from the cruise ship passengers visit. Some visitors may enjoy and appreciate the extra time spent in Glacier Bay observing the scenery and wildlife. For other visitors this additional time may appear to be an annoyance and delay them from their future itinerary. The increased time cruise ships spend in Glacier Bay could also increase the exposure other visitors have to the sights and sounds of cruise ships.

Vessel use and safety — The effects to vessel safety and use are summarized below according to vessel safety and traffic and the risk of major vessel accidents. Vessel safety and traffic reflects the number of vessels in Glacier and Dundas Bays and the speed at which the vessels travel. Alternative 1 reflects existing conditions and projected increases to fill vessel quotas. Given that there have been no major accidents since this management strategy was implemented and a good safety record from 1994-2001, the effect on vessel safety due to the implementation of alternative 1 would be negligible. The relative change in vessel safety between alternatives 1, 2, and 3 would be reflected in the number of vessels in Glacier Bay at any one time. The decrease in vessels in alternative 2 could increase the relative level of vessel safety and the increase in vessels in alternative 3 could decrease the relative level of safety compared to alternative 1.

Alternatives 4, 5, and 6 have vessel quotas for Dundas Bay as well as Glacier Bay and revised operating requirements. The decrease in the number of vessels, the designated vessel routes, and the speed limits included in alternative 4 could increase vessel safety by decreasing and controlling vessel traffic Glacier Bay. Restricting cruise ships and tour vessels from Dundas Bay in alternative 4 could reduce vessel congestion in that area and prevent groundings. Dundas Bay is poorly charted and contains many navigational hazards and shallow areas that could pose safety hazards to cruise ships and tour vessels.

The vessel quotas in alternatives 5 and 6 are comparable to current high use days; therefore, their effects are similar to alternative 1. However, alternative 5 measures vessel speed over the ground whereas alternative 6 would measure vessel speed through the water. The measurement of vessel speed over the ground could decrease vessel safety under alternative 5 because vessel maneuverability can be, at times, compromised when vessels try to maintain their speed over the ground and travel with currents. Under alternative 5 and 6 the restriction of cruise ships and tour vessels from Dundas Bay wilderness waters could increase vessel safety compared to alternative 1.

The risk of a major vessel accident is similar among all the alternatives. The history of vessel incidents shows that there have been no major accidents, however, the potential still exists. The worst case accident scenario for Glacier Bay would be a major fuel spill in ice-filled waters. Therefore, the risk of an accident increases with an increase in the number of vessels that can enter ice-filled water. Under alternative 1, the risk of such an accident is low and classified as minor. Because of the decreased number of total vessels under alternatives 2 and 4, the risk of an accident in ice filled waters would be reduced to extremely low. The increases in the number of vessels per season in alternatives 3, 5, and 6 incrementally increases the probability of accident to minor effect.

However, under alternatives 1, 2, and 3 all vessels would be able to travel at unlimited speeds throughout Glacier Bay and Dundas Bay with the exception of designated and temporary whale waters and those areas closed to motorized vessels. Under alternative 4, 5, and 6 all tour, charter, and private vessels would be able to travel at unlimited speeds in the same areas. The ability to travel at unlimited speeds could increase the potential for a vessel accident in the areas mentioned above. By reducing cruise ships to 13 knots or less under alternatives 4, 5, and 6 the potential for a vessel accident or grounding could be reduced.

One vessel accident involving a tour vessel has already occurred within the wilderness waters of Dundas Bay. Eliminating cruise ships and tour vessels from the wilderness waters of Dundas Bay under alternatives 4, 5, and 6 would reduce the risk of a vessel accident in this area to extremely low.

Wilderness resources — Under all alternatives, vessel traffic would reduce wilderness values along the terrestrial shoreline of Glacier Bay and Dundas Bay. Alternative 4 would have the lowest effect on wilderness values because of the lower vessel numbers and the elimination of cruise ships and tour vessels in all of Dundas Bay, East Arm of Glacier Bay, Beardslee Entrance, and Fingers and Berg Bays. Alternative 5 and 6 would eliminate cruise ships and tour vessels from the entrance to Adams inlet, Beardslee Entrance, and the wilderness waters of Dundas Bay, improving wilderness conditions there. Alternatives 3 and 6 would increase the potential for visible haze, noise, and naturalness in wilderness due to the increase in cruise ships.

Local and regional socioeconomics — In general, effects from changes in cruise ship and tour vessel quotas could occur at the tourism-industry level, while changes in charter and private vessels could occur at the local level, including the many small communities in the Icy Strait area.

Conclusions Regarding Impairment. A determination of impairment is dependent on an evaluation of the context, severity, duration, and timing of environmental effects. The effects of a proposed action would be considered impairment if 1) a native species would be lost or could no longer sustain a viable population in the park; 2) ecological processes would be diminished such that they were permanently disrupted in a large portion of the park; 3) resources would be diminished to the point that the public could no longer have the opportunity to enjoy them; and 4) if the park could not attain the goals set out in its management plans (NPS NRPC 2002).

The potential for impairment was evaluated for all the physical and biological resources, and some of the resources in the human environment (cultural and wilderness resources). The other elements of human environment, visitor experience, vessel use and safety, local and regional socioeconomics) are not park resources and therefore not subject to impairment evaluation. None of the effects resulting from the implementation of any of the proposed alternative constituted major effects and none had the context, severity, duration, and timing of effects which would result in impairment. Negligible, minor, or moderate effects are not likely to lead to impairment.

Tables 2-11 through 2-15 summarize and compare the alternatives and associated vessel quotas and operating requirements.

Ongoing and Potential Future Study and Monitoring Needs. Since the 1996 finding of no significant impact (FONSI) for the Vessel Management Plan and environmental assessment (VMP/EA), the NPS has instituted a research program. The VMP identified numerous information and management needs associated with determining appropriate levels of vessel traffic and designing mitigation measures to protect resources in Glacier Bay National Park and Preserve. Several of the studies identified in the VMP/EA have been accomplished and information from those studies is included in this environmental impact statement. Those studies include, but are not limited to, the following:

- Reaction of Steller sea lions to vessels — Completed in 2000
- Disturbance of harbor seals by motorized vessels in Johns Hopkins Inlet — Completed in 2001
- Monitoring underwater noise in Glacier Bay National Park — Ongoing
- Disturbance of harbor seals at a terrestrial haul-out in Glacier Bay National Park — Ongoing
- Population characteristics of humpback whales in Glacier Bay and adjacent waters — Ongoing
- Opportunistic sightings of marine mammals in Glacier Bay National Park — Ongoing
- Humpback whale song recording in Glacier Bay: their frequency and occurrence — Ongoing
- Humpback whale forage study — Completed in 2002
- Coastal resources inventory and mapping project — Ongoing
- Development of coastal monitoring protocols and process based studies — Completed in 2001
- Ecology of selected marine communities in Glacier Bay — Completed in 2003
- Distribution and abundance of small schooling fish in near shore communities - Completed in 2003
- Marine Predator studies in Glacier Bay National Park — Ongoing
- Sea otter distribution, relative abundance, prey analysis, and impact on benthic communities — Ongoing
- Fjord oceanographic processes in Glacier Bay, Alaska — Ongoing
- Mapping the benthic habitat in Glacier Bay, Alaska — Completed in 2001

- Abundance and distribution of forage fish and Plankton — Completed in 1999

Based on the analysis presented in the EIS, additional studies are needed in the following areas:

- More information is needed regarding vessel noise levels. Both surface and subsurface studies should be completed, including studies evaluating cruise ships traveling at relatively high speeds.
- Air quality studies need to be conducted where stack emissions may be causing visible plumes or haze.
- Humpback whale monitoring must continue to identify population trends and to locate concentration areas that warrant designation as temporary whale waters.
- Harbor seal populations should be closely monitored to document recovery or further declines.
- Visitor surveys should be conducted to monitor visitor use and experience.

Many other resource studies are either ongoing or planned, as well as the ongoing scientific research that is a major purpose of Glacier Bay National Park and Preserve.

NOAA Fisheries recommendations. NOAA Fisheries made four conservation recommendations in the 2003 Biological Opinion:

1. NPS should continue to monitor the levels of disturbance from vessels and vessel noise in Glacier Bay National Park Waters to determine the extent of take of Steller sea lions and humpback whales that would occur under the decision. Upon determination of appropriate take levels, and issuance of regulations or authorizations under Section 101(a)(5) of the Marine Mammal Protection Act and/or its 1994 Amendments, NOAA Fisheries would amend the opinion to include an ESA incidental take statement for listed species in the action area. No increases in cruise ship entries into Glacier Bay from the 2003 levels should occur until these determinations have been made.

2. NOAA Fisheries expressed concern about the potential for collisions to occur that result in serious injury or mortality to the whale, especially because as numbers of whales and vessels increase the probability of collision would likely increase. The Park Service continues to monitor the occurrence of whales in nearshore waters to determine if maximizing private vessel use in Glacier Bay by increasing the number of seasonal-use days for private vessels results in increased disturbances to marine mammals including sea lions on rocks, or foraging whales.

3. Given that vessel length and speed are an important factor in the severity of whale vessel collisions, and that NOAA Fisheries included waters immediately adjacent to the park entrance in Icy Strait and at Point Adolphus as part of the action area, and that the large whale concentration at Point Adolphus, a popular whale watching location for vessels entering and exiting NPS waters, is not protected by vessel speed limits NOAA Fisheries made the following recommendation. The NPS should work with NOAA Fisheries, the U.S. Coast Guard and the State of Alaska to implement vessel speed limits, or exclusion zones in nearshore waters of Icy Strait (i.e, within 1 mile [1.6 kilometers] of Point Adolphus) adjacent to park waters that contain known concentrations of whales, or establish agreements with cruise ship and tour vessel concessioners whereby vessel speed and course restrictions are adopted beyond the NPS boundaries in these areas where whales are known to forage and occur in large numbers.

4. And finally NOAA Fisheries concluded that the proposed increases in vessel traffic are occurring in an area where disturbance and collision risk are already a concern, and in

absence of a quantitative determination of ESA and MMPA take levels. It is NOAA Fisheries recommendation, therefore, that the Park Service should monitor and evaluate its vessel operating requirements to determine if they are effective at protecting whales in these nearshore waters. Two essential elements of this recommendation are measurements of compliance and effectiveness of regulations.

2.14 MITIGATION MEASURES

One potential mitigation measure was identified as part of the effects analysis. The measure responds to predicted disturbance to Steller sea lions, a threatened species. Current regulations require a 100-yard (90-meter) setback from the Steller sea lion haul-out at South Marble Island. However, recent research has shown that disturbance is still occurring under the regulation, including individual sea lions entering the water due to an approaching vessel (Mathews 1997 and 2000). The studies showed that the activity rate of sea lions at the haul-out increased as vessels approached within 200 yards (180 meters). The study also found that vessels regularly approached closer than the 100-yard (90-meter) buffer. Increasing the buffer, therefore, would likely reduce disturbances to the Steller sea lion haul-out at South Marble Island. This increase would, however, detract from visitor’s ability to see the haul-out. The haul out is an impressive sight and often ranks high among visitor’s experiences within Glacier Bay.

TABLE 2-11: OVERVIEW OF ALTERNATIVES EVALUATED IN THIS ENVIRONMENTAL IMPACT STATEMENT

Alternative	Vessel Quotas[a]	Operating Requirements
Alternative 1 (no-action alternative)	For Glacier Bay: Current quotas and quota season (see table 2-12).	Current operating requirements.
Alternative 2	For Glacier Bay: 1985-authorized quotas (those in effect in 1995). Current quota season (see table 2-12).	Current operating requirements.
Alternative 3	For Glacier Bay: Current quotas with a provision to increase seasonal quotas for cruise ships. Current quota season (see table 2-12).	Current operating requirements.
Alternative 4 (environmentally preferred alternative)	For Glacier Bay[b]: Current daily quotas for cruise ships; slightly reduced daily quotas for tour, charter, and private vessels. Reduced seasonal-use days for cruise ships, and tour and charter vessels; slightly increased number of seasonal-use days for private vessels. Quota season lengthened (May 1–Sept 30) for all vessel classes (see table 2-12). For Dundas Bay: Cruise ships and tour vessels not permitted. Vessel quotas initiated for charter vessels. No limits for private vessels (see table 2-13).	Revised operating requirements, including seasonal-entry quotas, not applicable; limited closures of certain waters to cruise ships and tour vessels; decreased vessel speed for large vessels (see table 2-14).
Alternative 5	For Glacier Bay[b]: Current daily quotas and quota season for cruise ships, and tour, charter, and private vessels. Current number of seasonal-use days for cruise ships, and tour and charter vessels during the current quota season. Decreased number of seasonal-use days for cruise ships during May and September. Increased number of seasonal-use days for private vessels (see table 2-12). For Dundas Bay: Cruise ships not permitted. Vessel quotas initiated for tour and charter vessels. No limits for private vessels (see table 2-13).	Revised operating requirements, including seasonal-entry quotas, not applicable; limited closures of certain waters to cruise ships and tour vessels; decreased vessel speed for large vessels; and use of “speed over ground” as a measure of speed (see table 2-14).
Alternative 6 (NPS preferred alternative)	For Glacier Bay[b]: Current daily quotas with a provision to increase seasonal-use days for cruise ships during the current quota season. Decreased seasonal-use days for cruise ships during May and September with the provision to increase to what is allowed under the current daily quota. Current daily quotas and seasonal-use days for tour and charter vessels and current daily quotas and increased seasonal-use days for private vessels during the current quota season (see table 2-12). For Dundas Bay: Cruise ships not permitted. Vessel quotas initiated for tour and charter vessels. No limits for private vessels (see table 2-13).	Revised operating requirements, including seasonal-entry quotas, not applicable; limited closures of certain waters to cruise ships and tour vessels; and decreased vessel speed for large vessels (see table 2-14).

a. Dundas Bay is not regulated under alternatives 1, 2, and 3 but is under alternatives 4, 5, and 6.

b. Comparisons are to alternative 1 (no action).

TABLE 2-12: COMPARISON OF VESSEL QUOTAS IN GLACIER BAY FOR ALTERNATIVES 1 THROUGH 6

Vessel Class		Alternative 1 [b]		Alternative 2 [b]		Alternative 3 [b]		Alternative 4		Alternative 5		Alternative 6	
		June 1 – Aug 31	May and Sept	June 1 – Aug 31	May and Sept	June 1 – Aug 31	May and Sept	June 1 – Aug 31	May and Sept	June 1 – Aug 31	May and Sept	June 1 – Aug 31	May and Sept
Cruise Ship[a]	Daily Vessel Quota	2	2	2	2	2	2	2	2	2	2	2	2
	Seasonal Entries	139	No limit	107	No limit	139 (potentially up to 184)	No limit	NA	NA	NA	NA	NA	NA
	Seasonal-Use Days	139	122	107	122	139 (potentially up to 184)	122	92	61	139	92	139 (potentially up to 184)	92 (potentially up to 122)
Tour Vessel [a]	Daily Vessel Quota	3	3	3	3	3	3	2	2	3	3	3	3
	Seasonal Entries	276	No limit	276	No limit	276	No limit	NA	NA	NA	NA	NA	NA
	Seasonal-Use Days	276	183	276	183	276	183	184	122	276	183	276	183
Charter Vessel	Daily Vessel Quota	6	No limit	6	No limit	6	No limit	5	5	6	No limit	6	No limit
	Seasonal Entries	312	No limit	271	No limit	312	No limit	NA	NA	NA	NA	NA	NA
	Seasonal-Use Days	552	No limit	511	No limit	552	No limit	460	305	552	No limit	552	No limit
Private Vessel	Daily Vessel Quota	25	No limit	25	No limit	25	No limit	22	22	25	No limit	25	No limit
	Seasonal Entries	468	No limit	407	No limit	468	No limit	NA	NA	NA	NA	NA	NA
	Seasonal-Use Days	1,971	No limit	1,714	No limit	1,971	No limit	2,024	1,342	2,300	No limit	2,300	No limit

a. Cruise ships and tour vessels are limited to the daily vessel quota year-round.

b. Information is shown for May and September to facilitate comparison with alternatives 4 and 5 where quota season is extended to include May and September (for all classes [alternative 4] and cruise ships only [alternative 5]).

NA = Not applicable.

TABLE 2-13: COMPARISON OF VESSEL QUOTAS IN DUNDAS BAY FOR ALTERNATIVES 1 THROUGH 6

Vessel Class	Quotas	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Cruise Ship	Daily Vessel Quota	---------------------- No limit[c] ----------------------			Not permitted	Not permitted[b]	Not permitted[b]
	Seasonal Entries	---------------------- No limit[c] ----------------------			NA	NA	NA
	Seasonal Use Days	---------------------- No limit[c] ----------------------			NA	NA	NA
Tour Vessel	Daily Vessel Quota	---------------------- No limit ----------------------			Not permitted	Not permitted in wilderness waters[b]; 1 in non-wilderness waters[c]	Not permitted in wilderness waters[b]; 1 in non-wilderness waters[c]
	Seasonal Entries	---------------------- No limit ----------------------			NA	NA	NA
	Seasonal-Use Days	---------------------- No limit ----------------------			NA	Not permitted in wilderness waters[b]; 92 in non-wilderness waters[c]	Not permitted in wilderness waters[b]; 92 in non-wilderness waters[c]
Charter Vessel	Daily Vessel Quota	---------------------- No limit ----------------------			3[a]	No limit	No limit
	Seasonal Entries	---------------------- No limit ----------------------			NA	NA	NA
	Seasonal-Use Days	---------------------- No limit ----------------------			459[a]	276[c]	276[c]
Private Vessel	Daily Vessel Quota	--- No limit ---					
	Seasonal Entries	--- No limit ---					
	Seasonal-Use Days	--- No limit ---					

a. Vessel quota season is May 1 through September 30.

b. This is a year-round limitation.

c. Vessel quota season is June 1 through August 31.

d. Through the NPS competitive allocation of cruise ship permits, existing cruise ship operators have committed to an itinerary that does not include Dundas Bay; however, there are currently no regulations that prohibit cruise ships from entering Dundas Bay.

TABLE 2-14: COMPARISON OF VESSEL OPERATING REQUIREMENTS FOR ALTERNATIVES 1 THROUGH 6

Requirement Regulation	Alternatives 1, 2, and 3 (Current Regulations)	Alternative 4	Alternative 5	Alternative 6
Quota Season	June 1 through August 31	May 1 through September 30	Glacier Bay: June 1 through August 31 for tour, charter, and private vessels. May 1 through September 30 for cruise ships. Dundas Bay: June 1 through August 31 for tour vessels in the lower Bay, and charter vessels. Year-round for cruise ships in Dundas Bay and for tour vessels in wilderness waters of Dundas Bay.	Same as alternative 5.
Speed Restrictions	May 15 through August 31, in the waters of the lower Bay whale waters the following is prohibited: (1) Operating a motor vessel at more than 20 knots speed through the water or (2) operating a motor vessel at more than 10 knots speed through the water when the superintendent has designated a maximum speed of 10 knots due to the presence of whales.	Year-round, in Glacier Bay the following is prohibited for motor vessels ≥262 feet (80 meters) in length: Operating at more than 13 knots speed through the water, to reduce risks of vessel collisions with whales. May 1 through September 30, in waters of lower Bay whale waters the following is prohibited for motor vessels <262 feet (80 meters): Operating at more than 20 knots speed through the water. May 1 through September 30, in waters of Glacier Bay and Dundas Bay, the following is prohibited: Operating a motor vessel at more than 10 knots due to the presence of whales.	Year-round, in Glacier Bay the following is prohibited for motor vessels ≥262 feet (80 meters) in length: Operating at more than 13 knots speed over the ground, to reduce the risks of vessel collisions with whales. May 15 through September 30, in waters of lower Bay whale waters, the following is prohibited for motor vessels <262 feet (80 meters) in length: Operating at more than 20 knots speed over the ground. May 15 through September 30 in waters of Glacier Bay and Dundas Bay the following is prohibited: Operating a motor vessel at more than 10 knots speed over the ground when the superintendent has designated a maximum speed of 10 knots due to the presence of whales.	Year-round, in Glacier Bay the following is prohibited for motor vessels ≥262 feet (80 meters) in length: Operating at more than 13 knots speed through the water, to reduce risks of vessel collisions with whales. May 15 through September 30, in waters of lower Bay whale waters, the following is prohibited for motor vessels <262 feet (80 meters) in length: Operating at more than 20 knots speed through the water. May 15 through September 30 in waters of Glacier Bay and Dundas Bay the following is prohibited: Operating a motor vessel at more than 13 knots speed through the water when the superintendent has designated a maximum speed of 13 knots due to the presence of whales.

TABLE 2-14: COMPARISON OF VESSEL OPERATING REQUIREMENTS FOR ALTERNATIVES 1 THROUGH 6

Requirement Regulation	Alternatives 1, 2, and 3 (Current Regulations)	Alternative 4	Alternative 5	Alternative 6
Whale Water Geographic Locations	May 15 through August 31: Lower Bay waters. June 1 through August 31: Whidbey Passage, East Arm Entrance waters, Russell Island Passage. The superintendent may designate temporary whale waters and impose motor vessel speed restrictions in whale waters (in Glacier Bay).	May 1 through September 30: Lower Glacier Bay waters. The superintendent may designate temporary whale waters and impose motor vessel speed restrictions in whale waters in any portion of Glacier Bay and Dundas Bay.	May 15 through September 30: Lower Glacier Bay waters. The superintendent may designate temporary whale waters and impose motor vessel speed restrictions in whale waters in any portion of Glacier Bay and Dundas Bay.	Same as alternative 5.
Measurement of Vessel Speed	Vessel speed is measured "through the water."	Same as alternatives 1, 2, and 3.	Vessel speed is measured "over the ground."	Same as alternatives 1, 2, and 3.
Non-Motorized (Closed) Waters for Cruise Ships	Operating a motor vessel or seaplane in closed waters (as defined in the current regulations) is prohibited.	Same as alternatives 1, 2, and 3 and the following additional closed waters in Glacier Bay: (1) Beardslee Entrance, (2) the East Arm, defined by an imaginary line drawn from southern Sebree Island to the mainland; also Dundas Bay.	Same as alternatives 1, 2, and 3 and the following additional closed waters in Glacier Bay: (1) Beardslee Entrance, (2) entrance to Adams Inlet, also Dundas Bay.	Same as alternative 5.
Non-Motorized (Closed) Waters for Tour Vessels	Operating a motor vessel or seaplane in closed waters (as defined in the current regulations) is prohibited.	Same as alternatives 1, 2, and 3 and the following additional closed waters in Glacier Bay: (1) Beardslee Entrance, (2) Muir Inlet defined by an imaginary line drawn from Muir Point west to the mainland, (3) Berg Bay, and (4) Fingers Bay; also Dundas Bay.	Same as alternatives 1, 2, and 3 and the following additional closed waters in Glacier Bay: (1) Beardslee Entrance, and (2) entrance to Adams Inlet; and in Dundas Bay the wilderness waters (on a year-round basis).	Same as alternative 5.
Ferry Vessel Operating Requirements	Per Section 127, Public Law 105-83, the ferry is restricted to the sole purpose of accessing the Bartlett Cove dock. The ferry is subject to speed, distance from coastlines, and other operating requirements common to all vessel types.	Same as alternatives 1, 2, and 3 and, in addition can not deviate from a direct coarse between the mouth of Glacier Bay and Bartlett Cove.	Same as alternative 4.	Same as alternative 4.

TABLE 2-14: COMPARISON OF VESSEL OPERATING REQUIREMENTS FOR ALTERNATIVES 1 THROUGH 6

Requirement Regulation	Alternatives 1, 2, and 3 (Current Regulations)	Alternative 4	Alternative 5	Alternative 6
Vessel Routes	None except in designated whale waters where: Operators of motor vessels over 18 feet in length will in all cases where the width of the water permits, maintain a distance of at least one nautical mile from shore, and, in narrower areas will navigate in mid-channel: Provided, however, that unless other restrictions apply, operators may perpendicularly approach or land on shore (i.e., by the most direct line to shore) through designated whale waters.	None for tour vessels, charter vessels, and private vessels, except in designated whale waters where operators would be under the same rules as for alternatives 1, 2, and 3. Routes for cruise ships would be defined.	Same as alternatives 1, 2, and 3.	Same as alternatives 1, 2, and 3.
Harbor Seal Vessel Approach Distance in Johns Hopkins Inlet	Cruise ships, tour vessels, charter vessels, and private vessels must maintain a 0.25 nautical mile distance from all harbor seals hauled out on ice in Johns Hopkins Inlet from July 1 through August 31.	Same as alternatives 1, 2, and 3, but on a year-round basis.	Same as alternative 4.	Same as alternative 4.
Short-Notice Private Vessel Permits	Not applicable.	Ten permits for private vessels would be issued on a short-notice. This number may be adjusted annually through use of the park compendium. Private vessel operators could obtain one of these permits by making a reservation within 48 hours of when they desired to enter Glacier Bay.	Same as alternative 4.	Same as alternative 4.

TABLE 2-14: COMPARISON OF VESSEL OPERATING REQUIREMENTS FOR ALTERNATIVES 1 THROUGH 6

Requirement Regulation	Alternatives 1, 2, and 3 (Current Regulations)	Alternative 4	Alternative 5	Alternative 6
Permit Exemption for Vessels Based in Bartlett Cove	A permit is not required to enter Glacier Bay when a private motor vessel based at Bartlett Cove is transiting between Barlett Cove and waters outside of Glacier Bay, or is operated in Bartlett Cove in waters bounded by the public and administrative docks.	Entrance and egress exemptions for vessels based in Bartlett Cove are eliminated. A permit is not required for a vessel that is operated in Bartlett Cove in waters bounded by the public and administrative docks.	Same as alternative 4.	Same as alternative 4.
Deviation from Vessel Operating Requirements	Not applicable.	Deviation from vessel operating requirements may be made when the safety of passengers or the vessel is immediately threatened. Where possible, operators should notify the National Park Service prior to the deviation. In all cases, notifications must be made as soon as it is safe to do so.	Same as alternative 4.	Same as alternative 4.

TABLE 2-15: SUMMARY OF DIRECT AND INDIRECT EFFECTS BY RESOURCE FOR EACH ALTERNATIVE

Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Physical Environment					
Soundscape					
Vessel noise would intrude on the natural soundscape on the surface and underwater. Shoreline areas would be subjected to vessel noise, potentially interfering with visitor enjoyment of the natural soundscape.	Fewer cruise ships, charter, and private vessels would reduce human-caused sounds, particularly along shorelines, where private vessels are more likely to travel.	Assuming 184 cruise ships during the summer, the underwater soundscape would be subjected to four cruise ship passings each day, every day during summer. Other vessel levels and operating requirements and associated human-caused noise would be the same as alternative 1.	The East Arm of Glacier Bay and Dundas Bay would be improved by limiting charter vessels and eliminating tour vessels. Reducing cruise ship speeds to 13 knots would greatly reduce underwater noise levels.	Increases in private vessels would increase vessel noise along shorelines and in the more remote places of Glacier Bay. Reducing cruise ship speeds to 13 knots would greatly reduce underwater noise levels.	Increases in private vessels would increase vessel noise along shorelines and in the more remote places of Glacier Bay. Underwater soundscape would be subjected to four cruise ship passings each day during summer. The reduction of cruise ship speeds to 13 knots would reduce underwater noise levels.
Air Quality					
Under certain weather conditions (calm with a temperature inversion), stack emissions would be visible and could linger for several hours.	Fewer cruise ships would reduce the frequency of haze or stack emissions.	Studies would need to demonstrate that air quality would not be significantly degraded before increasing cruise ships. A 32% increase in cruise ships would greatly increase the frequency of visible stack emissions.	Speed restrictions on cruise ships and lower vessel numbers would reduce emissions and visible plume events. Closure of the east arm to tour vessels could improve visibility there.	As with alternative 4, speed restrictions would reduce air emissions, but visible plumes would still occur under certain weather conditions. Increased private vessels would increase air emissions near shorelines.	Emissions would be less than baseline conditions due to the reduction of vessel speeds. Increases in cruise ships would increase the frequency of visible stack emissions. Studies would need to demonstrate that visibility would not be significantly degraded before increasing cruise ships. Increased private vessels would increase air emissions near shorelines.

TABLE 2-15: SUMMARY OF DIRECT AND INDIRECT EFFECTS BY RESOURCE FOR EACH ALTERNATIVE

Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Water Quality					
Effects would be minor since water quality impacts from spills would be short-term, localized, and the spill response capability is high. A major spill in ice-filled waters is unlikely, but would be a major effect since spill response would not be possible.	Effects not discernible from alternative 1. Effects related to discharge of bilge water and vessel grounding or collision would be incrementally lower due to the reduced number of cruise ships.	Should cruise ship numbers be increased, then an associated increase in inadvertent discharges into the water would occur. The risk of a major accident would increase, but still remain very low.	Similar to alternative 1; could result in a lower level of risk of inadvertent discharge of bilge water. Dundas Bay would benefit with restriction of tour vessels.	Effects would be similar to alternative 1. Restriction on tour vessels in Dundas Bay would reduce spill potential in those areas.	If cruise ship numbers increased, then there could be an associated increase in inadvertent discharges. The risk of a major accident would increase, but still remain very low and would lower than alternative 3 given that vessel speeds would be reduced.
Biological Environment					
Threatened and Endangered Species					
Vessel traffic would continue to adversely affect both humpback whale and Steller sea lions. Effects would be at the level of individual and not the population. Humpback whales would continue to be disturbed by the sight and sounds of vessels. Collisions with cruise ships would be rare but, over time, would be unavoidable. Existing regulations to protect whales and sea lions would remain in place.	Fewer cruise ships would lower exposure to noise and risk of collisions.	Increasing cruise ship numbers would increase associated noise exposure and risk of collisions.	The combination of reducing cruise summer ship numbers and speed would greatly reduce noise exposure and the risk of collision. Humpback whales would still be exposed to vessel noise from private vessels, which would slightly increase. Restrictions in Dundas Bay would benefit whale use there.	Speed reductions for cruise ships would greatly reduce noise and the risk of collision. Increasing private vessels would increase non-lethal injuries to humpback whales. Such events are expected to be rare but unavoidable.	Increasing cruise ship numbers in conjunction with the reduction of cruise ship speed would slightly increase associated noise exposure and risk of collisions. Increasing private vessels would increase non-lethal injuries to humpback whales.
Marine Mammals					
Vessel traffic may contribute to reported declines in harbor seal populations. Effects on Minke whales would be similar to those described for humpback whale. Other marine mammals would avoid vessel traffic but would otherwise not be harmed.	Similar to alternative 1, but slightly decreased chances of distribution shifts or animal collisions due to lower vessel numbers.	Similar to alternative 1, but potentially increased disturbance if cruise ship numbers are increased. Populations are expected to remain stable.	Much less frequent disturbance due to speed limits, vessel reductions, and restrictions at Dundas Bay and the East Arm. Additional protection for harbor seals in Johns Hopkins Inlet would reduce effects. Expanding seasonal restrictions would increase protection during early and late summer.	Increasing private boats would increase disturbance to marine mammals. Expanding seasonal restrictions would increase protection during early and late summer.	Abundance would be expected to remain stable, but disturbance would increase due to the increased number of cruise ships. This disturbance would be dampened by the decrease in cruise ship vessel speed. However, increase the number of private boats will increase disturbance. Expanding seasonal restrictions would increase protection during early and late summer.

Table 2-15: Summary of Direct and Indirect Effects by Resource for Each Alternative

Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Marine Birds and Raptors					
Vessel traffic in Sitakaday Narrows, Reid Inlet, the East Arm, and Dundas Bay would continue to disturb murrelets, molting waterfowl, and breeding harlequin ducts.	Overall effects would be similar to alternative 1. The amount of disturbances would decline slightly.	Overall effect would be similar to alternative 1. The amount of disturbances would increase if cruise ship numbers are increased.	Reduced vessel traffic would provide a corresponding reduction in vessel disturbance on marine birds.	Increases in private vessels, which can venture into remote bays and inlets, would increase disturbance to molting waterfowl, harlequin ducks.	The amount of disturbances would increase if cruise ship numbers are increased, but would not be as great as alternative 3 since cruise ship speeds would be reduced. Increases in private vessels would increase disturbance to molting waterfowl, harlequin ducks.
Marine Fish					
Vessel traffic could displace some fish, but overall, the current level of vessel traffic has not been found to seriously disrupt fish populations.	Effects not discernible from alternative 1.	Effects not discernible from alternative 1.	Effects not discernible from alternative 1.	Effects not discernible from alternative 1.	Effects not discernible from alternative 1.
Coastal/Shoreline Environment and Biological Communities					
Effects to shoreline would be minor because current vessel traffic does not cause significant erosion of shorelines. Effects to the biological shoreline communities would be minor. Individual beaches may experience some erosion and sediment suspension from vessel traffic.	Effects not discernible from alternative 1.	Effects not discernible from alternative 1.	Similar to alternative 1. Sediment erosion, re-suspension, or relocation would be slightly greater than current conditions due to a slight increase in private vessels.	Similar to alternative 1. Increase private vessels use would increase sediment erosion, re-suspension, and relocation.	Similar to alternative 1. Higher numbers of private vessels and cruise ships would have the potential to alter the shoreline to a greater extent due to vessel wakes.

Table 2-15: Summary of Direct and Indirect Effects by Resource for Each Alternative

Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Human Environment					
Cultural Resources					
Effects to archaeological and historic resources would be negligible because resources would remain eligible for the National Register of Historic Places. Effects to ethnographic resources would be moderate since the project would potentially affect the integrity of traditional cultural properties.	Effects not discernible from alternative 1.	Increasing cruise ship numbers to 2 per day, every day, during the summer would eliminate opportunities to undertake traditional activities in the central portions of Glacier Bay without the presence of a cruise ship.	Most effects not discernible from alternative 1. Effects to cultural landscapes would be minor due to longer restricted-entry season, slower vessel speeds, and additional restricted waters.	Most effects not discernible from alternative 1. Effects to cultural landscapes would be moderate because alternative 5 would allow more private vessels.	Most effects not discernible from alternative 1. Effects to cultural landscapes would be moderate because alternative 6 would allow more private vessels.
Visitor Experience					
Effects would be moderate for backcountry visitors because the presence of motorized vessels could lead to potential loss of opportunity to experience solitude.	A 30% reduction in cruise ships would decrease the opportunity for passengers to experience Glacier Bay proper.	Increase cruise ship numbers would disturb backcountry visitors as well as others because of the loss of opportunities for solitude.	Fewer vessels greatly increase solitude for park visitors.	Increases in private vessels would detract from wilderness experience for backcountry visitors.	Effects would be minor for charter and private vessel passengers and major for backcountry visitors because of the loss of opportunities for solitude.

TABLE 2-15: SUMMARY OF DIRECT AND INDIRECT EFFECTS BY RESOURCE FOR EACH ALTERNATIVE

Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Vessel Use and Safety					
Effects would be negligible because controls on vessel entry strictly limit the density of vessels in Glacier Bay, but limited congestion would continue to occur at Bartlett Cove and Tarr Inlet.	Effects not discernible from alternative 1.	Risks of vessel accidents would increase, but would remain minor, since overall vessel density would remain low.	Effects would be positive because reduced vessel entries and speed limits would increase vessel safety and decrease vessel traffic. Eliminating tour vessels from Dundas Bay would eliminate the current risks associated with operating large vessels in relatively shallow areas. Formally defining cruise ship routes would significantly reduce the risk of groundings and potential fuel spills. Reducing cruise ship speed would further reduce the currently low risk of accidents.	Reducing cruise ship speeds would further reduce the currently low risk of accidents.	Risks of vessel accidents would increase, but would remain minor, with the increase in both cruise ships and private vessels. However, the risk would be lessened by the reduction of cruise ship speeds, further reducing the currently low risk of accidents.
Wilderness Resources					
Effects would be minor for most areas and moderate for concentrated use areas, such as Johns Hopkins and Tarr Inlets, where vessel noise and air pollution would be heightened. Most effects would occur along shorelines.	Effects not discernible from alternative 1.	Increasing cruise ships to 184 during summer would reduce the naturalness of wilderness near the tidewater glaciers, where cruise ships spend most of their time while at Glacier Bay.	Reduced vessel numbers would reduce vessel exposures to wilderness. Reducing cruise ship speed limits would reduce vessel emissions and noise, but would also increase the time cruise ships are within Glacier Bay.	Effects would be similar to alternative 1, but with increased protection to Dundas Bay. As with alternative 4, reducing speed limits would reduce vessel emissions and noise, but would also increase the time cruise ships are within Glacier Bay.	Effects would be similar to alternative 1, but with increased protection to Dundas Bay. As with alternative 4, reducing cruise ship speed limits would reduce vessel emissions and noise, but would also increase the time cruise ships are within Glacier Bay. The increase of cruise ships to 184 during the summer would reduce the naturalness of wilderness near the tidewater glaciers when the cruise ships spend most of their time in Glacier Bay

TABLE 2-15: SUMMARY OF DIRECT AND INDIRECT EFFECTS BY RESOURCE FOR EACH ALTERNATIVE

Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Local and Regional Socioeconomics					
Effects to the economies of neighboring communities and Southeast Alaska would be negligible, as would the effects to Glacier Bay-dependant businesses.	Effects would be minor to moderate due to decrease in income and employment for communities with economic linkages to Glacier Bay. Reduced local spending associated with private vessels.	Effects on local communities would be negligible.	Effects would minor to moderate due to income and employment decrease related to vessel decreases and reduced local spending associated with private vessels.	Effects would be similar to alternative 1; changes to Dundas Bay management could have a minor positive effect on commercial users.	Effects would be positive due to increase in cruise ships; effects on local communities would be negligible. Changes to Dundas Bay management could have a minor positive effect on commercial users.

AFFECTED ENVIRONMENT

GLACIER BAY
NATIONAL PARK AND PRESERVE, ALASKA

CHAPTER 3. AFFECTED ENVIRONMENT

3.1 INTRODUCTION

This chapter describes the existing environment that could be affected by the alternatives in this environmental impact statement and is divided into sections that discuss the physical, biological, and human environment. The topics associated with each environment are as follows:

Physical Environment

- Fjord Dynamics and Oceanographic Processes.
- Soundscape.
- Air Quality.
- Water Quality.

Biological Environment

- Threatened and Endangered Species.
- Marine Mammals.
- Marine Birds and Raptors.
- Marine Fishes.
- Coastal/Shoreline Environment and Biological Communities.

Human Environment

- Cultural Resources.
- Visitor Experience.
- Vessel Use and Safety.
- Wilderness Resources.
- Local and Regional Socioeconomics.

These topics were selected based on federal laws, regulations, executive orders, NPS management policies, NPS subject matter expertise, and concerns expressed by other agencies or members of the public during scoping and comment periods. The conditions described establish the baseline for the analyses of effects found in “Chapter 4. Environmental Consequences.”

3.2 PHYSICAL ENVIRONMENT

This section describes the physical environment of Glacier and Dundas Bays, including fjord dynamics, oceanographic processes, soundscape, air quality, and water quality. Subsection 3.2.1, “Fjord Dynamics and Oceanographic Processes,” is purely informational; potential effects of the alternatives on these aspects of the physical environment are not discussed in chapter 4.

3.2.1 FJORD DYNAMICS AND OCEANOGRAPHIC PROCESSES

3.2.1 Fjord Dynamics and Oceanographic Processes

Glacier Bay is a recently deglaciated fjord in Southeast Alaska. A fjord is a long, narrow estuary, usually hundreds of meters deep, that is formed by the retreat of a glacier. The glacial retreat leaves a U-shaped valley that is filled by the ocean.

The main body of Glacier Bay is approximately 60 miles (97 kilometers) long, with a 4-mile- (6-kilometer-) wide mouth between Point Gustavus and Point Carolus. The Bay widens to approximately 12 miles (19 kilometers) at the base of the East and West Arms (see figure 1-2). The Chilkat Range bounds Glacier Bay to the east, the Takinsha Range bounds the Bay to the north, and the Fairweather Mountain Range bounds the Bay to the northwest. The peaks and ridges of the Brady Glacier form the Bay's west boundary. The north end of Glacier Bay's main body divides into two fjord systems known as "the East and West Arms." Muir Inlet is included in the East Arm. Glacier Bay (including the two arms) has steep slopes and displays the typical U shape of a glacially formed valley. The sea floor of Glacier Bay, with average depths more than 1,000 feet (305 meters), is often too deep for anchoring vessels. With freshwater inputs from the surrounding watersheds and glaciers, multiple sills, high sedimentation, and large tidal fluctuations, Glacier Bay comprises a complex oceanographic system. The system experiences high variability in salinity, temperature, sediment load, light penetration, and current patterns (NPS 1983; NPS 2002k; Hooge and Hooge 2002).

The movement of water through Glacier Bay is determined by several of the Bay's physical characteristics, including the presence of a single opening to the ocean, a shallow sill entrance at the opening, deeper basins behind the shallow entrance, and multiple embayments and sills backed by deep basins. Figure 3-1 shows the bathymetry of Glacier Bay, as well as the locations of sills (NPS 1983; NPS 2002k; Hooge and Hooge 2002).

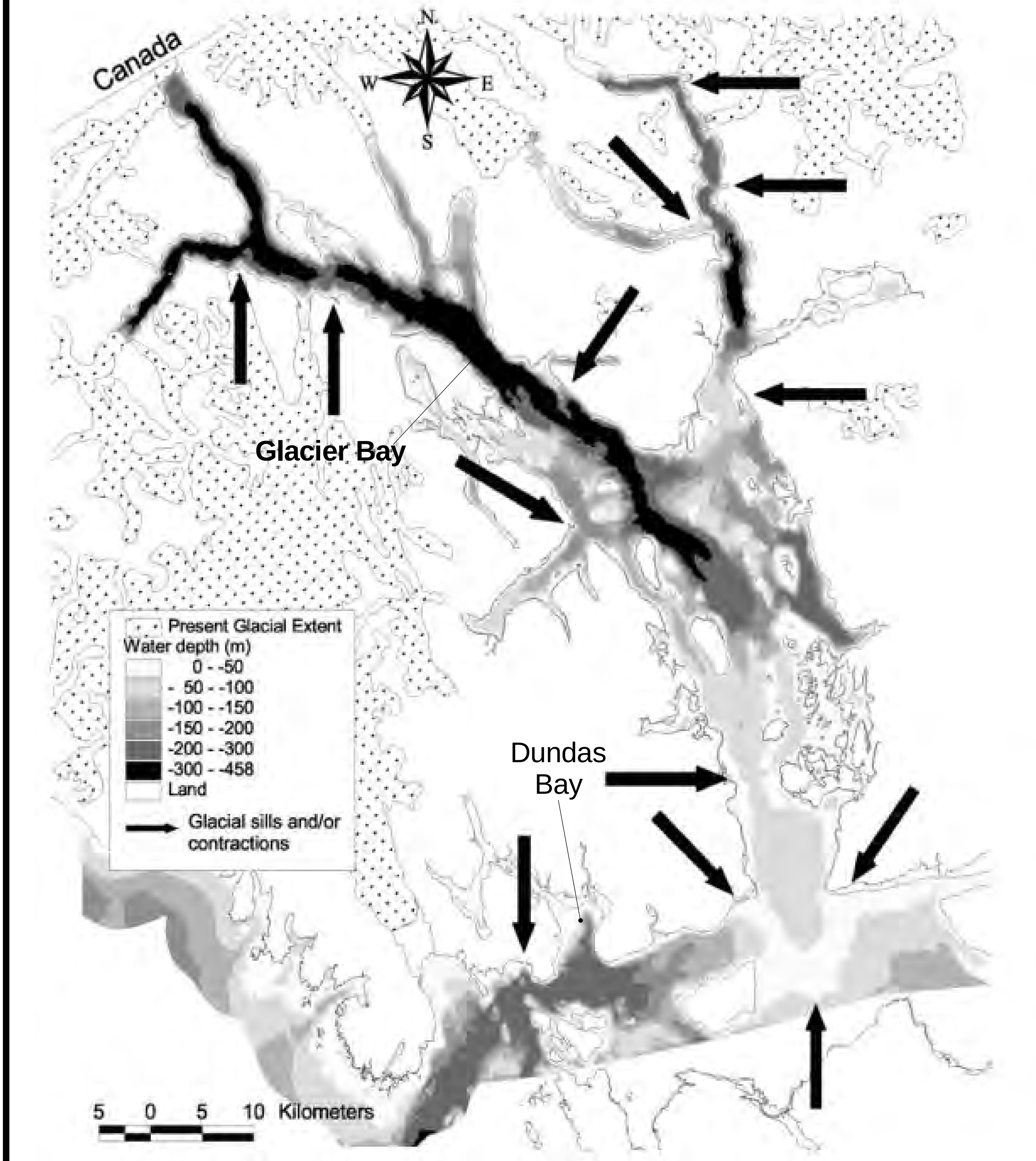
Glacier Bay's water regime also contributes to the complexity of the system. The Bay is a tidally influenced estuary. The tidal range varies throughout the Bay, with the greatest ranges (more than 25.5 feet [7.8 meters]) in the Bay's northern portion. The tidal exchange, in conjunction with the density-driven flow of water between the ocean and the Bay, provides the input for marine water. Freshwater inputs include runoff, creeks and rivers, precipitation, snowmelt, and continuous glacial melting.

Salinity and temperature are two measurable physical parameters that determine the density of a water mass and indicate how water circulates through a water body. Glacier Bay tends to stratify in the summer, but the level of stratification varies throughout the Bay. Stratification is the layering of water due to differences in salinity or temperature. Tidally induced currents produce more mixing and upwelling near the Bay's entrance than within the main body of the Bay. This entrance area tends to be well mixed and to stratify only during slack water conditions (when the tide is changing direction from high to low or low to high). The salinity generally is higher near the Bay's mouth than at the head of the Bay. This is likely due to the large influx of fresh water at the head of the Bay, as well as the Bay's single point of entry for marine water at the mouth. The mid-Bay region tends to be stratified much of the year because of the input of freshwater runoff, rather than insolation, which causes temperature differences. Figure 3-2 shows winter and summer salinity readings in Glacier Bay in 2000. Hooge and Hooge (2002) state, "Water in the top 10m[eters] is much fresher during summer, when the surface brackish layer is also much narrower and distinct (stratified). Salinities at the bottom of the basins do not change as much, although intermediate-depth waters are most saline during early spring and summer months." The upper arms of Glacier Bay tend to have surface lenses of less saline water. Generally, the salinity and density of water in the upper arms are almost identical to those of the mid-Bay. The sills in the upper arms of Glacier Bay may prevent or enhance mixing with the mid-Bay water.

Bathymetry of Glacier Bay

National Park Service
U.S. Department of the Interior

Figure 3-1



Bathymetry of Glacier Bay proper and adjacent waters, and present extent of glaciation. Numerous contractions and glacial sills are indicated.

Source: Hooge, P.N. and E.R. Hooge. 2002. *Fjord Oceanographic Processes in Glacier Bay, Alaska.* Gustavus, AK: U.S. Geological Survey, Alaska Science Center, Glacier Bay Field Station.

Glacier Bay National Park and Preserve

Vessel Quotas and Operating Requirements
Environmental Impact Statement

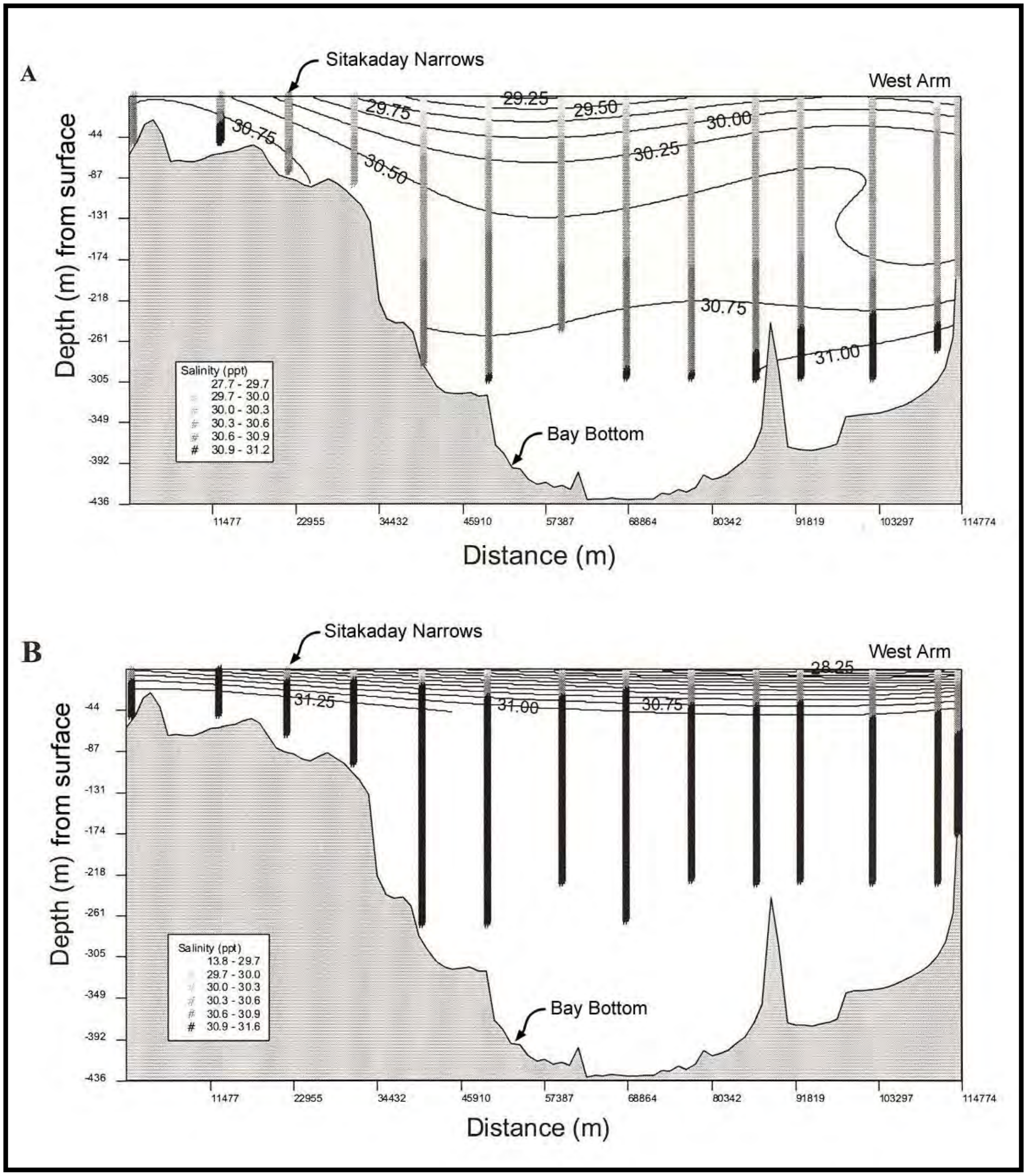


Figure 3-2 Salinity Contours

Salinity contours along the main Glacier Bay-West Arm oceanographic survey line during (A) January 2000 and (B) June 2000. Salinity values are contoured every 0.25 ppt. This figure shows the seasonal variability in salinity in the main body of Glacier Bay to the West Arm. The top figure shows the even mixing that occurs in winter. The lower figure shows the typical layer that develops in summer. The top 10 meters are fresher during the summer as well as having a narrow and distinct (stratified) brackish layer near the surface. The Bay is more saline with depth than what is typical for winter conditions as indicated by the dark lines in (B) (darker lines mean more saline or salty water).

Source: Hooge, P.N. and E.R. Hooge. 2002. *Fjord Oceanographic Processes in Glacier Bay, Alaska.* Gustavus, AK: U.S. Geological Survey, Alaska Science Center, Glacier Bay Field Station.

Temperature tends to follow a pattern similar to salinity, with colder temperatures near the glacier input and warmer temperatures near the Bay's mouth. The waters of Glacier Bay are warmer in the summer and colder in the winter because of seasonal temperature variations (see figure 3-3). A thermocline, which is a region where there is a rapid change in temperature with depth (stratification), often exists in the summer when the sun heats the surface water, but the deeper water remains cool. A double thermocline (four layers of water) often occurs near the glaciers in the upper fjords because of cold freshwater glacial runoff.

The Bay tends to be homogenous in the winter, so thermoclines generally are absent. Hooge and Hooge (2002) frequently reported "pan" ice conditions (freezing of the surface water) during winter surveys in smaller embayments and the upper 6 to 12 miles (10 to 20 kilometers) of the main arms of Glacier Bay.

Internal waves are a naturally occurring process that destabilizes stratified layers of water. Internal waves can occur only when the water is stratified. The internal wave causes a vertical oscillation of the water molecules that breaks down the boundary between stratified layers. Internal waves do not affect the shoreline. Hooge and Hooge (2002) state that there is good mixing throughout the water column in the winter, but that stratification can occur in the summer. They found that the first layer of stratification occurs at approximately 33 feet (10 meters).

Vessels can create internal waves as well, but these waves are shallow (less than 40 feet [12 meters] for the vessels in Glacier Bay) compared to natural internal waves. A vessel creates an internal wave when the hull breaks the plane of the stratified layer. The vessel only affects the volume of water it displaces when moving through the water. The deepest vessel listed in the NPS Vessel Database for Glacier Bay National Park and Preserve (Nemeth 2002) has a draft (depth) of 33 feet (10.1 meters). Most of the cruise ship class has a draft of 25 to 27 feet (7.6 to 8.2 meters). All other vessels will be shallower. Most vessels in Glacier Bay have drafts deep enough to affect only the shallowest stratified layers; however, there are times when a vessel may cause localized mixing of the upper stratified layers along its track line. Localized effects are approximately the same width as the beam of the vessel and trail behind the track. An effect is expected to be short-term because this is a relatively small volume of disturbance compared to the total volume of stratified water in Glacier Bay. The water will tend toward recovery to the original stratified state.

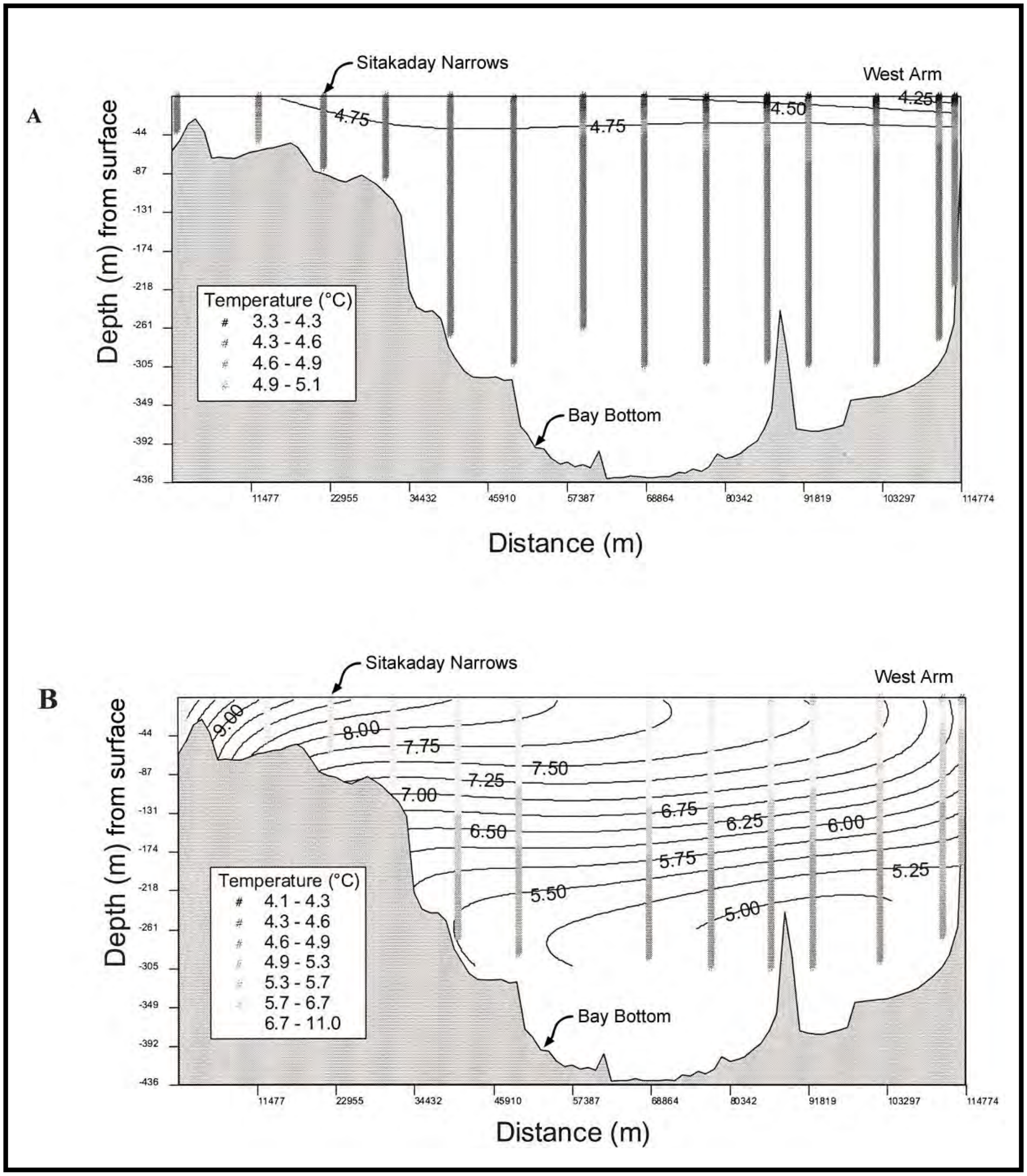


Figure 3-3 Temperature Profiles and Contours

Temperature profiles and contours along the main Glacier Bay-West Arm oceanographic survey line during (A) March 2000 and (B) August 2000. Temperature values are contoured every 0.25°C. This figure shows the seasonal variability in temperature in the main body of Glacier Bay to the West Arm. The top figure shows more even temperatures throughout the water column due to mixing. The lower figure shows how the water sorts out in layers of differing temperature (each layer being called an isotherm) during the summer. The figure also shows the rapid change in temperature with depth known as a thermocline. The Bay is warmer during the summer months as indicated by the lighter lines in (B) (lighter lines mean warmer temperatures). The Bay is warmer near the mouth and cooler near the glaciers year-round.

Source: Hooge, P.N. and E.R. Hooge. 2002. *Fjord Oceanographic Processes in Glacier Bay, Alaska.* Gustavus, AK: U.S. Geological Survey, Alaska Science Center, Glacier Bay Field Station.

3.2.2 Soundscape

Consistent with "Director's Order 47, Sound Preservation and Noise Management" (NPS 2001c), "soundscape" refers to the total ambient acoustic environment associated with the park. The park's soundscape includes naturally occurring and human-made sounds. The Park Service considers natural sounds to be vital to the natural functioning of many parks and valuable indicators of an ecosystem's health. Natural sounds also contribute to visitor experience in a park. Because of the importance of natural sound in the park environment, the Park Service considers the natural soundscape to be a resource, similar to air and water. Director's Order 47 articulates NPS operational policies that require, to the fullest extent practicable, the protection, maintenance, or restoration of the natural soundscape resource in a condition unimpaired by inappropriate or excessive noise sources.

Appropriate and Inappropriate Noise. Human-made sound that interferes with visitor enjoyment of park resources or a park's ecological functioning is inappropriate; however, not all sounds are considered inappropriate. For example, activities associated with each park's purpose often are found to be appropriate even though they generate elevated sound levels for areas within a park. However, when activities (inside or outside a park) generate excessive levels of noise, they can jeopardize the natural soundscape resource or the purposes for which the park was created.

Functions of Sound in National Parks. Sound plays an important role in the behaviors and other biological functions of terrestrial and marine organisms. For many animals, sound is used for communication. For example, birdcalls and songs during spring are used to establish and defend territories, among other functions. Similarly, the calls and songs of whales and wolves have a variety of functions. Insects also use sound to define territories or attract mates. Other examples of sound as a critical element of animals' functioning include a bat's use of sound (echolocation) to find prey, or its reception of sound as a way to detect predators. Bears foraging in a field are aware of sounds, and often respond to sounds they perceive as possible threats.

Sound is also an important element of the physical environment, although its role in the functioning of physical processes is considerably less than that in the biological realm. Because inanimate objects do not perceive or react to sound, they are affected only by the physical impact of vibration. Examples of natural sounds created within the physical environment include sounds produced by wind passing through trees, claps of thunder, falling water, or the crash of calving glaciers as they tumble into water.

Sound is an important element in the human perception of the natural world. For the Hoonah people, the natural soundscape is an aspect of the spiritual world as well as the physical and biological realms.

Finally, sound is an important aspect of visitor use, especially near park attractions and in natural settings. Natural sounds are very important to many recreational experiences, especially those related to wilderness. As reported to the U.S. Congress in the "Report on the Effects of Aircraft Overflights on the National Park System," a system wide survey of park visitors revealed that nearly as many visitors come to national parks to enjoy the natural soundscape (91%) as come to view the scenery (93%). Noise can distract visitors from the tranquility of natural landscapes.

Existing Soundscape in Glacier Bay and Dundas Bay. The following discussion of the existing soundscape in Glacier Bay and Dundas Bay relates to all resource topics evaluated in this environmental impact statement; however, for the purposes of this report, and because sound travels differently in the air and water, this environmental impact statement considers two aspects of the soundscape: the atmospheric soundscape (air above ground and water surfaces) and the underwater soundscape. The natural and human-made sounds in these two soundscapes are described. This discussion is relevant because this environmental impact statement focuses on, among other things, how the soundscape could be affected by changes in vessel quotas and operating requirements. These changes could affect the perceptions of visitors along the shorelines of Glacier Bay who hear passing motorized vessels, or could result in increased disturbance to wildlife exposed to the sounds of motorized vessels.

Atmospheric Soundscape. Natural sounds in the air above Glacier Bay and Dundas Bay include sound created by biological and physical processes:

- breaking waves.
- wind moving across the water; across glaciers; through canyons; across the landscape; and at a microscale, across the ear of an observer.
- animal calls.
- falling rock and ice associated with geological processes, including the movement of glaciers.

Currently, much of the human-made sounds in the park originate from motorized vessels and aircraft; therefore, these sounds are most prevalent over the water and along the shoreline. The sources of these human-made sounds include:

- vessel motors, exhaust, and vessel movement through the water.
- human voices.
- public address systems on cruise ships and tour vessels.
- aircraft overflights, landings, and takeoffs.

Most park visitors detect only the sounds generated in the atmosphere; therefore, it is critical to evaluate areas where visitors congregate to evaluate the variations in soundscape. The Park Service wishes to preserve the natural quietness in areas such as those where tidewater glaciers of Glacier Bay are available to the public. One of the park's purposes, however, is to provide access to these areas; therefore, to fulfill their mission, park administrators must maintain a balance between access to these areas and the resultant sounds produced by motorized vessels in these areas.

The public address systems on cruise ships are one source of human-made sounds in Glacier Bay. All cruise ships and most tour vessels broadcast an interpretive program by an NPS naturalist through their public address systems.

Aircraft noise, which includes the landings and takeoffs of float planes, is another important human-made sound in the park. Aircraft regularly fly over the park for scenic flights and to drop off and pick up passengers, and when traveling through park airspace to other areas. The park does not maintain records of overflights through park airspace.

Underwater Soundscape. While the term "Silent World" has been used to describe the underwater environment, sounds abound there. As with the atmospheric soundscape, the sounds in Glacier Bay's underwater soundscape result from natural and human-made sources (Although no sound data are available from Dundas Bay, the following discussion is generally applicable to Dundas Bay.). Natural sound sources include wind-generated surface noise, rainfall, sound generated by high tidal currents in restricted channels, and noise from marine life. In the upper Bay, and in Queen Inlet, in particular, glaciers and related processes (e.g., submarine sediment movement) produce strong low-frequency underwater rumbles that resemble thunder and may be seismic events (Malme et al. 1982). As these sounds propagate into the Bay, they occasionally can be heard as far as the Marble Islands and Bartlett Cove.

The human-made components of sound in Glacier Bay mainly are caused by water transportation activities. Cruise ships, tour vessels, charter vessels, fishing vessels, private skiffs, and airplanes contribute to underwater sound levels in areas near Bartlett Cove and other areas where park visitors may be concentrated.

Measurement of underwater noise in Glacier Bay — An underwater noise study was completed by the Naval Surface Warfare Center (NSWC) in December 2002. For that study, a hydrophone was placed in lower Glacier Bay and 5,200 underwater noise samples were collected from that location from August 2000 to June 2002. These samples were analyzed and logged into a database, and statistics were developed for natural and human-made sounds. Although no other recent studies have been conducted to define the park's underwater sound levels, some quantitative analyses of underwater noise in Glacier Bay were undertaken using measurements taken in the 1980s (see appendix C, which contains chapters entitled "Acoustic Concepts and Terminology," "Sound Propagation," "Zones of Influence," and "Marine Mammal Hearing").

Underwater sound measurements were recorded in the 1980s to determine whether Glacier Bay is more or less "noisy" than nearby open water areas. The ambient sound levels from various parts of Glacier Bay were measured by Miles and Malme (1983), and were compared to archival data obtained from open water areas (Wenz 1962; Urick 1983). The data for Bartlett Cove were obtained under conditions of very light winds, so the variation in sound level over the two eight-hour measurement periods was due mainly to vessel traffic, rather than differing environmental conditions. The mean sound level from vessel traffic in Bartlett Cove was found to correspond to the wind and wave noise associated with Sea State 4 in open water. Sea State 4 is equivalent to wind speed of about 20 knots, forming moderate waves on the ocean's surface.

This long-term average for Sea State 4 conveys the impression that underwater sound levels are nearly constant; however, Miles and Malme (1983) found that, depending on the duration of the period considered (i.e., from hours to days), there actually are fluctuations in overall sound levels due to humpback whale vocalizations, ship arrivals and departures, and fishing vessel movements, at least for Bartlett Cove. These measurements were taken from a graphic-level recording sequence obtained over two 10-minute periods in Bartlett Cove (Miles and Malme 1983).

Sound levels recorded at Station 17 near North Marble Island are lower than Sea State 0 (calm winds, smooth seas) at frequencies above 250 hertz. Low-frequency noise occurs from either distant ships or glacier motion. Intermediate levels of sound occur in the spectrum obtained in Queen Inlet. Glacier rumbles cause the narrow-band peaks in this spectrum. Lastly, the spectrum obtained near Muir Glacier is dominated by the sound of out-gassing from the glacial ice nearby. The high-frequency sounds have a higher sound pressure level than would be obtained by wind and wave noise at Sea State 6 (wind speed about 30 knots forming large waves on the ocean's surface).

Natural sources of noise in Glacier Bay — The Glacier Bay underwater noise report (NSWC 2002) identifies three main sources of natural underwater noise: wind-generated surface noise, rainfall, and marine life. The dominant source of underwater noise is wind-generated surface noise. According to this study, "in 62% of the usable samples, the 1 kHz [kilohertz] one-third octave band level was controlled by wind noise. The average wind noise level over the entire period was 83 dB (decibels; 1 kHz one-third octave band level)." The maximum noise level recorded was 100 decibels.

Rainfall noise levels averaged 89 decibels, although levels as high as 110 decibels were recorded. This study found that rain was not more prevalent in the winter months; the month with the highest number of samples per day containing rain noise was June 2002 (NSWC 2002).

This study also found that the most common source of marine life sound came from humpback whales. "Humpback whale grunts, groans, whoops, squeaks, and other similar sounds were present in 219 samples, and 24 samples contained humpback whale song sounds. Eighty-two samples contained sounds from other biologic sources such as killer whales. Humpback whale sounds were most common in the August through November time period. Seventy percent of all humpback songs were observed in October 2000. The frequency of occurrence of biologic noise was compared to that of marine vessel noise. Except for October 2000, vessel noise was more common in all months" (NSWC 2002).

Description of noise range for each vessel class — As previously mentioned, the human-made components of underwater sound in Glacier Bay and Dundas Bay are produced mainly by vessel movements. Although the classes of vessels using the Bays can be categorized by type or application, this analysis focuses on vessel size and type. The database used in the 2002 Glacier Bay underwater noise study divides vessel noise into five categories: small vessel, medium vessel, large vessel, multiple types present at the same time, and other types of vessel noise. In the study, small vessels were characterized by high-speed propeller and engine noise and mainly consisted of vessels powered by outboard or inboard/outboard motors. Medium vessel noise was characterized by mid-speed propellers and larger, inboard propulsion plants. Vessels in this category generally ranged from 50 to 200 feet (15 to 60 meters) in length. The large vessel category included vessels more than 200 feet (60 meters) in length (cruise ships and Alaska state ferries fall into this category) and was characterized by slow-speed propellers and low-frequency sound.

The study found that medium vessels were the most common and constituted 62% of vessels observed. "In August 2000 and June 2002, large vessel noise, i.e. large cruise ships, reached an average of about 4 samples per day. . . On the average, large vessels were slightly louder at the hydrophone than medium and small craft. Large vessels averaged 98 dB, while the average noise levels for medium and small vessel were 93 and 96 dB, respectively. A large vessel logged the highest level, 129 dB. The maximum level for both medium and small vessels was 126 dB" (NSWC 2002). The frequency range for large vessels was found to be typically within the lower end of the spectrum, between 80 and 200 hertz. Medium vessels varied, between 125 and 3,150 hertz, and small vessels typically peaked at frequencies above 800 hertz (NSWC 2002).

The summer months, as expected, were when vessel noise was most common, but even during this time period, 40% of noise samples contained no vessel noise. In October through April, approximately 90% of samples were free of vessel noise. During May and September, 60% of samples had no vessel noise. "On the average, vessel noise levels exceeded wind noise levels. Overall the average vessel noise level was 94 dB, 11 dB greater than the average wind noise" (NSWC 2002).

3.2.3 Air Quality

Ambient air in the park and preserve is not monitored. It is assumed, however, that because of the presence of only a few small emission sources at several locations in the park, air pollutant levels in the park are low, and well below any existing ambient air quality standards.

The Alaska Department of Environmental Conservation (ADEC) conducted air quality monitoring in Juneau from May to July 2001 and August to September 2001. This study determined that ambient air levels of nitrogen oxides (NO_X), sulfur dioxide (SO_2), and particulate matter of 10 microns or less (PM_{10}) are well below state and federal allowable limits. Maximum readings of ambient air concentrations of nitrogen dioxide, sulfur dioxide, and particulate matter of less than 10 microns are between 10% and 40% of the National Ambient Air Quality Standards (NAAQS; ADEC 2001a). Because Juneau has similar air pollution sources, but many more than the park, these findings support the assumption that the park's air pollutant levels do not exceed the National Ambient Air Quality Standards.

Air emission sources within the park include exhaust from fuel combustion during vessel operations, fuel combustion for heating of buildings at Bartlett Cove, fuel use by vehicles in the park, occasional campfires, exhaust from electric power generators, and vessel traffic emissions. Emissions from motorized vessels contain respirable PM_{10} (particulate matter that can be taken into the lungs) and particulate matter smaller than 2.5 microns in diameter ($PM_{2.5}$), carbon monoxide (CO), sulfur dioxide, nitrogen dioxide (NO_2), lead (Pb), and ozone (O_3).

Other trace constituents found in the fuels used by the vessels are negligible and are not considered in this evaluation. Visibility reductions occasionally occur in the park during certain unique weather conditions that trap air pollution within a layer of cold air near the surface.

Meteorological Conditions. Meteorological conditions, such as wind speed and atmospheric stability measurements (determined by difference in temperature at different heights at the same location), provide information about air movement at a location, and influence the dispersion of air pollutant emissions. No meteorological recording station exists within the park to record these specific data; therefore, there are no park-related routine short- or long-term weather data records or climatological statistics that can be used to describe average conditions. Meteorological data from the Gustavus Airport are insufficient to evaluate conditions in the fjords because of the drastic difference in topography.

Based on a 1978 air pollution study, Bensen et al. (1978) concluded that within the fjords, atmospheric mixing is limited because of low wind speeds and temperature inversions. Temperature inversions form because air within a layer from the water surface to approximately 35 to 100 feet (10 to 30 meters) above the water surface is cooler than the air above that layer. This cold air layer develops because low wind speeds limit the ability of the atmosphere to completely mix. Emissions into the cooler air layer within the fjords cannot readily disperse because of low wind speeds, and are trapped below the warmer air above the cooler layer. Bensen et al. (1978) estimated that temperature inversions occurred for at least part of the day on about one-third of all days, and occurred mainly during clear conditions. During temperature inversion and low wind speed conditions, pollution is more likely to remain trapped in the park's fjords.

Existing Air Emissions. Existing air emissions were estimated using 2001 vessel operation data (NPS, Nemeth, electronic mail, October 21, 2002). The estimation method is detailed in appendix D. Table 3-1 presents estimates of daily emissions in the park, using 2001 vessel operation data. Annual data provided by the park are used to calculate annual emissions. These emissions are distributed from the entrance of Glacier Bay to the heads of the West and East Arms and other side bays and fjords as the vessels move through the Bay. The annual emissions are calculated from the estimated maximum vessel traffic during the operating season (April through October) and expressed in tons per year (see table 3-1). These estimates present the high end of the expected total emissions of the criteria pollutants from vessels operating in Glacier Bay.

TABLE 3-1: 2001 EMISSIONS FROM VESSELS IN GLACIER BAY

Vessel Type	# entries	PM	NO_X	SO_2	CO	HC
Emissions Pounds per Day (lbs/day) (maximum allowable entries)						
Cruise Ships	2	136.01	4,393.30	4,614.38	511.46	57.50
Tour Vessels	3	17.25	695.38	110.02	73.74	7.04
Charter Vessels	6	7.42	297.51	46.93	35.42	3.70
Private Vessels	25	70.53	2,836.98	449.15	307.51	29.93
Total		231.22	8,222.17	5,220.49	928.13	98.17
Emissions Tons per Year (TPY)[a]						
Cruise Ships	219	7.45	240.53	252.64	28.00	3.15
Tour Vessels	435	0.99	39.70	6.29	4.22	0.40
Charter Vessels	316	0.20	7.83	1.24	0.93	0.10
Private Vessels	2,004	2.83	113.69	18.00	12.32	1.20
Total		11.45	401.76	278.16	45.47	4.85

a. Includes the season and off-season (May through September).

Note: Totals may not reflect the sum of the figures due to rounding.

CO = Carbon dioxide.
HC = Hydrocarbons.
NO_x = Nitrogen oxides.
PM = Particulate matter.
SO_2 = Sulfur dioxide.

Visibility. No historical data regarding visibility within the park, other than personal observations, are available. Daily emission totals, visible plumes of smoke from vessel stacks, and weather conditions contribute to reductions in visibility. During temperature inversions or days with low winds, stack emissions do not dissipate quickly and can result in long plumes from vessel stacks that block views. Visible vessel emissions can produce haze within the park.

3.2.4 Water Quality

This subsection describes Glacier Bay's current water quality and the physical conditions that affect marine water quality in the park.

Natural Factors Affecting Water Quality in the Park. Water quality is affected by many factors, including runoff, sedimentation, tidal variations, large-scale mixing and upwelling zones, and the overall complex underwater topography or bathymetry of the area. These factors cause high variability in salinity, temperature, sediment, productivity, light penetration, and current patterns (Hooge and Hooge 2002). In addition, the year-round glacial meltwater input (water from the melting of glacial ice when it contacts the ocean) is thought to stimulate estuarine circulation even through the winter (Hooge and Hooge 2002).

Existing Water Quality. Conclusions regarding overall water quality for Glacier Bay are limited. No data are available to assess the current or historical water quality of Dundas Bay. No water body in the park is on the Alaska Clear Water Action list, which identifies impaired waters in need of action to recover water quality, and none are included on the list of impaired water bodies as regulated under section 303(d) of the Clean Water Act (CWA).

The NPS Water Resources Division (WRD) created a database inventory of existing water quality data for Glacier Bay collected from 1963 to 1993. According to a summary report of the database, the results of the water quality criteria screening indicated that turbidity exceeded the WRD screening limit for the protection of aquatic wildlife; however, high turbidity exceeding WRD turbidity standards is normal in many glacial meltwater stream systems within the park. Additional conclusions about the overall quality of Glacier Bay are not provided (NPS 1995b).

Water quality parameters — Water quality data collected in the park include information regarding salinity, temperature, and turbidity from 1992 to 2000 (Hooge and Hooge 2002). Water quality information for Dundas Bay is not available. Conclusions regarding the available water quality data include the following:

- **Salinity.** Salinity is a measure of the total dissolved solids in water. Salinity in Glacier Bay ranges from 3.8 to 31.9 parts per thousand (ppt). Salinity generally increases from the head of Glacier Bay to the mouth. The least saline waters were found near tidewater glaciers, and the most saline waters were at depth near and just outside the mouth of Glacier Bay. By comparison, the average ocean salinity is 35 ppt. Variations can be caused by river runoff, ice formation, and precipitation.
- **Temperature.** Surface water temperature is highly variable from the mouth of Glacier Bay to its headwaters, with ranges of 1.9 degrees Celsius (°C) to 12.2°C, respectively, and varies with the season. Deeper waters experience less variation than do surface waters and range from 4.5°C to 5.75°C. Pan ice frequently forms on the surface of smaller embayments of the upper 10 to 20 kilometers of the West and East Arms in the winter months. A recent study describes a warming trend of the Bay of up to 2°C on average. This warming trend could be a result of increased temperatures in the Gulf of Alaska. The increase in temperature is consistent with increased glacial melting in the winter, and may in part account for the differences in circulation, mixing, and renewal noted in this recent study, as compared with research conducted in the 1960s. The recent study identifies the Bay as characterized by renewal and mixing events throughout the year (Hooge and Hooge 2002).
- **Turbidity.** Turbidity is the cloudiness of water resulting from suspended particles, including silts and clays, microorganisms, and chemicals. Although highly variable, background turbidity levels of at least 5 to 15 millivolts (mV) were found throughout Glacier Bay and in Icy Straight. Much higher turbidity levels were detected immediately adjacent to the tidewater glaciers of the upper East and West Arms — up to 231 millivolts in the West Arm and up to 531 millivolts in the East Arm. This turbidity is attributed primarily to turbid glacial meltwater inputs. Peak

sediment discharges occurred in August and September, with the fewest discharges occurring in October and May. Sedimentation rates in Glacier Bay were among the highest rates ever recorded.

3.3.1 THREATENED AND ENDANGERED SPECIES

3.3 BIOLOGICAL ENVIRONMENT

3.3.1 Threatened and Endangered Species

This subsection addresses the two species, both marine mammals, that are resident seasonally or year-round within Glacier Bay and Dundas Bay and that are listed as threatened or endangered under the Endangered Species Act (ESA) of 1973. The central North Pacific stock of humpback whales occurs seasonally and is listed as endangered. The eastern stock of Steller sea lions uses a haul-out (Marble Island) in Glacier Bay, may use one rookery (Graves Rock) along the outer coast of the park, and is listed as threatened. The U.S. Geological Survey identified habitat used by schooling fish predators in Glacier Bay, including humpback whales and Steller sea lions. Humpback whale and Steller sea lion concentration areas, sensitive areas, haul-outs, and sightings are identified on figure 3-4.

Each of the following subsections regarding the humpback whale and the Steller sea lion includes discussions of their respective population and status, reproduction and recruitment, and natural history. One concern of this environmental impact statement is the effects that sounds generated by vessels have on these species and the other marine mammals in Glacier Bay, so the natural history subsections include discussions of the sounds that each species makes.

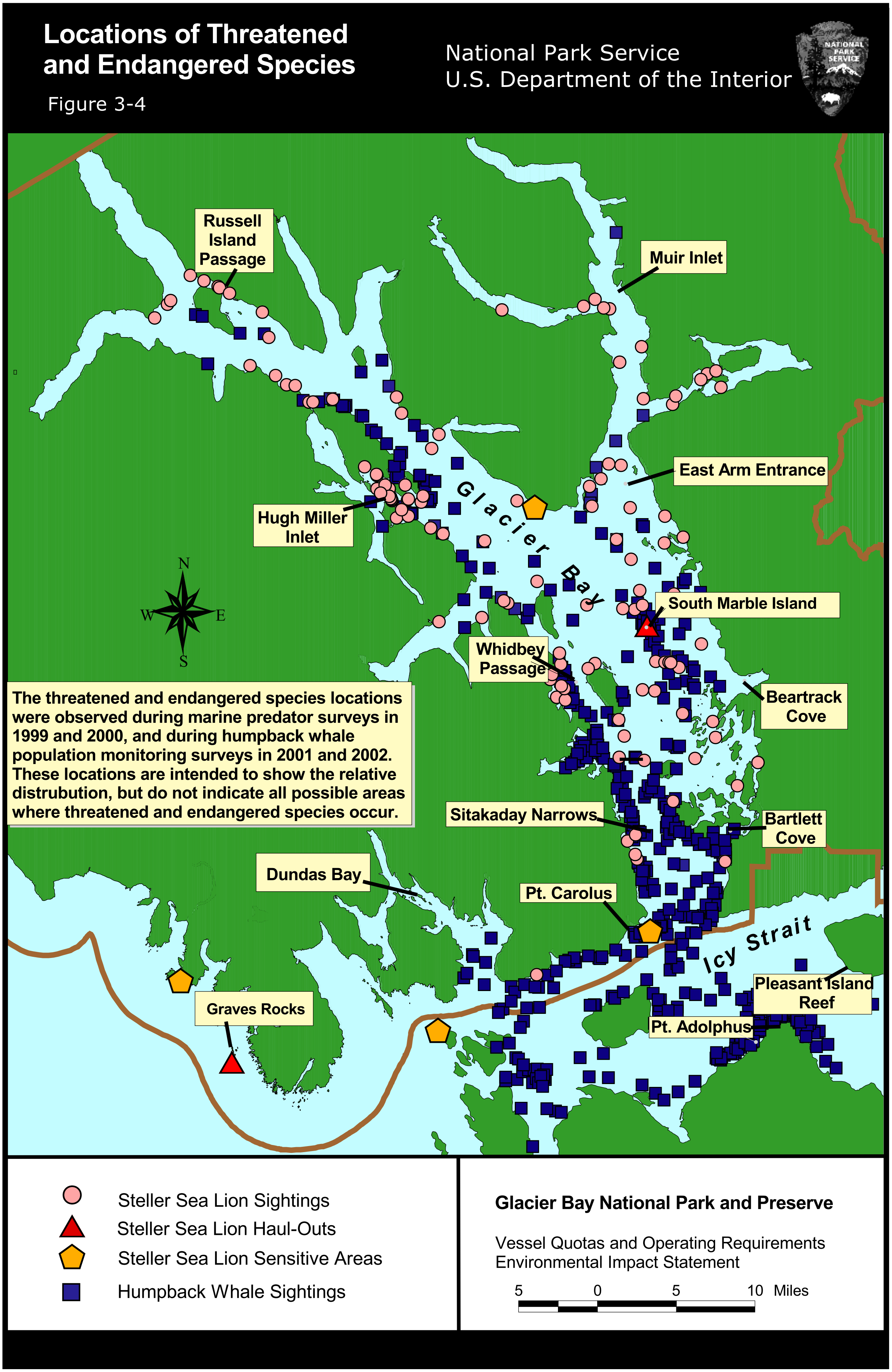
The sounds created by marine mammals are a good indication of frequencies important to those species. “Marine Mammal Hearing,” the last subsection within subsection 3.3.1, is applicable to the humpback whale and Steller sea lion, as well as to the species in subsection 3.3.2, “Marine Mammals.”

Humpback Whale *(Megaptera novaeangliae)*.

Population, status, distribution, and demographics — Humpback whales are baleen whales that occur in all ocean basins (Rice 1998). Their range extends from Disko Bay in northern Greenland to the pack-ice zone around the Antarctic continent. Commercial whalers heavily exploited humpbacks throughout their range. In 1955, the International Whaling Commission (IWC) prohibited commercial hunting of humpbacks in the North Atlantic, and in 1965, their protection was extended to the North Pacific and Southern Hemisphere populations. Humpback whales were declared an endangered species in 1973, and all populations remain endangered.

The humpback population before commercial exploitation is estimated to have been more than 125,000 worldwide (Rice 1978; NMFS 1991). Commercial whalers heavily exploited humpbacks until the middle of the 20th century. American whalers alone killed 14,000 to 18,000 humpbacks from 1805 to 1909 (Best 1987), and the total North Pacific kill is estimated to be 28,000 (Rice 1978). By the time the IWC moratorium on commercial whaling occurred after the 1965 hunting season, the worldwide population of humpbacks was estimated to have declined to fewer than 5,000 (Baker et al. 1993).

A recent study (Calambokidis et al. 1997) estimated the entire North Pacific humpback whale population to be 6,000 to 8,000, well above the 1,400 estimated in the 1980s. Genetic studies (Baker et al. 1993) and photo-identification studies (Calambokidis et al. 1997, 2001) indicated that individual humpback whales tend to return to the same summering and wintering areas year after year. Humpbacks identified at some feeding areas also showed a preference for particular wintering areas: whales feeding in Southeast Alaska (including Glacier Bay) tended to migrate to Hawaii, while whales feeding off California migrated to Mexico (Calambokidis et al. 1997, 2001).


Locations of Threatened and Endangered Species
Figure 3-4
National Park Service
U.S. Department of the Interior
Russell Island Passage
Muir Inlet
East Arm Entrance
Hugh Miller Inlet
Glacier Bay
South Marble Island
Whidbey Passage
Beartrack Cove
The threatened and endangered species locations were observed during marine predator surveys in 1999 and 2000, and during humpback whale population monitoring surveys in 2001 and 2002. These locations are intended to show the relative distrubution, but do not indicate all possible areas where threatened and endangered species occur.
Sitakaday Narrows
Bartlett Cove
Dundas Bay
Pt. Carolus
Icy Strait
Pleasant Island Reef
Graves Rocks
Pt. Adolphus
N
S
E
W
Steller Sea Lion Sightings
Steller Sea Lion Haul-Outs
Steller Sea Lion Sensitive Areas
Humpback Whale Sightings
Glacier Bay National Park and Preserve
Vessel Quotas and Operating Requirements Environmental Impact Statement
5 0 5 10 Miles

The limited movements of whales between wintering and feeding areas, and the genetic differences among whales utilizing different feeding areas, make it inappropriate to treat the North Pacific as a single population of humpbacks. Calambokidis et al. (1997) concluded that there are at least three populations of humpback whales in the North Pacific: those wintering off Hawaii, Japan, and Mexico. While fidelity to wintering areas is currently the most defensible way to subdivide the North Pacific population, there is also fidelity to feeding areas. Identifiable populations or subpopulations may be associated with those feeding areas (Calambokidis et al. 1997).

Humpback whales were first observed near the mouth of Glacier Bay in 1899, and were reported intermittently throughout the Bay by the 1950s and 1960s (Vequist and Baker 1987). The Park Service has monitored the humpback whale population of Glacier Bay each year since 1985 to document the number of individuals, residence times, spatial and temporal distribution, reproductive parameters, feeding behavior, and human/whale interactions (Doherty and Gabriele 2001). These data are used to form NPS policies regarding when and where vessel operating restrictions in whale waters are needed during the summer visiting season. The NPS whale monitoring program covers most of Glacier Bay and Icy Strait.

Humpback whales are found throughout Glacier Bay and Dundas Bay (see figure 3-4). Feeding congregations often use specific areas such as Bartlett Cove, Sitakaday Narrows, Whidbey Passage, and the East Arm (Doherty and Gabriele 2002). Whale sightings in areas where NPS personnel do not routinely survey (e.g., non-motorized waters) are reported by park visitors and staff on an opportunistic basis; therefore, the presence of whales in these areas is probably under-reported.

The whales that inhabit the park are part of the Southeast Alaska feeding herd; Straley (1994) estimated this herd to be 404, but it could range from 350 to 458 (95% confidence interval of 350 to 458). Site fidelity to the Glacier Bay area is high. Approximately 70% of the whales identified in the Glacier Bay area have been re-sighted in the Glacier Bay / Icy Strait area (Gabriele 1995). The number of whales that used the Bay and Icy Strait from 1985 to 2001 ranged from 41 to 104 (Doherty and Gabriele 2001). The humpbacks typically move between Glacier Bay and Icy Strait and other areas of Southeast Alaska (Baker 1986; Baker et al. 1990; Straley 1994).

The total 2001 count of 97 whales using Glacier Bay and Icy Strait is the second highest recorded since 1985, despite a low number of survey hours in the study areas (Doherty and Gabriele 2001); however, relatively few whales (45) were seen in the park, while more whales were recorded in Icy Strait (82) than ever before (Doherty and Gabriele 2001). This suggests that whales may have moved from the park to Icy Strait during 2001, presumably because of differences in prey availability (Doherty and Gabriele 2001).

Reproduction, recruitment, and calf return — Humpback whales give birth and are presumed to mate on their Hawaii wintering grounds. Calambokidis et al. (1997) indicate that whales found in Glacier Bay and Dundas Bay calve in Hawaii. Female humpbacks typically reproduce at two- to three-year intervals, although calving intervals vary substantially (Glockner-Ferrari and Ferrari 1990; Straley 1994). Calf survivability is difficult to determine because the color patterns of a calf’s flukes and body change between seasons and it is often difficult to identify a specific calf from one year to the next; however, the maximum calf mortality rate has been estimated to be 0.150 to 0.241 (Gabriele et al. 2001). Comparison of the estimate for the central North Pacific stock of 4,005 humpbacks (Calambokidis et al. 1997) to the 1981 estimate of 1,407 (Baker and Herman 1987) suggests that the stock increased from the early 1980s to the late 1990s. The estimate by Baker and Herman (1987) is questionable, however, because of small sample size; therefore, while these data support an increasing humpback population in the central North Pacific stock, it is not possible to accurately assess the rate of increase (NMFS 2001a).

Natural history (prey and prey dynamics, temporal and spatial use patterns, and use of sound) — Whales in the park typically feed alone or in pairs, mainly on small schooling fishes such as capelin

(Mallotus villosus), juvenile walleye pollock *(Theragra chalcogramma)*, sand lance *(Ammodytes hexapterus)*, and Pacific herring (*Clupea pallasii*; Wing and Krieger 1983; Krieger and Wing 1984). Several stable groups commonly are found feeding at Point Adolphus, Bartlett Cove, and Pleasant Island Reef (Baker 1985b; Perry et al. 1985; Gabriele 1997). Whales in the park tend to feed below the surface. Very few direct observations of humpback whales consuming their prey have been made, because this typically happens underwater; however, in 2001, humpbacks were photographed feeding on sand lance in Adams Inlet (Doherty and Gabriele 2001). The results of studies conducted during commercial whaling operations identified a wide range of prey species for humpbacks in the North Pacific (Frost and Lowry 1981).

The availability of humpback whale prey in terms of distribution and abundance appears to vary considerably both spatially and temporally within the park and other areas of Southeast Alaska within and between years (Vequist and Baker 1987). Such variations are probably caused by many physical and biological factors. Most likely, the variability in humpback whale abundance and occupancy time in the park is driven by the variability in prey availability. Following a record-high number of whales (62) recorded in the park during 1998 (Doherty and Gabriele 2001), the number of whales recorded within Glacier Bay declined to a low of 45 in 2001. Concurrent studies of small schooling fish in Glacier Bay (Robards et al. 1999; J. Piatt, pers. com., in Doherty and Gabriele 2001) indicated that prey species, including capelin, were “surprisingly absent” from the Bay during that same time period, although data regarding the abundance and distribution of forage fish in Glacier Bay and Icy Strait are not collected annually.

The number of whales using the park typically rises in mid-June, peaking in July and August. Abundance is lower in May and September, and lowest from October through April. In 2001, however, whale activity did not concentrate in the lower Bay until late August, and Bartlett Cove was not used as heavily as it had been in most of the several previous years (Doherty and Gabriele 2001). By contrast, humpback use of Icy Strait far exceeded that documented for previous years.

Male humpback whales sing long, complex songs on their wintering grounds (Payne and McVay 1971). These songs are likely associated with reproduction (Tyack 1981). Song elements range from less than or equal to 20 hertz to 4 or 8 kilohertz, with estimated source levels ranging from 144 to 174 decibels relative to 1 micropascal (dB re 1 μPa; Thompson et al. 1979). The songs are shared by all singing whales while on the breeding grounds and may serve to attract reproductive females, or they may be a form of competitive behavior with other males. Humpback songs have also been recorded on feeding grounds in Stellwagen Bank in the North Atlantic (Mattila et al. 1987), as well as in Southeast Alaska (McSweeney et al. 1989), and have occasionally been recorded on the high-latitude summer feeding grounds in late summer or early fall (Mattila et al. 1987; McSweeney et al. 1989; Gabriele et al. 2001). The songs heard on the summering grounds are generally condensed versions of songs heard during the winters. The function of songs on the summer feeding grounds is unknown. Gabriele et al. (2001) suggest that the increase in song frequency in fall may correspond with the beginning of hormonal activity in male humpbacks associated with the migration to the wintering grounds. Although songs appear to be rare in summer, they increase in frequency in fall, and are heard in pelagic waters as whales make their migration to wintering grounds (Mattila et al. 1987).

Humpback whales also have been recorded uttering stylized rhythmic vocalizations identified as “feeding calls” (Baker 1985b) and “cries” while feeding cooperatively in Southeast Alaska (Cerchio and Dahlheim 2001). Feeding calls range from 236 to 1,219 hertz (Cerchio and Dahlheim 2001) and are similar within series, but different between series (Cerchio and Dahlheim 2001). It has been suggested that these calls may serve to manipulate prey distribution by creating a broad band of frequencies to which the prey may be sensitive (e.g., scaring fish into tighter groups). The calls also may be assembly calls to coordinate feeding (Baker 1985b). Researchers have also concluded that the cries carry signature information (Sharpe et al. 1998).

Humpbacks also produce sounds associated with aggressive, negative behavior (such as fighting, threatening, and fleeing) in social groups on the wintering grounds. These sounds extend from 50 hertz to approximately 10 kilohertz. These sounds may elicit response from humpbacks up to 5.5 miles (9 kilometers) away (Tyack and Whitehead 1983).

Information regarding hearing in baleen whales (which include humpbacks) is based on behavioral observations, anatomical evidence, and extrapolations from other marine mammal hearing characteristics. Field observations of the responsiveness of baleen whales to sounds can set an upper bound for detection thresholds; however, it is not possible to clarify the whales' reactions to sounds at levels lower than those that elicited a response. The whales either could detect the sounds but simply did not overtly respond, or may not have detected the lower-level sounds at all. Humpback whales reacted to calls from other humpbacks at levels as low as 102 dB re 1 μPa, and bowhead whales fled from an approaching boat when the noise level was 90 dB re 1 μPa (Frankel et al. 1995; Richardson and Greene 1993).

Baleen whales are probably able to hear low-frequency sounds, including infrasounds (less than 20 hertz), and react to sounds from members of their same species that range from 20 hertz (fin whales) to 550 hertz (humpback whales; Watkins 1981; Frankel et al. 1995). Humpback, gray, and bowhead whales react to airgun pulses and underwater playbacks of low-frequency (50 to 500 hertz) human-made sounds (Richardson et al. 1995). Anatomical evidence also suggests that baleen whales are adapted to hear low-frequency sounds (Ketten 1998). The upper bounds of baleen whale hearing are not as high as those of odontocetes (toothed whales). Humpback whales reacted to sonar signals at 3.1 to 3.6 kilohertz and broadband clinkers centered around 4 kilohertz (Lien et al. 1990, 1992; Maybaum 1993). Watkins (1986) reported that baleen whales react to sonar sounds up to 28 kilohertz, but not to sounds 36 kilohertz and above.

Steller Sea Lion *(Eumetopias jubatus)*.

Population, status, distribution, and demographics — Steller sea lions occur in the coastal and immediate offshore waters of the North Pacific. They are distributed from the Bering Strait along the Aleutian Islands, the Kuril Islands, and the Okhotsk Sea to Hokkaido, Japan, in the western Pacific, and along the coast of North America to the Channel Islands off Southern California in the eastern Pacific (Rice 1998). Two stocks of Steller sea lions are recognized in U.S. waters, based on differences in population dynamics (York et al. 1996) and mitochondrial DNA sequence distribution (Bickham et al. 1996). Cape Suckling (144º W longitude, 308 miles [495 kilometers] west of Gustavus, Alaska), located in the north-central Gulf of Alaska between Prince William Sound and Icy Bay, forms the boundary between these two stocks, dividing them into eastern and western populations (Loughlin 1997). Sea lions from the eastern U.S. stock are most likely to enter Glacier Bay and Dundas Bay, although members of the western stock can travel the distance to the park and have been observed within Glacier Bay. Aerial and ground-based surveys suggest that the population size of the eastern U.S. stock of Steller sea lions is at least 31,000 (Angliss et al. 2001a). Matthews (1993a) documented that more than 1,100 sea lions (approximately 9% of the Southeast Alaskan population at the time) used haul-outs in Glacier Bay and along the park's outer coast. The U.S. Geological Survey identified a haul-out on South Marble Island and several "sensitive areas," or areas where a number of sea lions may haul out for up to a few weeks at a time, in some years (see figure 3-4).

Steller sea lions were declared a threatened species throughout their range in 1990. In 1997, the western stock was listed as endangered (Loughlin et al. 1992; 62 *Federal Register* 30772, June 5, 1997) as a result of the precipitous decline in the Alaskan population from 140,000 in 1956 to between 60,000 and 68,000 in 1985 (Merrick et al. 1987). Worldwide, the estimated population dropped from between 240,000 and 300,000 to 116,000 (Loughlin et al. 1992) during a 30-year period. The decline in numbers has been greatest for the western stock, with some breeding rookeries in the Aleutians declining as much as 87% between 1960 and 1989 (Loughlin et al. 1992). There has been no associated decline in the eastern stock, with the number of Steller sea lions in Southeast Alaska showing increases by as much as 70% between 1960 and 1989 (Loughlin et al. 1992).

Although Kruse et al. (2001) have reported that the abundance of the eastern stock may be the highest ever recorded and that re-evaluation of the threatened listing is warranted, the eastern stock is still listed as threatened (Angliss et al. 2001a).

Reproduction and recruitment — During the breeding season, adult sea lions use some haul-outs as rookeries where adult males establish territories, breeding occurs, and pups are born. Breeding adults occupy rookeries from late May to early July (NMFS 1992). Males become sexually mature at 3 to 7 years and physically mature at around 10 years of age. Physically mature males may gain and hold a territory for up to seven years (NMFS 1992). Females become sexually mature at 3 to 6 years and may produce young into their early 20s. Most females breed annually. Copulation occurs approximately 11 to 14 days after birth, but implantation is delayed until late September to early October. Pups are born from late May to early July. Pups are usually weaned by the end of their first year, but may continue to nurse until age 3 (Lowry et al. 1982). Females frequently return to the same pupping site within the rookery in successive years.

The pregnancy rate of mature females in the Gulf of Alaska in April and May 1985 was 60%, a rate slightly lower than the 67% recorded between 1975 and 1978 (NMFS 1992). A decline in juvenile survival appears to be an important cause of the declines in western Alaskan stocks of Steller sea lions. Declines in the numbers of juvenile sea lions have been reported at many Alaskan rookeries and haul-outs since the 1980s (Merrick et al. 1987; Loughlin et al. 1992); however, the ultimate causes of the decline in survival are not yet known.

Natural history — Steller sea lions haul out on beaches and rocky shorelines of remote islands, often in areas exposed to wind and waves (NMFS 1992). Sometimes haul-outs with gently sloping beaches that are protected from waves are used as rookeries (NMFS 1992). There are three known rookeries in Southeast Alaska: Hazy Island and White Sisters Island near Sitka, and Forrester Island near Dixon Entrance (Calkins et al. 1996). Recently, up to 49 pups were seen in June 2000 and 2001 on Graves Rock along the park's outer coast; this area may be a new rookery (Raum-Suryan and Pitcher 2000; Raum-Suryan 2001).

During the non-breeding season, sea lions may disperse great distances from the rookeries. For example, juvenile sea lions branded as pups on Forrester Island, located west of Prince of Wales Island, have been observed at South Marble Island in the park (Mathews 1996) — a distance of more than 200 miles (160 kilometers) south of the park — and some juveniles from the western stock have been observed at South Marble Island and Graves Rock within the park (Raum-Suryan 2001).

Killer whales and sharks probably prey on Steller sea lions, although the effect of these predators is not known (NMFS 1992). Natural mortality is highest for pups, and includes drowning, starvation, crushing by males, disease, predation, and aggression from females other than the mother.

Steller sea lions eat a variety of fishes and invertebrates. In Alaska, walleye pollock is the principal prey item, followed by Pacific cod, octopus, squid, herring, flatfishes, and sculpins. Harbor seals, spotted seals, bearded seals, ringed seals, fur seals, and sea otters are occasionally eaten by adult male Steller sea lions (Gentry and Johnson 1981; Lowry et al. 1982; Pitcher and Fay 1982; NMFS 1992).

No information regarding the frequency, composition, or source levels of Steller sea lion calls exists. Only California sea lion calls have been recorded and analyzed, and these are thought to be generally consistent with those of Steller sea lions. Underwater sounds of California sea lions are generally associated with social situations (Schusterman et al. 1966). Most underwater sounds are barks that are produced while the head is above the surface. Most of the energy is at frequencies below 2 kilohertz, and is similar in water and air (Schevill et al. 1963). When submerged, California sea lions produce barks, whinny and buzzing sounds, and click trains (Schusterman et al. 1966). Steller sea lions are said to produce clicks, growls, snorts, and bleats under water (Poulter 1968).

Marine Mammal Hearing. Sound and the way in which humpback whales and Steller sea lions perceive it are important factors by which the effects of altering the vessel quota and operating requirement strategies will be evaluated. This subsection describes the factors affecting marine mammals' hearing and how marine mammals hear. This information is applicable to all marine mammals and therefore is applicable to subsection 3.3.2. Table 3-2 includes definitions of terms related to underwater acoustics that are used throughout this subsection.

TABLE 3-2: UNDERWATER ACOUSTICS TERMS

Hertz (Hz)	A unit of frequency equal to one cycle per second that is abbreviated as "Hz." The usual metric prefixes apply (1,000 hertz is equal to 1 kilohertz).
Low-frequency sound	Below 1,000 Hz. Typical low-frequency underwater sounds are made by large ships as well as the vocalization of marine animals. To the human ear in air, 262 Hz sounds like middle C on the musical scale (Richardson et al. 1995).
Mid-frequency sound	1,000 Hz to 10,000 Hz. Natural underwater mid-frequency sounds are typically created by marine mammals (mainly dolphins) and precipitation.
High-frequency sound	Above 10,000 Hz. Natural underwater high-frequency sounds are typically created by snapping shrimp and echolocation of marine mammals.
Sound intensity	Sound measurements can be expressed in two forms: intensity and pressure. The intensity of a sound is the average rate of energy transmitted through a unit area in a specified direction, expressed in Watts per square meter (W/m^2). Acoustic intensity is rarely measured directly. Instead, when acousticians refer to intensities or powers, they derive them from ratios of pressures. To present sound measurements as ratios of pressures that can be compared to one another, a standard reference pressure needs to be used in the denominator of the ratio. The American National Standard and the international (metric) standard is to use 1 micropascal (µPa) as the reference pressure for underwater sound and 20 µPa as the reference pressure for airborne sounds.

Factors affecting marine mammal hearing — The hearing abilities of marine mammals (and other animals) are functions of the following (after Richardson et al. 1995):

- absolute hearing threshold — the level of sound that is barely audible in the absence of significant ambient noise.
- frequency and intensity discrimination — the ability to discriminate among sounds of different frequencies and intensities.
- directional hearing — the ability to localize sound direction at the frequencies under consideration.
- auditory masking — the ability or inability to distinguish target sounds from ambient noise.
- motivation — the psychological state of the animal may influence whether the sound is detected, and whether the animal reacts.
- individual variation — the variation in hearing sensitivity between individuals.

Following are summaries of the above items; each of these topics is described in depth in appendix C.

Absolute hearing threshold — Odontocetes (toothed whales) in Glacier Bay and Dundas Bay (these include the killer whale, harbor porpoise, and Dall's porpoise) generally have very acute hearing at the middle frequencies, with lower sensitivity at low and high frequencies. The best frequencies for seven species of odontocetes range from approximately 8 to 90 kilohertz (Richardson et al. 1995).

Pinnipeds in the *Phocidea* family (fur seals, which include the harbor seal found in Glacier Bay and Dundas Bay) generally hear from 1 kilohertz to between 30 and 50 kilohertz, with thresholds between 60 and 85 dB re 1 μPa (Richardson et al. 1995). Sensitivity for most phocids remains good until approximately 60 kilohertz, after which sensitivity is poor (Richardson et al. 1995).

Underwater sensitivity at the high- and low-frequency ends for pinnipeds in the *Otariidae* family (which includes the Steller sea lion found in Glacier Bay and Dundas Bay) is generally lower than that for phocids, but there is little difference in the middle frequencies (Richardson et al. 1995). The high-frequency limit for most otariids appears to be approximately 36 to 40 kilohertz (Schusterman 1981), and sensitivity in the 100-hertz to 1-kilohertz range appears to be lower than that for phocids.

Pinnipeds respond to airborne sounds as well as underwater sounds. Otariids apparently are more sensitive to airborne sounds and appear to detect higher-frequency airborne sounds more than phocids. The high-frequency limit of airborne sounds for otariids is similar to the underwater limit of 36 to 40 kilohertz, whereas for phocids, the upper limit appears to be around 20 kilohertz, considerably lower than the 60-kilohertz limit under water. Sensitivity to airborne sounds for otariids and phocids deteriorates as the frequency goes below 2 kilohertz.

Mysticetes (baleen whales) include the humpback and minke whales found in Glacier Bay and Dundas Bay. It is not known how well baleen whales use low-frequency sound, but the anatomy of their auditory organs suggests that they may have good low-frequency hearing.

Frequency and intensity discrimination — The ability to differentiate between two signals of different frequency and intensity is important in detecting sound signals amidst background noise. This ability is also important for detecting calls from the same species, prey, and predators. Odontocetes (toothed whales) apparently have very good frequency discrimination and may be able to detect intensity differences as small as 0.35 to 2 decibels (Johnson 1971). No information is available for mysticetes (baleen whales). There is little data regarding the ability of pinnipeds to detect differences in intensity, but it is believed that pinnipeds have less precise frequency discrimination than odontocetes.

Directional hearing — The ability to localize sounds may be important for interactions among social marine mammals, and for prey detection by echolocation or passive signal detection. In mysticetes, the auditory organs are isolated from the skull, enhancing the ability to localize sound. There is some indirect evidence that baleen whales have the ability to localize sounds at frequencies of a few hundreds to tens of hertz (Richardson et al. 1995). Baleen whales sometimes orient and swim toward distant calling from others of their species (Watkins 1981; Tyack and Whitehead 1983), or swim directly away from predator calls (Malme et al. 1983) or industrial noise (Richardson et al. 1995).

Odontocetes also have very good ability to localize sound, as might be expected based on knowledge of their echolocation abilities.

Pinnipeds' auditory structures are fused to the skull, which suggests a reduced ability to localize underwater sounds. Accordingly, pinnipeds have less precise abilities to localize sounds than odontocetes, but pinnipeds have other adaptations for hearing in-air and underwater sounds.

Auditory masking — Normal background noise (natural and human-made) may mask other sounds, interfering with the ability of an animal to detect a sound signal. In general, the masking effect of background noise is reduced if the noise either comes from a direction other than that of the target or is omnidirectional (Richardson et al. 1995).

In general, marine mammals that localize sounds reduce the effect of masking through directional hearing. That is, masking is not as severe for important sounds that come from directions different from those of the noise. In order to reduce masking, marine mammals may shift the frequency of their calls from a "noisy" frequency band to one with less ambient noise (Lesage et al. 1999), increase the length of calls (Miller et al. 2000), change the duration of elements in calls (Norris 1999), or increase the number of specific calls (Lesage et al. 1999) or elements within calls (Serrano and Terhune 2001).

Motivation and individual variation — In addition to the physical factors that influence marine mammal hearing, individual variation in hearing abilities and differences in motivation will influence the effects of sound on marine mammals. Reactions of marine mammals to sounds vary considerably. For example, some humpbacks show little or no reaction to vessels within distances at which other humpbacks have shown obvious reactions. Krieger and Wing (1984, 1986) observed that humpbacks are less likely to react to vessels while actively feeding than when resting or engaging in other activities. Small humpback pods, or pods with calves, were more likely to react to vessels than were larger pods or pods without calves (Bauer et al. 1993). Thus, the motivation (behavioral state, whether sound is perceived as a threat) will affect how or whether marine mammals will react to sound, regardless of the species involved.

3.3.2 MARINE MAMMALS

3.3.2 Marine Mammals

This subsection describes those marine mammals that inhabit the park seasonally or year-round other than the two marine mammals listed as threatened or endangered: the humpback whale and Steller sea lion (see subsection 3.3.1). Each marine mammal species identified in table 3-3 is described in the following subsections, including information about its status in the park and its range, abundance, and natural history. Sightings of each species made during the USGS predator surveys are shown in figure 3-5.

TABLE 3-3: MARINE MAMMAL SPECIES, OTHER THAN THREATENED AND ENDANGERED SPECIES, KNOWN TO INHABIT THE WATERS OF GLACIER BAY NATIONAL PARK AND PRESERVE

Common Name	Scientific Name
Cetaceans (Whales and Dolphins)	
Minke Whale	*Balaenoptera acutorostrata*
Harbor Porpoise	*Phocoena phocoena*
Dall's Porpoise	*Phocoenoides dalli*
Killer Whale	*Orcinus orca*
Pinnipeds (Sea Lions and Seals)	
Harbor Seal	*Phoca vitulina richardsi*
Marine Fissipeds	
Sea Otter	*Enhydra lutris*

Minke Whale *(Balaenoptera acutorostrata)*. Minke whales are small baleen whales (up to 31 feet [9.5 meters] long in the North Pacific) that inhabit all oceans of the world from the high latitudes to near the equator (Leatherwood et al. 1982). Two minke whale stocks are recognized in U.S. waters — the Alaskan stock and the California/Oregon/Washington stock (Angliss et al. 2001a). No population estimates exist for the Pacific population as a whole or for the Alaskan stock; however, an estimate of 936 minke whales was made for the central Bering Sea during July through August 1999 (Angliss et al. 2001a). It is not known whether the minke whales in Southeast Alaska are from the Alaskan stock or California/Oregon/Washington stock.

Females in the North Pacific reach sexual maturity at approximately 24 feet (7.3 meters) in length; males reach sexual maturity between 21 and 23 feet (6.4 and 7 meters; Horwood 1990). The timing of conception and birthing in minke whales in the North Pacific is not precisely known. There appear to be two peaks of conception — February through March and August through September (Horwood 1990). Gestation time is estimated to be 10 months (Best 1982), resulting in birthing peaks from December through January and June through July (Horwood 1990).

There are several studies of minke whale feeding from the North Pacific and none of quantitative significance from the eastern North Pacific (Horwood 1990). Stomach contents of minke whales taken in the Japanese Minke fishery indicate that minke whales feed on a variety of fishes and invertebrates (Tamura and Fujise 2000). Minke whales killed in the northwest Pacific fed mainly on Japanese anchovy, Pacific saury, and walleye pollock (Tamura and Fujise 2000). Krill (euphausids and copepods) also made up a large part of the stomach contents in some areas (Tamura and Fujise 2000).

In Glacier Bay, minke whale sightings of between five and eight individuals annually were reported between 1996 and 1999 (Gabriele and Lewis 2000). Sightings were concentrated in Sitakaday Narrows and in central Icy Strait. One minke whale was sighted north of Strawberry Island, and there are anecdotal reports of minke whales in the upper West Arm (Gabriele and Lewis 2000).

Marine Mammal Sighting Locations

Figure 3-5

National Park Service
U.S. Department of the Interior

The marine mammal species locations were observed during marine predator surveys in 1999 and 2000. These locations are intended to show the relative distrubution, but do not indicate all possible areas where marine mammal species occur.

- Harbor Seal Sightings
- Sea Otter Sightings
- Harbor Porpoise Sightings
- Killer Whale Sightings
- Minke Whale Sightings

Glacier Bay National Park and Preserve

Vessel Quotas and Operating Requirements
Environmental Impact Statement

5 0 5 10 Miles

Because baleen whales, including the minke whale, have rarely been held in captivity, sounds created by baleen whales have generally been recorded in the wild. Most baleen whale sounds are dominated by low frequencies, generally below 1 kilohertz, although a few recordings of clicks with dominant frequencies from 16 to 25 kilohertz have been recorded near minke, fin, and blue whales (Beamish and Mitchell 1973; Thompson et al. 1979; Beamish 1979). However, these high-frequency sounds are thought to have been either from odontocetes in the area or from recording artifacts (Richardson et al. 1995).

Harbor Porpoise *(Phocoena phocoena)*. Harbor porpoises in the eastern North Pacific range from Point Barrow, Alaska, to Point Conception, California, inhabiting shallow coastal waters (Rice 1998; Angliss et al. 2001a). Angliss et al. (2001a) estimated that there are approximately 43,000 harbor porpoises in Alaskan waters divided into three recognized stocks, although it is difficult to determine the true stock structure of harbor porpoise populations in the eastern North Pacific (NMFS 2000a). Dahlheim et al. (2000) estimated that up to 35,500 harbor porpoises inhabit Alaskan waters, based on aerial surveys conducted between 1991 and 1993. The Southeast Alaska stock inhabits waters from the northern border of British Columbia to Cape Suckling, Alaska; the Gulf of Alaska stock occurs from Cape Suckling to Unimak Pass; and the Bering Sea stock occurs from the Aleutian Islands and all waters north of Unimak Pass. Individuals from the Southeast Alaska and Gulf of Alaska stocks, with population estimates of 10,508 and 21,451, respectively, may enter Glacier Bay or Dundas Bay.

Harbor porpoises appear to reproduce annually (Read and Hohn 1995) or biannually (Hohn and Brownell 1990). Reproduction is thought to be strictly seasonal, with parturition, ovulation, and conception occurring in the spring or summer (Read and Hohn 1995). This species seems to be shorter-lived than most odontocetes (toothed whales), because most of the individuals for which age data have been recorded in various locations have been less than 10 years old. Locations have included the Gulf of Maine (Read and Hohn 1995), the Bay of Fundy (Read and Gaskin 1990), California (Hohn and Brownell 1990), the United Kingdom (Lockyer and Walton 1994), and Greenland (Kinze et al. 1990). An abandoned harbor porpoise calf, estimated to be 2 days old, was found in Glacier Bay in July 1993 (Matthews 1993b). The age of the calf indicated to scientists that the calf may have been born in the park.

Harbor porpoises are known to feed on a multitude of fishes, including herring, hake, lantern fish, capelin, and various species of cephalopods (Palka et al. 1996). A report of opportunistic sightings of harbor porpoises in the park (Gabriele and Lewis 2000) suggests that harbor porpoise numbers within the park may be declining. Gabriele and Lewis (2000) reported that harbor porpoises were distributed throughout lower to mid-Glacier Bay and Icy Strait, most often in waters less than 230 feet (70 meters) deep, but were also seen in waters more than 328 feet (100 meters) deep (see figure 3-5).

Harbor porpoises are odontocetes, as are Dall's porpoises and the killer whales (discussed in the following subsections), all of which are found in or near the park. Odontocetes produce three broad types of sounds — tonal whistles; short-duration pulsed sounds; and less distinct pulsed sounds such as cries, grunts, and barks. Odontocetes that produce whistles tend to be social, gathering in large groups of up to thousands of individuals, while non-whistling odontocetes tend to be non-social or gather in small groups of a few individuals (Tyack 1986; Herman and Tavolga 1980).

Most odontocetes' whistles have most of their energy below 20 kilohertz and can vary greatly in frequency structure. Some odontocetes may use special, unique whistles as "signature calls" that may carry some information about the sender. Whistles also may serve to coordinate activity, such as feeding in large, dispersed groups (Norris and Dohl 1980; Würsig and Würsig 1980). Clicks and pulsed sounds are typically short bursts of sound (50 to 200 microseconds in length) that can range in frequency from 0.1 to 200 kilohertz (Watkins 1980; Santoro et al. 1989). Clicks have been demonstrated to be used for echolocation in several species of odontocetes, and numerous other species produce echolocation-type sounds, although they have not been proven to echolocate. Echolocating odontocetes produce forward-directional, pulsed sounds of high frequency (12 to 150 kilohertz), short duration (50 to 200 microseconds), and high intensity (up to 220 to 230 decibels standardized at 1 micropascal at 1 meter).

Dall's Porpoise *(Phocoenoides dalli)*. Dall's porpoises inhabit deep waters over the continental shelf and the oceanic basin in the North Pacific Ocean (Rice 1998; Angliss et al. 2001a). The Alaskan population of Dall's porpoise is managed as a single stock ranging from Southeast Alaska to the northern Bering Sea, and is estimated to be 83,400 with a minimum population size of 76,874 (Angliss et al. 2001a). The only gaps in distribution in Alaskan waters are in the upper Cook Inlet and the shallow waters of the eastern Bering Sea (Angliss et al. 2001a). Throughout their range, Dall's porpoises are present in all months of the year (Angliss et al. 2001a). Dall's porpoises were seen in Icy Strait six times between 1994 and 1999, but never in Glacier Bay (Gabriele and Lewis 2000).

Very little information about reproduction of Dall's porpoise in the eastern North Pacific is available; most information comes from animals taken in small whale fisheries in the western Pacific. Dall's porpoises are assumed to calve yearly (Jefferson 1989; Ferrero and Walker 1999), with a summer calving peak from June through August, and perhaps a smaller peak in March (Jefferson 1989). Ferrero and Walker (1999) estimated the peak of calving for Dall's porpoises in the central North Pacific to be in July. Females reach sexual maturity when they are approximately 68 inches (172 centimeters) long and between 3.8 and 4.4 years; males reach sexual maturity at 71 inches (180 centimeters) and 4.5 to 5 years (Ferrero and Walker 1999). Males and females reach physical maturity at 7.2 years (Ferrero and Walker 1999).

A variety of prey items has been recorded for Dall's porpoises. In the nearshore waters of Washington, British Columbia, and the Gulf of Alaska, Dall's porpoises fed heavily on capelin, Pacific herring, and cephalopods. In the southern Sea of Okhotsk, north of Japan, Dall's porpoises have been found to feed on Japanese pilchard, walleye pollock, and the *Berryteuthis* squids (Walker 1996).

Killer Whale *(Orcinus orca)*. Killer whales inhabit all oceans and contiguous seas from the Arctic to the Antarctic, though they are generally more abundant near shore and toward the poles of both hemispheres (Rice 1998). The total number of killer whales estimated to inhabit Southeast Alaskan waters is 318 (99 resident, 219 transient).

Killer whales in Southeast Alaska can be divided behaviorally and ecologically into three types: residents, transients, and offshore (Bigg et al. 1990; Ford et al. 1994; Black et al. 1997; Dahlheim et al. 1997). Resident-type killer whales usually feed on fish (Olesiuk et al. 1990), travel in pods of 10 to 50 individuals (identified by biologists using a system of letters and numbers), vocalize more, and have smaller home ranges than transient killer whales. Two resident pods (identified as "AF" and "AG") are known to frequent the Glacier Bay / Icy Strait area (see figure 3-5). These pods contain 42 whales and 24 whales, respectively (Dahlheim et al. 1997). Two other pods (AP: 30 whales [September 1989], and AZ: 23 whales [May 1994]) have been seen once in the Icy Strait area (Dahlheim et al. 1997). Several transient pods and assemblages are known to travel through Southeast Alaska and may enter Glacier Bay (Dahlheim et al. 1997). Transient killer whales mainly feed on marine mammals, including seals, sea lions, and other whales; travel in smaller pods of one to 15 individuals; and are rarely seen in association with resident whales (Olesiuk et al. 1990). Offshore killer whales appear to be rare in Alaskan waters (Dahlheim et al. 1997), and little is known about this type, although they appear to be more closely related genetically, morphologically, behaviorally, and vocally to the resident-type than transient-type killer whales (Black et al. 1997; Hoelzel et al. 1998).

Female killer whales reach sexual maturity when they are 15 to 16 feet (4.6 to 4.9 meters) long, or about 15 years of age (Olesiuk et al. 1990). Female killer whales are thought to reach reproductive senescence at about 40 years; i.e., the female is beyond her reproductive age. Males appear to reach sexual maturity between 15 and 21 years of age, and reach maximum size at about 21 years (Olesiuk et al. 1990). Females typically give birth to a single calf every two to 12 years, with a mean of 5.3 years (Oliseuk et al. 1990). Twins are rare; Oliseuk et al. (1990) estimate the twinning rate to be

1.5%. The fecundity rate (the proportion of females that produce viable calves each year) for the British Columbia population was estimated to be 0.224 (Olesiuk et al. 1990). The calving period has been determined from stranded newborns, observations of births, and records of fetuses in whaling data. In Prince William Sound, most new calves are seen in spring, but a birth was observed in July, and a newborn was stranded near Homer, Alaska, in January (Matkin and Saulitis 1994).

Harbor Seal *(Phoca vitulina richardsi)*. Harbor seals range from Baja California; north along the western coasts of the U.S., British Columbia, and Southeast Alaska; west through the Gulf of Alaska and the Aleutian Islands; and in the Bering Sea north to Cape Newenham and the Pribilof Islands. Angliss et al. (2001a) identified three stocks in Alaska: the Southeast Alaska stock, Gulf of Alaska stock, and Bering Sea stock. More recent genetic evidence was noted, however, indicating a need to reassess these boundaries. Angliss et al. (2001a) estimated 35,226 individuals in the Southeast Alaska stock (from the Alaska/Canada border to Cape Suckling). Trend estimates for Sitka, Ketchikan, and Glacier Bay indicate that the Southeast Alaska stock had been increasing since at least 1983 (Small et al. 1997); however, from 1992 through 1998, overall harbor seal abundance in Glacier Bay declined between 34% and 50% (Mathews and Pendleton 2001).

Harbor seals inhabit estuarine and coastal waters, hauling out on rocks, reefs, beaches, and glacial ice flows (see figure 3-5). They are generally non-migratory, but move locally with the tides, weather, season, and food availability, and to find suitable habitat for reproduction (Scheffer and Slipp 1944; Fisher 1952; Bigg 1969; Bigg 1981a). Juvenile harbor seals can travel significant distances (326 miles [525 kilometers]) to forage or disperse, whereas adults were found within 118 miles (190 kilometers) of the tagging location in Prince William Sound (Lowry et al. 2001). The smaller home range used by adults in the Sound is suggestive of a strong level of site fidelity (Lowry et al. 2001; Pitcher and Calkins 1979; Pitcher and McAllister 1981). The level of site fidelity that may apply to the Southeast Alaska stock and the interchange between seals using haul-outs within Southeast Alaska and Glacier Bay are unknown.

Female harbor seals give birth to a single pup while hauled out on shore or on glacial ice flows. The mother and pup remain together until weaning occurs at 3 to 6 weeks (Bishop 1967; Bigg 1969). Little is known about breeding behavior in harbor seals. When molting, seals spend most of the time hauled out on shore, glacial ice, or other substrates.

Harbor seals consume a wide variety of fishes, cephalopods, and crustaceans in estuarine and marine waters (Sease 1992). Pitcher (1980) reported that harbor seals feed on numerous fish species from a variety of families, including *Gadidae* (cods), *Clupeidae* (herring), *Cottidae* (sculpin), *Pleuronectidae* (righteye flounders), *Salmonidae* (salmon and trout), and *Osmeridae* (smelt).

In a study of harbor seal scat and stomach samples, Jemison (2001) reported differences in harbor seal diets from different locations in Alaska. The most frequently occurring prey species identified from scat in Southeast Alaska were walleye pollock *(Theragra chalcogramma)* and arrowtooth flounder *(Atheresthes stomias)*. In the Kodiak Archipelago, the most frequently occurring prey species were Irish lord *(Hemilepidotus)* and sand lance *(Ammodytes hexapterus)*. In the Bering Sea, sand lance, rock sole *(Lepidopsetta)*, various flounder species (family *Pleuronectidae*), sculpin (family *Cottidae*), yellowfin sole *(Pleuronectes asper)*, rainbow smelt *(Osmerus mordax)*, and tomcod *(Microgadus proximus)* were the most commonly occurring prey identified in scat samples. Prey items from stomach samples collected in Southeast Alaska and Prince William Sound were similar; the most commonly occurring prey were herring, cephalopods, and pollock.

Harbor seals spend considerable time hauled out on land, although much social behavior occurs under water as well. Males produce repeated call trains of low-frequency (less than 4 kilohertz) underwater pulses, including roars, grunts, and creaks (Hanggi and Schusterman 1994). Calls from pups are individually distinct and broadcast simultaneously in air and under water when the pup's head is in the air. Females use their pups' calls in air and under water to recognize and maintain contact with their pups. Pup calls in air are centered around 350 hertz (Ralls et al. 1985), while underwater calls are at higher frequencies (Richardson et al. 1995).

Sea Otters *(Enhydra lutris)*. Before commercial exploitation, the worldwide population of sea otters was estimated to number between 150,000 (Kenyon 1969) and 300,000 (Johnson 1982), and occupied coastal areas from Hokkaido, Japan, around the North Pacific rim to central Baja California, Mexico (Rotterman and Simon-Jackson 1988). Commercial exploitation reduced the total sea otter population to as low as 2,000 in 13 locations (Kenyon 1969). In 1911, sea otters received protection from the North Pacific Fur Seal Convention and otter populations recovered quickly (Kenyon 1969). More than 90% of the worldwide sea otter population now lives in Alaskan waters (Rotterman and Simon-Jackson 1988). There are an estimated 54,523 sea otters in three stocks in Alaskan waters: the southwestern stock with 23,967, the southcentral stock with 21,749, and the southeastern stock with 8,807 (U.S. Fish and Wildlife Service [USFWS] 2002a).

Sea otters were reintroduced into Southeast Alaska between 1965 and 1969, when 412 otters were transplanted from Amchitka Island and Prince William Sound, including 25 that were moved to Cape Spencer in the park and preserve. Otters were not reported in Glacier Bay until 1993 (Gabriele and Lewis 2000). Between 1995 and 2000, the number of otter sightings in Glacier Bay increased from five to 554 annually (Bodkin et al. 2001). The increase in the Glacier Bay population is far greater than the maximum growth rate expected for sea otters, and probably results from reproduction of females in the Bay coupled with immigration of adults and juveniles from outside the Bay. Concentrations of sea otters within Glacier Bay occur in the vicinity of Sita Reef and Boulder Island, and between Point Carolus and Rush Point (see figure 3-5; Bodkin et al. 2001).

Sea otters usually give birth at 4 years of age; thereafter, 85% to 90% of females pup annually, and their reproductive cycle is approximately 12 months (Jameson and Johnson 1993). It is predicted that the otter population in Glacier Bay likely will continue to increase, and that the increasing otter population may have profound effects on the benthic community structure and function of the Glacier Bay ecosystem.

Sea otters generally occur in shallow (less than 115 feet [35 meters]), nearshore waters in areas with sandy or rocky bottoms, where they feed on a wide variety of sessile and slow-moving benthic invertebrates (Rotterman and Simon-Jackson 1988). Foraging studies in Glacier Bay indicate that sea otter diets consist of 40% clams, 21% urchins, 18% mussels, 4% crabs, and 17% other and unidentified food items (Bodkin et al. 2001).

Sea otters spend much of their time in water, but underwater sounds have not been studied. Airborne sounds of adult sea otters include whines, whistles, growls, cooing, chuckles, snarls, and screams (Kenyon 1981). Otters may also produce sounds by vigorously kicking and splashing while at the water's surface (Calkins and Lent 1975). Calls between mothers and pups appear to be important for maintaining contact (Sandegren et al. 1973). Most of the energy in mother and pup calls is between 3 and 5 kilohertz.

3.3.3 Marine Birds and Raptors

3.3.3 Marine Birds and Raptors

This subsection describes the bird community of Glacier Bay and Dundas Bay, which is typical of Southeast Alaska. Following are the common marine-oriented bird groups:

- loons and grebes.
- shearwaters and storm-petrels.
- cormorants, jaegers, gulls, and terns.
- alcids (murres, guillemots, murrelets, and puffins).
- waterfowl.
- hawks and eagles (raptors).
- shorebirds.
- herons.
- kingfishers.
- crows and ravens.

Common and scientific names in this environmental impact statement follow the conventions of the American Ornithologists' Union (AOU 1998, 2000).

Marine birds are birds that spend most or all of their life near and in marine areas and are the most common type of bird in the planning area. Of these, the most important in terms of sensitivity to vessel traffic are colonial nesting seabirds, molting waterfowl, murrelets, raptors, shorebirds, and seaducks.

Murrelets, scoters, and glaucous-winged gulls are very common year-round. In summer, these are joined by large numbers of black-legged kittiwakes, and in winter, by large numbers of goldeneyes, mergansers, and murres (Conant et al. 1988; Piatt et al. 1991; Agler et al. 1995; USFWS 1996).

The terrestrial avifauna comprises inhabitants of the large coastal rain forest that stretches from the Pacific Northwest to Kodiak Island, Alaska, and includes such characteristic species as blue grouse, rufous hummingbird, and hermit thrush.

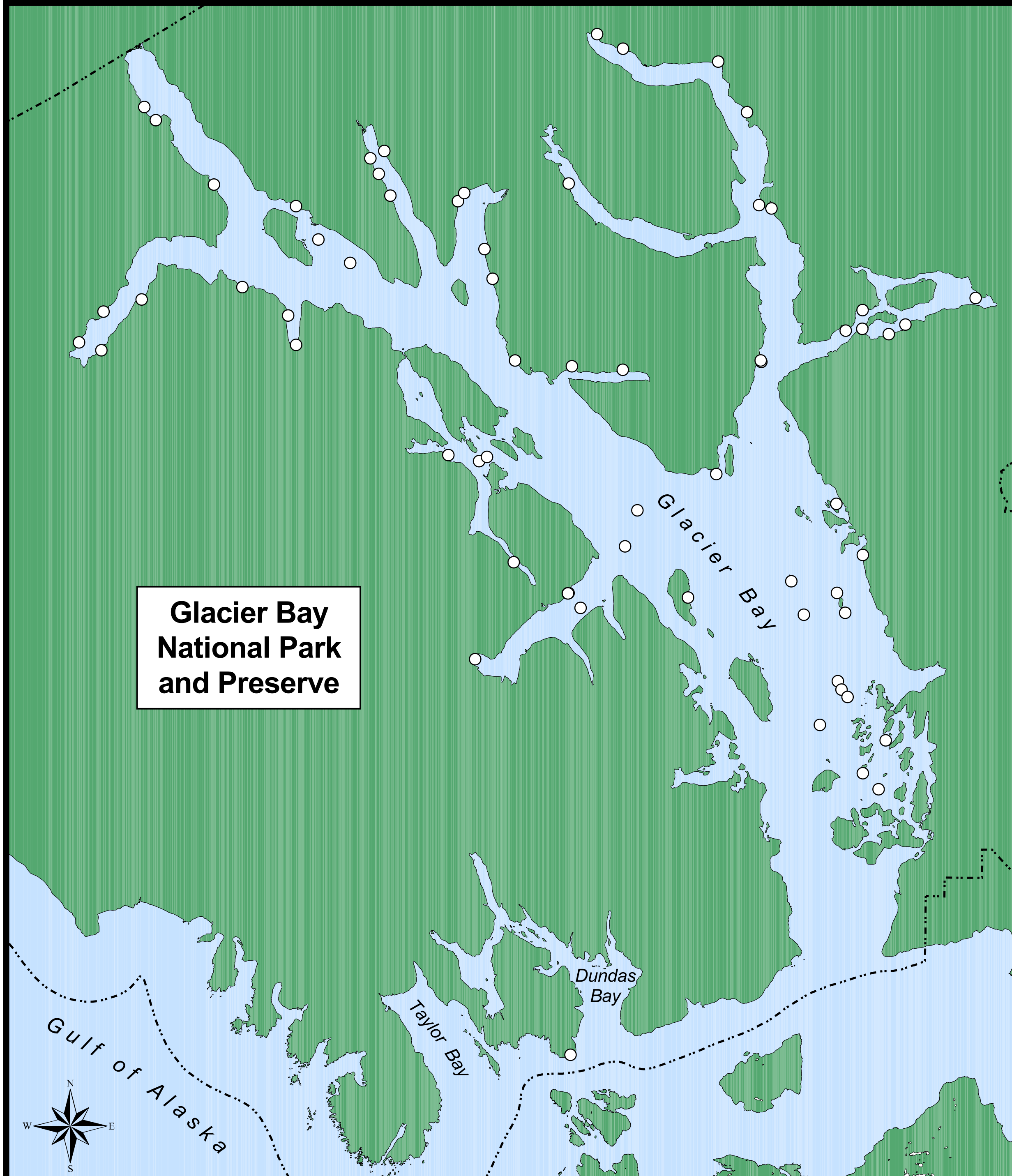
None of the bird species found within the park are listed as threatened or endangered under the Endangered Species Act of 1973 (USFWS, Brockman, pers. com., May 29, 2002). One breeding species (Kittlitz's murrelet) is being considered for protection under this act. The marbled murrelet is listed (since 1992) as a threatened species in California, Oregon, Washington, and British Columbia.

Colonial Nesting Seabirds. Sixty-six seabird colonies are located within Glacier and Dundas Bays (see figure 3-6). Colonies of more than 500 birds are found on South Marble Island and at Margerie Glacier. Colonies of 100 to 499 birds are located throughout Glacier Bay and are found in Hugh Miller Inlet, on Eider Island, on Flapjack Island, and on Gloomy Knob. The remaining colonies are small and scattered around the coastlines of Glacier Bay and Dundas Bay. The most abundant breeding colonial birds in the planning area are black-legged kittiwakes (more than 4,500 birds), glaucous-winged gulls (more than 2,200 birds), and pigeon guillemots (1,000 birds; see table 3-4). Other species of substantial numbers within Glacier Bay and Dundas Bay include pelagic cormorant, mew gull, arctic tern, and tufted puffin.

Seabird Colonies

Figure 3-6

National Park Service
U.S. Department of the Interior



○ Seabird Colony Locations
Park Boundary
Land
Water

Glacier Bay National Park and Preserve

Vessel Quotas and Operating Requirements
Environmental Impact Statement

5 0 5 10 Miles

TABLE 3-4: COLONIAL NESTING BIRDS BREEDING IN GLACIER BAY AND DUNDAS BAY

Species	Estimated number of birds
Pelagic Cormorant	142
Parasitic Jaeger	present
Mew Gull	"hundreds"
Herring Gull	20
Glaucous-Winged Gull	2,223
Black-Legged Kittiwake	4,600–4,800
Arctic Tern	"hundreds"
Common Murre	30
Pigeon Guillemot	1,000
Tufted Puffin	110
Horned Puffin	28

Sources: NPS 1995a; USFWS 2002c; NPS, Kralovec, electronic mail, July 30, 2002.

Murrelets. Glacier and Dundas Bays support one of the highest populations, if not the highest, of Kittlitz's murrelets worldwide (van Vliet 1993; Day et al. 1999); however, populations have declined in the park and elsewhere (USGS, Drew, pers. com., May 10, 2002). The U.S. Fish and Wildlife Service is considering listing the Kittlitz's murrelet as threatened under the Endangered Species Act.

Kittlitz's and marbled murrelets nest in the planning area. Both are small, brownish or grayish seabirds. Nesting numbers are not known for either species, but are likely in the order of a few thousand (less than 5,000) of Kittlitz's murrelets and several thousand (more than 5,000) of marbled murrelets (Piatt et al. 1991).

Kittlitz's murrelets are unique in that they specialize in foraging near glaciers, glacial ice, and turbid glacial water (Day and Nigro 2000; Day et al. in review), resulting in a very limited distribution (Day et al. 1999). Because this species depends on glacial ice and is representative of this unique ecological system, it is a key park resource.

During summer, Kittlitz's and marbled murrelets forage in scattered locations within Glacier Bay and Dundas Bay, with concentrations occurring in the Beardslee Entrance / Sitakaday Narrows area; Berg Bay; Geikie Inlet; the Hugh Miller / Scidmore Inlet complex; Rendu Inlet; Muir Inlet, in general; Wachusett Inlet; the northeastern part of the main body of Glacier Bay; and outer Dundas Bay (see figure 3-7).

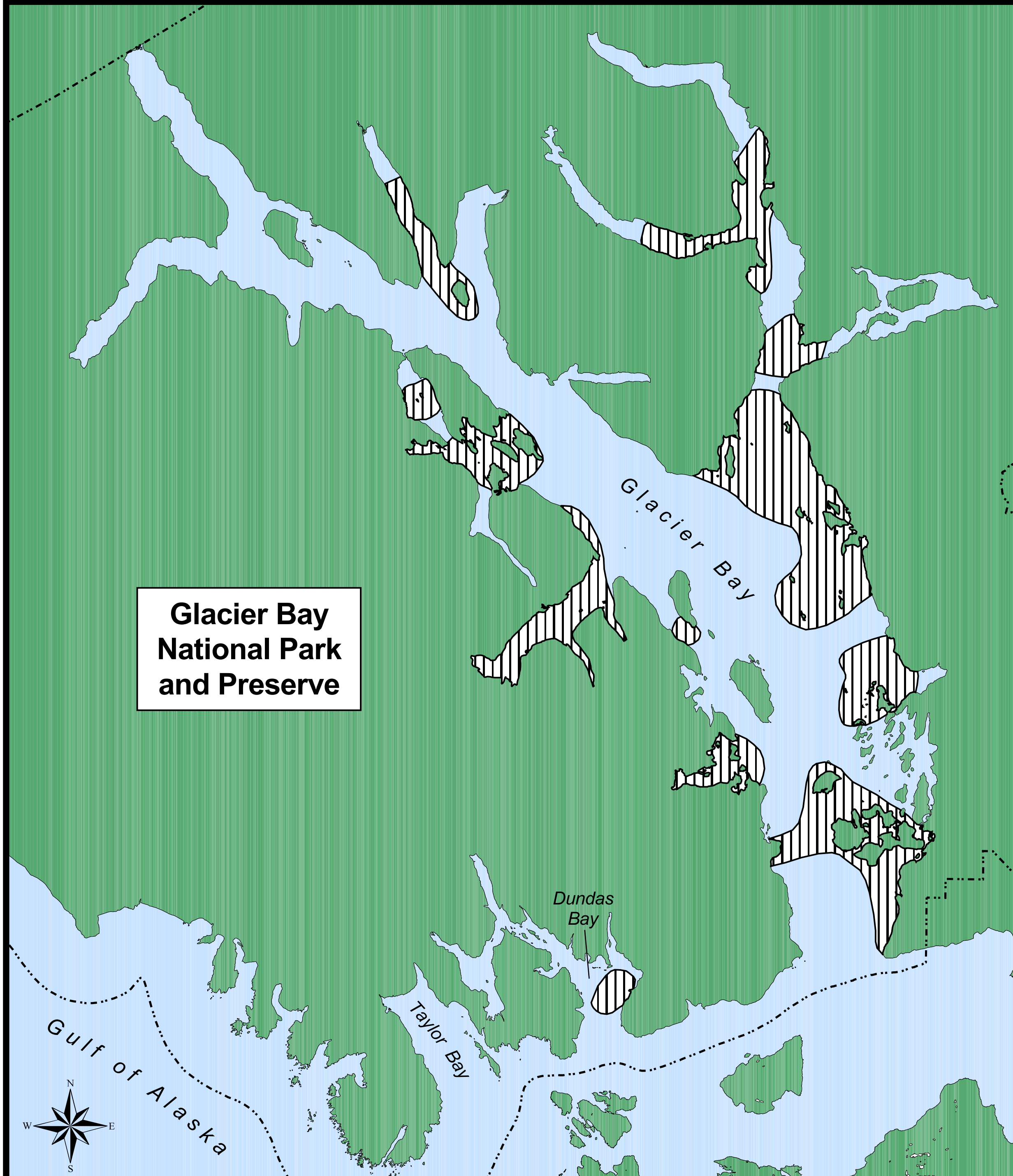
Raptors. Five species of marine-oriented raptors have been recorded within Glacier Bay and Dundas Bay: osprey, bald eagle, sharp-shinned hawk, northern goshawk, and peregrine falcon. The osprey, bald eagle, and peregrine falcon feed on fishes and birds and mammals that feed on marine life or live along the coast. The sharp-shinned hawk and northern goshawk feed only on birds that may occur along the coast. Osprey are rarely sighted in Glacier Bay or Dundas Bay and therefore are not addressed further in this document.

Of these species, bald eagles are of particular interest because they feed and nest along shorelines and are probably the most marine-oriented of the five species of raptors. Little information regarding the estimated population size of bald eagles within Glacier Bay or Dundas Bay is available. Cain (1982, cited in Kralovec 1994a) counted 439 eagles and located 197 nests in Glacier Bay (the exact area surveyed was not discussed by Kralovec). The most recent estimate is 291 nests, not all active, in Glacier Bay (NPS, Kralovec, electronic mail, July 30, 2002).

Concentrations of Marbled and Kittlitz's Murrelets

Figure 3-7

National Park Service
U.S. Department
of the Interior



Concentrations of Marbled and Kittlitz's Murrelets
Park Boundary
Land
Water

Glacier Bay National Park and Preserve

Vessel Quotas and Operating Requirements
Environmental Impact Statement

5 0 5 10 Miles

Within Glacier Bay, bald eagles nest primarily in deciduous trees (73%), secondarily in conifers (23%), and little in snags (4%; Kralovec 1994a). Figure 3-8 illustrates the locations of known bald eagle nest sites in Glacier Bay.

Shorebirds. Shorebirds are of interest because they feed and nest along the coast or in nearby coastal marshes; in most cases, they are obligate users of the shoreline. Of the approximately 35 species of shorebirds recorded in Glacier Bay and Dundas Bay, nine have been recorded as breeding or suspected of breeding (Paige 1986). The breeding species are from three species groups: plovers (semipalmated plover and possibly killdeer), oystercatchers (black oystercatcher), and scolopacid shorebirds (greater and lesser yellowlegs and solitary, spotted, and least sandpipers).

Of the nine breeding species found within the park, the black oystercatcher is probably the most unique. This bird is large, distinctive (black with a bright red clothespin-shaped bill), and noisy, and is an easily spotted shorebird along the coast of Alaska. The estimated population of black oystercatchers within Glacier Bay and Dundas Bay is 270 (USFWS 2002). Large numbers of black oystercatchers also concentrate in the park during late summer (August and September) to stage during fall migration (van Vliet 2002).

Little is known about post-breeding concentrations of black oystercatchers in Glacier Bay and Dundas Bay. Wik (1967) counted 124 oystercatchers in Geikie Inlet in late August 1967. In the 1990s, van Vliet (2002) counted 300 to 600 oystercatchers in Geikie Inlet in late summer and suggested that this may be the world's largest concentration of this species.

Seaducks. Seaducks are diving ducks that spend most of their lives at sea, with some even nesting along the coast and raising their young on salt water. Of the 13 species of seaducks recorded in Glacier and Dundas Bays, six are thought to breed in the area (Paige 1986). This group includes harlequin duck, Barrow’s goldeneye, and common and red-breasted mergansers. All raise their young on salt water. The most common breeding species seen on salt water in Glacier Bay and Dundas Bay are harlequin duck, Barrow’s goldeneye, and common merganser. Nearly one-half of the seaducks in Glacier Bay in the summer are white-winged and surf scoters, although they do not breed in the Bay (USGS, Bodkin, pers. com., May 10, 2002).

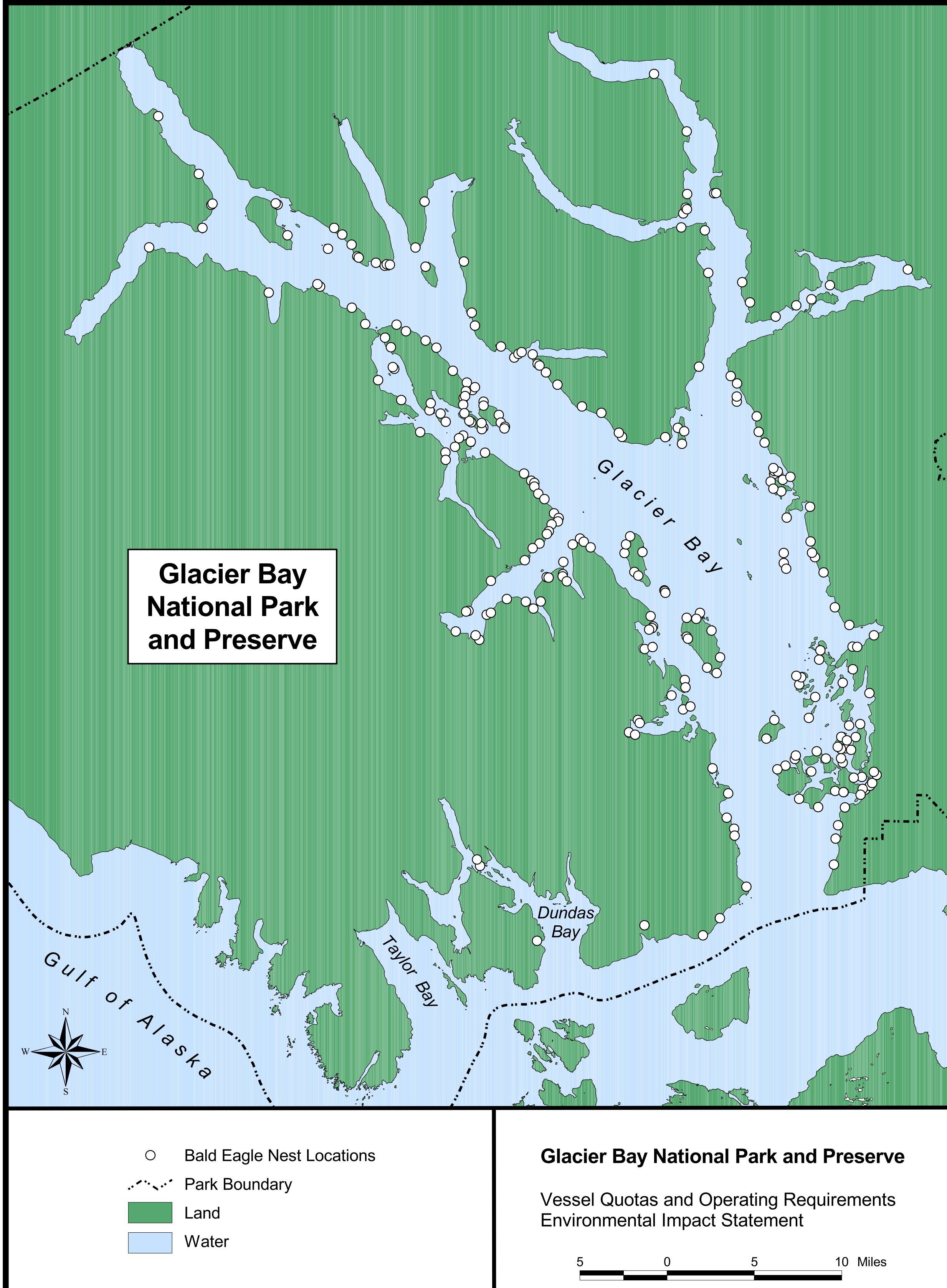
Molting Waterfowl. Waterfowl, including seaducks, use Glacier and Dundas Bays’ protected coves for molting and resting during mid- to late summer (June through September; Duncan and Climo 1991; USGS, Bodkin, pers. com., May 10, 2002). The molt is a time of great energetic stress on waterfowl. Molting occurs after birds have successfully reared their young, and involves the shedding and regrowth of feathers, including the major flight feathers. Molting imposes high energetic costs because all of the body feathers are replaced at once, and most waterfowl fatten before beginning the molt. Molting birds are extremely sensitive and easily disturbed (Welty 1975; Bellrose 1976).

In Glacier and Dundas Bays, the main molting species include Canada goose, harlequin duck, long-tailed duck, white-winged and surf scoters, Barrow’s goldeneye, and common and red-breasted mergansers (Climo and Duncan 1991; Duncan and Climo 1991; NPS 1995a; USGS 2002a). The total population of molting seaducks in the summer is 22,000 to 23,000, including surf and white-winged scoters (7,000 birds, respectively), common mergansers (4,200 birds) and harlequin ducks (1,200 birds; USGS, Bodkin, pers. com., May 10, 2002). These species concentrate particularly in the areas of Adams Inlet, Wachusett Inlet, central and lower Muir Inlet, the Hugh Miller / Scidmore Inlet complex, Tidal Inlet, Berg Bay, the Beardslee Islands, and Rendu Inlet (see figure 3-9; Climo and Duncan 1991; Duncan and Climo 1991; USGS 2002c; USGS, Bodkin, pers. com., May 10, 2002; USGS, Drew, pers. com., May 10, 2002; USGS, Litzow, pers. com., May 10, 2002).

Bald Eagle Nests

Figure 3-8

National Park Service
U.S. Department of the Interior



Glacier Bay National Park and Preserve

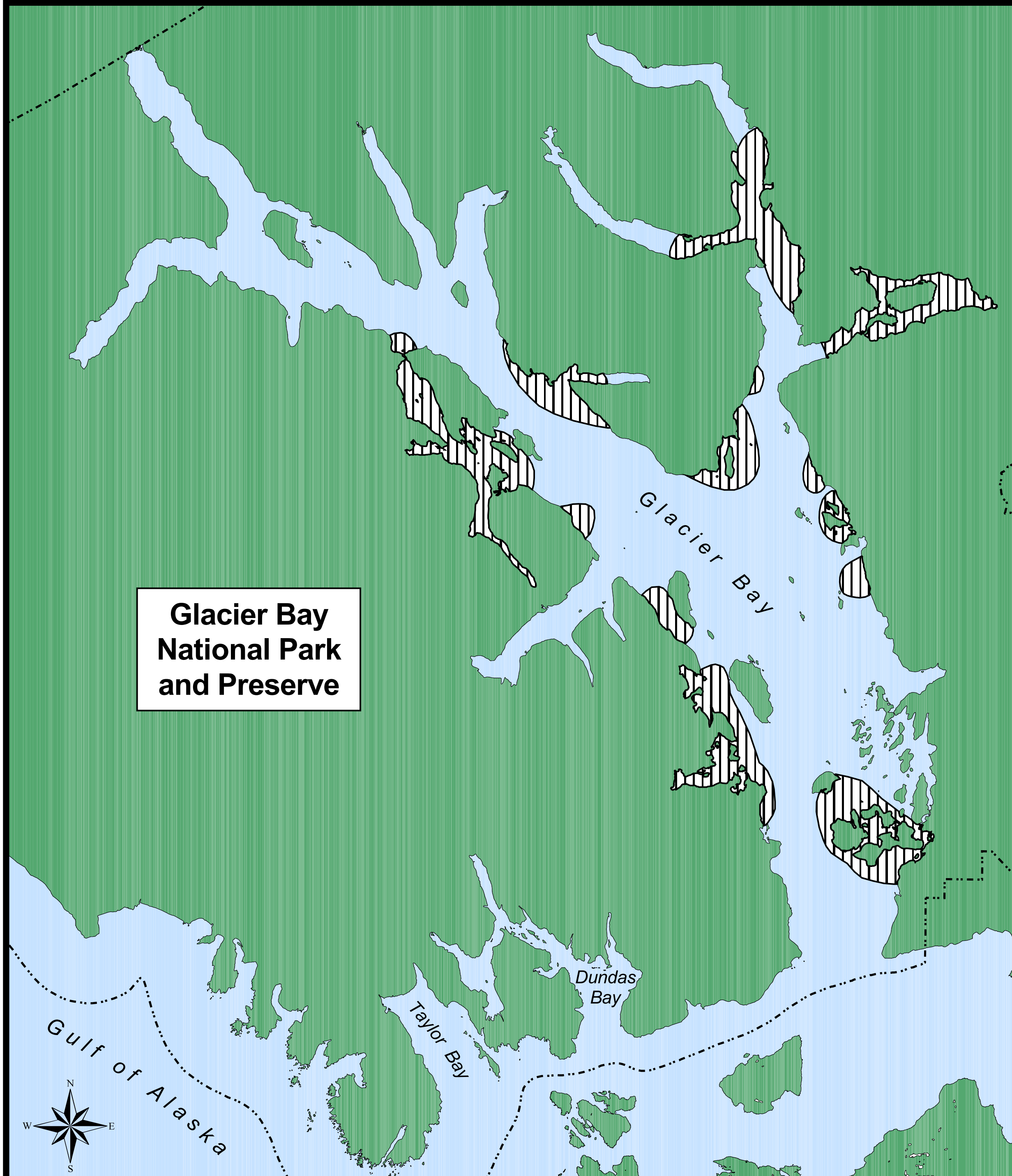
Vessel Quotas and Operating Requirements
Environmental Impact Statement

5 0 5 10 Miles

Concentrations of Summering Waterfowl

Figure 3-9

National Park Service
U.S. Department of the Interior



Concentrations of Summering Waterfowl
Park Boundary
Land
Water

Glacier Bay National Park and Preserve

Vessel Quotas and Operating Requirements
Environmental Impact Statement

5 0 5 10 Miles

3.3.4 Marine Fishes

This subsection describes marine fishes that occur in Glacier and Dundas Bays, with separate discussions for pelagic and demersal fish. These discussions include lists of the fish species found in Glacier and Dundas Bays and detailed descriptions of the most abundant species. A description of the various salmon species that occur in Glacier and Dundas Bays follows these discussions.

Relatively little baseline data exist for the status and distribution of marine fishes in Glacier and Dundas Bays. Fish found by Lenz et al. 2001 in Glacier Bay National Park and Preserve are listed in table 3-5.

TABLE 3-5: FISH FOUND IN GLACIER BAY NATIONAL PARK AND PRESERVE

Common Name	Scientific Name
Pacific Hagfish	*Eptatretus stouti*
Salmon Shark	*Lamna ditropis*
Pacific Sleeper Shark	*Somniosus pacificus*
Roughtail Skate	*Bathyraja trachura*
Big Skate	*Raja binoculata*
Longnose Skate	*Raja rhina*
Starry Skate	*Raja stellulata*
Wolf-Eel	*Anarrhichthys ocellatus*
Pacific Herring	*Clupea pallasii*
Capelin	*Mallotus villosus*
Eulachon	*Thaleichthys pacificus*
Pink Salmon	*Oncorhynchus gorbuscha*
Chum Salmon	*Oncorhynchus keta*
Chinook Salmon	*Oncorhynchus tshawytscha*
Coho Salmon	*Oncorhynchus kisutch*
Sockeye Salmon	*Oncorhynchus nerka*
Steelhead/Rainbow Trout	*Oncorhynchus mykiss*
Cutthroat Trout	*Oncorhynchus clarki*
Dolly Varden	*Salvelinus malma*
Atlantic Salmon	*Salmo salar*
Pacific Cod	*Gadus macrocephalus*
Walleye Pollack	*Theragra chalcogramma*
Rougheye Rockfish	*Sebastes aleutianus*
Pacific Ocean Perch[1]	*Sebastes alutus*
Redbanded Rockfish	*Sebastes babcocki*
Shortraker Rockfish	*Sebastes borealis*
Silvergray Rockfish	*Sebastes brevispinis*
Dusky Rockfish	*Sebastes ciliatus*
Yellowtail Rockfish	*Sebastes flavidus*
Shortbelly Rockfish	*Sebastes jordani*
Quillback Rockfish	*Sebastes maliger*
Black Rockfish	*Sebastes melanops*
China Rockfish	*Sebastes nebulosus*
Tiger Rockfish	*Sebastes nigrocinctus*
Yelloweye Rockfish	*Sebastes ruberrimus*
Harlequin Rockfish	*Sebastes variegatus*
Silverspotted Sculpin	*Blepsias cirrhosus*
Coastrange Sculpin	*Cottus aleuticus*
Spinyhead Sculpin	*Dasycottus setiger*
Buffalo Sculpin	*Enophrys bison*
Red Irish Lord	*Hemilepidotus hemilepidotus*
Brown Irish Lord	*Hemilepidotus spinosus*
Bigmouth Sculpin	*Hemitripterus bolini*
Shaggy Sea Raven	*Hemitripterus villosus*
Northern Sculpin	*Icelinus borealis*
Pacific Staghorn Sculpin	*Leptocottus armatus*

TABLE 3-5: FISH FOUND IN GLACIER BAY NATIONAL PARK AND PRESERVE

Common Name	Scientific Name
Great Sculpin	*Myoxocephalus polyacanthocephalus*
Sailfin Sculpin	*Nautichthys oculofasciatus*
Tidepool Sculpin	*Oligocottus maculosus*
Tadpole Sculpin	*Psychrolutes paradoxus*
Soft Sculpin	*Psychrolutes sigalutes*
Smooth Lumpsucker	*Aptocyclus ventricosus*
Pacific Spiny Lumpsucker	*Eumicrotremus orbis*
Kelp Greenling	*Hexagrammos decagrammus*
Rock Greenling	*Hexagrammos lagocephalus*
Masked Greenling	*Hexagrammos octogrammus*
Whitespotted Greenling	*Hexagrammos stelleri*
Lingcod	*Ophiodon elongatus*
Sablefish	*Anoplopoma fimbria*
Alaskan/Threespine Stickleback	*Gasterosteus aculeatus*
Pacific Saury	*Cololabis saira*
Searcher	*Bathymaster signatus*
Northern Ronquil	*Ronquilus jordani*
Pacific Pomfret	*Brama japonica*
Jack Mackeral	*Trachurus symmetricus*
Kelp Clingfish	*Rimicola muscarum*
Crescent Gunnel	*Pholis laeta*
Quillfish	*Ptilichthys goodei*
Snake Prickleback	*Lumpenus sagitta*
Pacific Sandfish	*Trichodon trichodon*
Prowfish	*Zaprora silenus*
Northern Smoothtongue	*Leuroglossus schmidti*
Pacific Sand Lance	*Ammodytes hexapterus*
Northern Lampfish	*Stenobrachius leucopsarus*
Arrowtooth Flounder	*Atheresthes stomias*
Slender Sole	*Eopsetta exilis*
Petrale Sole	*Eopsetta jordani*
Flathead Sole	*Hippoglossoides elassodon*
Pacific Halibut	*Hippoglossus stenolepis*
Starry Flounder	*Platichthys stellatus*
Yellowfin Sole	*Plewonectes stellatus*
Rock Sole	*Lepidosetta bilineata*

[1] Lenz et al. (2001) do not list this species as "present in park"; however, it does have essential fish habitat in the park.

Source: Lenz et al. 2001.

Pelagic Species. Pelagic species live and feed in the open sea; they are associated with the surface or middle depths of a body of water (FishBase 2003). Pelagic fishes include the salmon species during their oceanic phase, as well as the various forage fishes and other mid-water and surface-dwelling species. Thirty-one species were found in mid-water trawls, 12 of which previously had not been documented for Glacier and Dundas Bays (Litzow et al. 2002). Pelagic species were often a dominant group among the fish collected in beach seines in the West and East Arms, and the lower and middle portions of Glacier Bay (Robards et al. 2002). Samples from the lower Bay in June 1999 contained mostly pink salmon (85%), with the rest made up of demersal fishes. The catches in August 2000 contained only 20% pink salmon, with an additional 39% coming from herring and sand lance. Samples from the middle Bay in June 1999 contained at least 91% pelagic species, while pelagic fish in the August 2000 sampling comprised at least 98% of the catch. Samples from the West and East Arms typically contained greater percentages of demersal fishes mixed with the pelagic species, and the samples from June and July 2000 also contained greater proportions of demersal fishes in all areas sampled. An exception was the East Arm in August 2000, where 90% of the catch was pelagic species, with sand lance predominating.

Litzow et al. (2002) listed capelin, walleye pollock, Pacific herring, and northern lampfish *(stenobrachius leucopsarus)* as the most common pelagic species caught in Glacier Bay, accounting for 89% of the mid-water catches.

Capelin — Capelin has been reported as the most abundant species caught in mid-water trawls in Glacier and Dundas Bays (Litzow et al. 2002). Capelin, a type of smelt, has an elongated, slender body, and is typically found from the surface to a depth of 655 feet (200 meters). Capelin migrate to nearshore areas to spawn on sandy beaches. They appear to spawn in upper Glacier Bay, as large numbers of young-of-year capelin were caught in these areas (Robards et al. 2002). Capelin are a very important prey item for a broad range of fishes, marine mammals, and seabirds (Sturdevant 1999).

Walleye pollock — The walleye pollock also is a common species reported from mid-water trawls in Glacier and Dundas Bays (Litzow et al. 2002). The walleye pollock is a member of the cod family *(Gadidae)*. Although found in open water, pollock are also commonly reported from bottom trawls. Walleye pollock also have been reported from beach seines in several park locations, with high concentrations in upper Glacier Bay (Robards et al. 1999); however, they were seldom captured in beach seines in 1999 and 2000 by Robards et al. (2002). Most pollock netted by Robards et al. (1999) were larval. Pollock feed on various crustaceans, herring, and sand lance. They are one of the most important commercial species in the North Pacific Ocean and Bering Sea. Pollack are also an important prey species of humpback whales.

Pacific herring — Pacific herring are fairly common species caught in mid-water trawls in Glacier and Dundas Bays. Pacific herring is a schooling species found in coastal and offshore waters and is important to commercial and subsistence fisheries in Alaska and western Canada (Litzow et al. 2002). Herring are seasonally abundant along the coast of Alaska. Adult Pacific herring have been reported from beach seines at several locations along the shorelines in the middle region of Glacier Bay (Robards et al. 1999). Herring spawn along the coastline in intertidal and shallow subtidal zones (Mecklenburg et al. 2002) by depositing eggs on eelgrass, seaweed, rocks, pilings, or other substrates (Clemens and Wilby 1961). The nearest known major spawning ground is at Auke Bay, approximately 50 miles (80 kilometers) east of Glacier and Dundas Bays (O’Clair and O’Clair 1998). The Alaska Department of Fish and Game (ADF&G) has not identified any locations within park waters for herring spawning (O’Clair and O’Clair 1998). When abundant, they form an important part of the diets of large predatory fishes and marine mammals, such as humpback whales.

Northern lampfish — Northern lampfish are members of the lanternfish family *(Myctophidae)*. Lampfish are equipped with photophores and other luminous tissue that can produce a variety of colors and light patterns. They are of particular importance as forage fish because of a very high fat content, which may be as high as 10 times the fat level of other forage fishes, such as capelin or sand lance (Van Pelt et al. 1997, cited in Robards et al. 2002). Lampfish are typically found in deeper water during the day and rise toward the surface at night. They occasionally are found in salmon stomachs (Clemens and Wilby 1961). They may also be an important prey source to predators in Glacier Bay because of unique oceanographic conditions (Robards et al. 2002). Apparently because of either high turbidity or high productivity near some glacier faces, they are found in the near-surface water column during the day, where they are more available to predation, especially by birds.

Other pelagic species — Other pelagic species in Glacier Bay and Dundas Bay include two additional forage fishes: eulachon *(Thaleichthys pacificus)* and Pacific sand lance *(Ammodytes hexapterus)*. Eulachon are members of the smelt family, and enter large rivers to spawn in fresh water. They are preyed upon by Chinook salmon, fur seals, and a variety of other marine vertebrate predators. The Pacific sand lance feed on plankton and in turn are preyed upon by salmonids, lingcod, halibut, and many other fish species (Clemens and Wilby 1961). They tend to live in clean sandy substrates, coming out of the sand to feed. Sand lance were found throughout Glacier Bay, with the highest concentrations in the middle region, followed by the upper region (Litzow et al. 2002).

Demersal Species. Demersal fishes are found lying on the bottom or living on or near the bottom and feeding on benthic organisms (FishBase 2003). Most demersal fishes found in Glacier Bay and Dundas Bay are members of the skates, cods, rockfishes, sculpins, and flatfishes. Most of these fish lack a swim bladder, leaving them negatively buoyant.

Skates — Skates (family *Rajidae*) are demersal members of a group of vertebrates with a skeleton of cartilage rather than bone, and have been found in Glacier and Dundas Bays (Lenz et al. 2002; Litzow et al. 2002). The *Rajidae* is a large skate family whose members inhabit marine waters nearly worldwide, but are most common in cold temperate to tropical regions (Mecklenburg et al. 2002). Skates live on the bottom in waters near shore to depths of more than 9,840 feet (3,000 meters). They feed on benthic invertebrates and fishes. The longnose skate *(Raja rhina)* has been reported in Glacier and Dundas Bays (Litzow et al. 2002). This species is usually found at depths from 180 to 1,150 feet (55 to 350 meters) on muddy or sandy bottoms. They likely feed on clams and other large invertebrates that may be found on soft substrates. The roughtail, big, and starry skates are found in park waters, while the Aleutian, Bering, and Alaska skates are probably found in the park, but their presence has not been confirmed (Lenz at al. 2002).

Cod — Members of the cod family found in the park include Pacific cod *(Gadus macrocephalus)* and walleye pollock. The Pacific cod is a schooling species, typically found over sand or gravel bottoms in 150 to 600 feet (46 to 183 meters) of water. They typically move to deep water for spawning in the late fall and winter, then return in spring to shallower water for feeding. Common prey items include crustaceans and fish. The walleye pollock is discussed in the pelagic fishes subsection because they are often found in mid-water.

Rockfish — Rockfish are members of the family *Scorpaenidae*. Approximately 30 rockfish species in the genus *Sebastes* inhabit Alaskan waters; they usually populate rocky areas in shallow to moderately deep water, although some species may be found in silty and sandy areas (Mecklenburg et al. 2002). They are a free-swimming species, but are often found close to substrate. Little is known of the breeding habits of rockfishes in Glacier and Dundas Bays, but the presence of larger individuals of some rockfish species in the Bays, and the fact that many species of rockfishes have internal fertilization (Clemens and Wilby 1961) suggest that spawning may occur in the Bay. Four species of rockfishes — rougheye *(Sebastes aleutianus)*, vermilion *(S. miniatus)*, yelloweye *(S. ruberrimus)*, and quillback *(S. maliger)* rockfishes — have been identified in park waters (Litzow et al. 2002; Bishop et al. 1995; NPS 1998a). The rougheye rockfish is found in areas with gently sloping substrates and boulders, and on seamounts. The vermilion rockfish is found on rocky reefs and seamounts, usually deeper than 590 feet (180 meters; Mecklenburg et al. 2002). The yelloweye and quillback rockfish are the most commonly reported rockfish from longline catches in Glacier Bay and adjacent waters (Bishop et al. 1995; NPS 1998a). Other species of rockfishes may also be found in Glacier and Dundas Bays, but are likely to be more common in other areas of the park along the outer coast. Large rockfish often prey upon smaller ones, and many rockfish species are sought after in commercial and sport fisheries in Southeast Alaska, but few are known to occur in Glacier Bay or Dundas Bay.

Sculpins — Numerous species of sculpins in several families have been reported for Glacier and Dundas Bays (Litzow et al. 2002). Sculpins are found from shallow tidepools to waters of considerable depth. Six species of sculpins were reported from bottom trawls in Glacier and Dundas Bays during summer 2001: spinyhead sculpin *(Dasycottus setiger)*, thorny sculpin *(Icelus spiniger)*, armorhead sculpin *(Gymnocanthus galeatus)*, blackfin sculpin *(Malacocottus kincaidi)*, northern sculpin *(Icelinus borcalis)*, and ribbed sculpin (*Triglops pingelii*; Litzow et al. 2002). Yellow and brown Irish lords (*Hemilepidotus jordani* and *H. spinosus*) were the most common sculpins caught in longline surveys (Bishop et al. 1995).

Spinyhead sculpin are found on soft bottoms, usually at depths ranging from 165 to 985 feet (50 to 300 meters), although they also may be found in shallower and deeper waters (Mecklenburg et al. 2002). The northern and blackfin sculpin also are reported to be present, but are not common (Litzow et al. 2002). The remaining sculpin species reported by Litzow et al. (2002) for Glacier and Dundas Bays are in the family *Cottidae*, the largest of the sculpin families. Lenz et al. (2002) list more than 50 species of cottids as either present or probably present in Glacier and Dundas Bays. The thorny sculpin is found at bottom depths of 30 to 770 meters, although more commonly from 150 to 350 meters. The armorhead sculpin is found on soft bottoms near shore to a depth of 580 meters, although it is most common at depths between 50 and 165 meters (Mecklenburg et al. 2002). The ribbed sculpin is found on sand, pebble, gravel, and rocky bottoms, most frequently at depths of 20 to 150 meters.

Flatfish — The flatfishes in Alaska are in two families: the small family *Paralichthyidae*, which includes sand flounders (or sanddabs), and the larger *Pleuronectidae* (or righteye flounders), which includes flounders, sole, and halibut. Flatfish have highly compressed bodies. Pacific halibut *(Hippoglossus stenolepis)* is the only commercially important flatfish in Glacier Bay. Lenz et al. (2002) list 20 species of flatfishes as present or probably present in Glacier and Dundas Bays. The most common species reported in bottom trawls in Glacier and Dundas Bays were rex sole *(Glyptocephalus zachirus)*, flathead sole *(Hippoglossoides elassodon)*, rock sole *(Lepidopsetta bilineata)*, slender sole *(Lyopsetta exilis)*, and Dover sole (*Microstomus pacificus*; Litzow et al. 2002).

Because of its commercial value, the Pacific halibut is the most high-profile demersal fish species in the park area. Halibut are found on a variety of bottom types. Bishop et al. (1995) reported a significantly higher abundance of halibut on rock and sand substrates than other substrate types in Glacier Bay. Halibut range from shallow water to depths of 1,100 meters, although they are usually found in depths shallower than 300 meters (Mecklenburg et al. 2002). Bishop et al. (1995) reported that halibut in park waters occurred over the entire depth range of their sampling (0 to 325 meters) and that length increased with increasing depth for fish caught from 0 to 250 meters, and decreased thereafter. Young halibut feed mainly on small crustaceans, and as the fish mature, the diet changes to a wide variety of fish species (Hooge and Taggart 1996). Halibut also feed on crabs, clams, squid, and other invertebrates (Clemens and Wilby 1961). Tagging studies in Glacier and Dundas Bays indicate an age-related shift in home range patterns (Hooge et al. in prep.). Juvenile halibut move widely, although often still within the Glacier Bay and Dundas Bay area, while large, sexually mature fish exhibit smaller home ranges, which are often less that 0.5 square kilometer. Occasionally, large halibut alter their pattern of small-home-range use and travel widely before returning to a more sedentary pattern; a few individuals appear to never establish home ranges. More than 95% of halibut tagged in park waters were recaptured within Glacier Bay, indicating a high degree of site fidelity.

Pacific Salmon Species. Five species of salmon occur in the waters of the Glacier Bay and Dundas Bay area. The steelhead trout *(Oncorhynchus mykiss)*, a rainbow trout that spends much of its life in salt water, also is found in the waters of Glacier Bay. These species occur along the Pacific coast of North America, from Southern California to the Arctic coastline of Alaska (Mecklenburg et al. 2002; Groot and Margolis 1991; Morrow 1980). These are anadromous species that spend most of their lives in marine waters, but spawn in fresh water. Salmon are important components of the commercial, subsistence, and sport fisheries in Alaska.

Chinook salmon — Chinook, or king, salmon *(Oncorhynchus tshawytscha)*, is the largest-bodied species of the group. Any occurring in Glacier Bay or Dundas Bay are presumably foraging or moving through the area, because they are not known to breed in the streams in either Glacier Bay or Dundas Bay (ADF&G 2002a). Orsi and Jaenicke (1996) identify Southeast Alaska marine waters as an important nursery area for "an amalgam of pre-recruit Chinook salmon stocks originating from Oregon to Alaska." The relative importance of the park's marine waters in this respect is not well known.

Coho salmon — Coho salmon *(O. kisutch)* are known to occur in most streams in Glacier and Dundas Bays (Soiseth, pers. com.). Coho salmon return to natal streams to spawn from mid-summer to winter depending on geographic location. Coho salmon generally spawn in short coastal streams, including several that drain into park waters. Timing for the spawning in park streams is not well known. The fry feed on a variety of food types, including terrestrial insects, aphids, mites, beetles, spiders, and zooplankton. As the young fish grow, they consume larger prey that may include young sockeye salmon. Generally, coho salmon spend one to two years in fresh water before moving to the sea. As the young fish move into the sea, they remain close to shore, feeding on crustaceans. As they grow larger, they move offshore and feed on larger prey, particularly herring and sand lance. In the southern part of their range, coho salmon generally stay close to the shore, while northern populations spread out across the North Pacific and Bering Sea. After two to three years in the ocean, they return to natal streams to spawn.

Pink salmon — Pink salmon *(O. gorbuscha)* migrate to spawning streams between June and September, depending on geographic location. Spawning is typically in tidal areas at the mouths of streams or in streams near the coast. Fry emerge from the gravel in the spring and almost immediately migrate downstream to marine waters. At first, they remain near the coast or in estuaries, where they feed on copepods and larvacean tunicates. As they become larger, pink salmon feed on amphipods, euphausiids, and fish. Pink salmon from the southern part of the range tend to remain closer to the coast during the marine portion of their lives than Alaskan populations, which range across most of the northeast Pacific Ocean. After about 18 months at sea, the adults return to natal streams, although pink salmon demonstrate less site fidelity to natal streams than other salmonid species (Morrow 1980). Use of intertidal areas and streams entering Glacier and Dundas Bays for spawning has been documented for pink salmon, but the extent of use is not well known; however, most park streams accessible to salmonids probably contain pink salmon (Soiseth and Milner 1995).

Sockeye salmon — Sockeye salmon *(O. nerka)* were identified in one-fourth of the streams in Glacier and Dundas Bays (ADFG 2002a). They typically spawn in lake habitats or in streams connected to lakes. Most fry rear one to two years in lake systems before smolting and emigrating to the marine environment. While in fresh water, the fry feed on ostracods, cladocerans, and insect larvae. Once in marine waters, they stay close to shore and feed on zooplankton, insects, and small fish. As they grow, the young fish move out to sea and feed on fish, especially sand lance. They typically return to their natal lake or stream to spawn at four or five years of age.

Chum salmon — Chum salmon *(O. keta)* were found in almost one-half of the streams in Glacier and Dundas Bays (ADFG 2002a). They generally spawn later than most other salmonids, with spawning activity peaking in September and October (Morrow 1980). In most populations, chum salmon do not migrate far upstream and only one run per season is evident. Young chum fry emerge from the spawning gravels during late winter and early spring and begin their migration downstream. They remain close to shore for several months after reaching salt water, feeding on small crustaceans, terrestrial insects, and young herring. As they grow, their diet changes to copepods, tunicates, euphausiids, squid, and various fish species. Adult chum salmon return to spawn after three to five years at sea.

Essential Fish Habitat. Essential fish habitat (EFH) is defined in the Magnuson-Stevens Fishery Conservation and Management Act (Public Law 94-265) as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (see table 3-6). Essential fish habitat is designated by the NOAA Fisheries for species managed under existing fishery management plans to assist in maintaining sustainable fisheries (see figure 3-10).

TABLE 3-6: SPECIES WITH ESSENTIAL FISH HABITAT IN GLACIER BAY AND DUNDAS BAY

Common Name	***Scientific Name***
Skate	*Raja spp.* and *Bathyraja spp.*
King Salmon[a]	*Oncorhynchus tshawytscha*
Sockeye Salmon[a]	*O. nerka*
Coho Salmon[a]	*O. kisutch*
Pink Salmon[a]	*O. gorbuscha*
Chum Salmon[a]	*O. keta*
Pacific Cod	*Gadus macrocephalus*
Rougheye Rockfish	*Sebastes aleutianus*
Yelloweye Rockfish	*S. ruberrimus*
Shortraker Rockfish	*S. borealis*
Dusky Rockfish	*S. ciliatus*
Pacific Perch	*S. alutus*
Sculpin	*Cottidae* family
Walleye Pollock	*Theragra chalcogramma*
Sablefish	*Anoplopoma fimbria*
Rock Sole	*Lepidopsetta bilineata*
Pacific Halibut[b]	*Hippoglossus stenolepis*

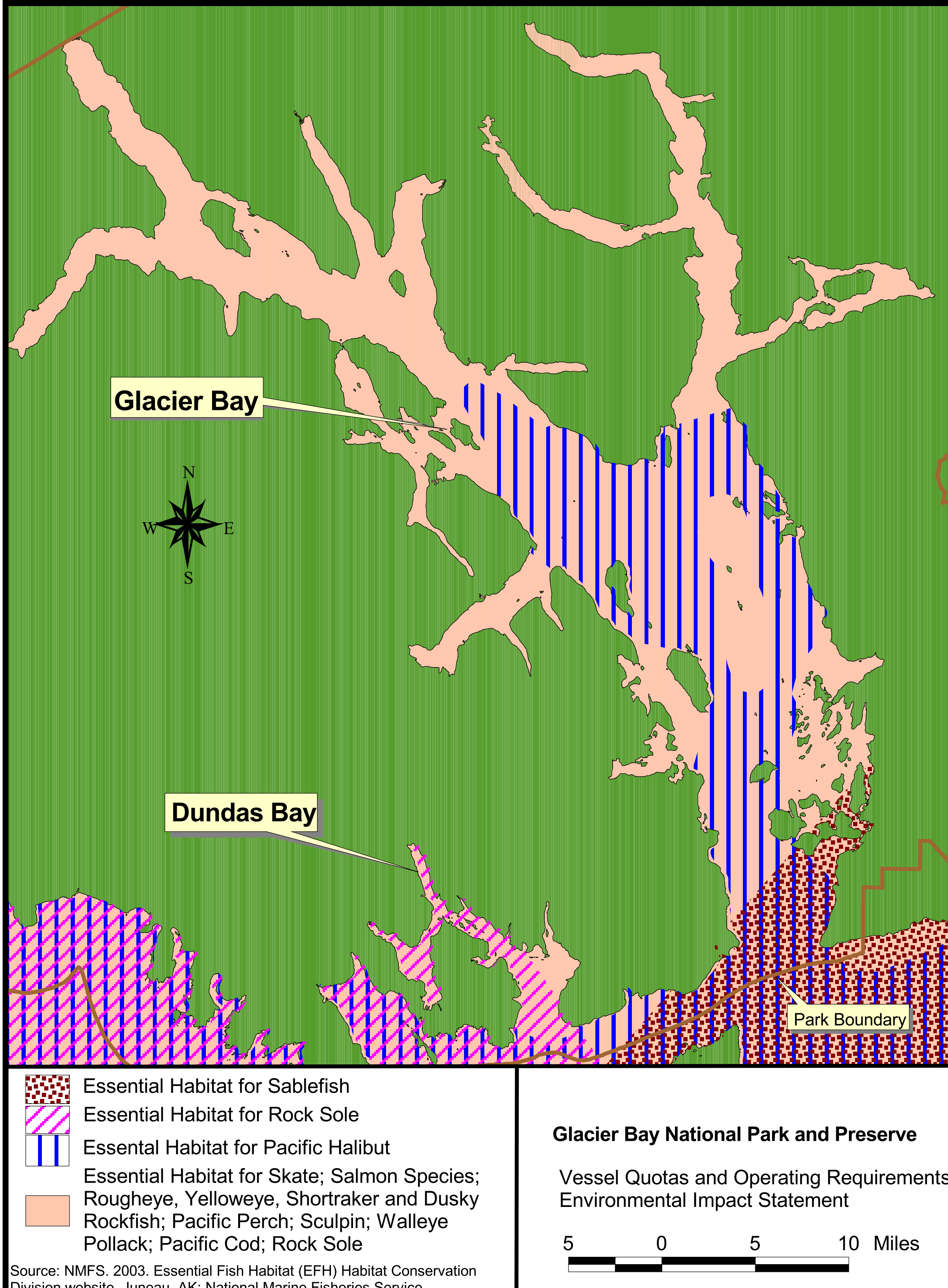
[a] Determined by the Alaska Department of Fish and Game, not NOAA Fisheries.
[b] Determined by the International Pacific Halibut Commission, not NOAA Fisheries.

Source: NOAA Fisheries 2003.

Essential Fish Habitat in Glacier Bay and Dundas Bay

National Park Service
U.S. Department of the Interior

Figure 3-10



3.3.5 Coastal/Shoreline Environmental and Biological Communities

3.3.5 Coastal/Shoreline Environment and Biological Communities

This subsection describes the physical composition of the Glacier Bay and Dundas Bay shorelines and then discusses the biological communities that inhabit these shorelines.

Coastal Geomorphology. The coastal geomorphology of Glacier Bay was shaped by the glaciers that formed the Bay. The last glacial advance in Glacier Bay started approximately 4,000 years ago and is known as "the Little Ice Age." Around 750 A.D., Glacier Bay was completely covered by a glacier that was more than 4,000 feet (1,219 meters) thick and an estimated 20 miles (32 kilometers) or more wide. During this time, the glacier extended more than 100 miles (160 kilometers) to the St. Elias Mountain Range. As recently as 250 years ago, ice or ice-generated outwash (material deposited by melting glaciers) covered the entire watershed from the headlands through the Sitakaday Narrows. The glacial retreat continues today on the Bay's east and southwest sides; however, Johns Hopkins and Gilman Glaciers on the western side of Glacier Bay are advancing (NPS 1983; Hooge and Hooge 2002).

Glaciers are not the only powerful force acting on the Glacier Bay shoreline. While glaciers originally shaped the Bay, powerful and large low-pressure weather systems from the Gulf of Alaska dominate the climate. Seasonal storms bring wind and waves that change the shore structure and material size. The dominant wind direction for the Gustavus Airport is northwest-southeast, which roughly corresponds to the north-south wind direction expected in the main body of Glacier Bay. Wind requires sufficient duration, intensity, and fetch (open water) in order to create waves. The main body of Glacier Bay has "open water" fetches that are similar to the open ocean, where there are no obstructions to the wind, such as trees or mountains. Glacier Bay also has many narrow passages or inlets that are not oriented to the wind direction. In these cases, wave growth is fetch limited and large waves often cannot be generated, regardless of the intensity or duration of a storm.

Dundas Bay also was formed by glacial advances and retreats. It is likely that the Brady Glacier once covered the Dundas Bay area; however, Dundas Bay has been free of ice for much longer than Glacier Bay, as is evident with forests more than 400 years old. One archeological site is 800 years old, which indicates that Dundas Bay has been free of ice for at least that amount of time. Today, Dundas Bay is largely influenced by glacial meltwater and is considered shallow for larger vessels. Dundas Bay also is subject to the large low-pressure weather systems from the Gulf of Alaska (NPS 2002k; Geiselman et al. 1997).

In addition, earthquakes, tsunamis, and landslides can act to shape the Glacier Bay and Dundas Bay shoreline. Rebound also alters the sea level. Rebound occurs after a glacier retreats. A glacier may grow to several thousand feet thick, and, over many thousands of years, the weight of the ice compresses the Earth's crust beneath it. As the glacier melts and retreats, this weight is removed, and the land mass gradually rebounds. This slow process may take several hundreds or thousands of years. The rate of rebound in Glacier Bay is 2 inches per year, greater than the region's average rebound rate of 1 inch per year (NPS 2002k).

Much of Dundas Bay has a north-south orientation. Dundas Bay is very windy, which would be expected in the main channel because of the orientation of the channel and the wide mouth that would not limit wind exposure to the Bay.

The recent and relatively rapid deglaciation of Glacier Bay over the past 250 years has resulted in a wide range of shoreline structure in a relatively short distance. The shoreline structure ranges from bedrock to a mudflat. For coastal geomorphological purposes, the shoreline vertical gradient ranges from the extreme low waterline to the extreme high waterline (up to 25 vertical feet or 7 to 8 vertical meters). According to the NPS coastal resources inventory, the shoreline slopes range from very gentle (3 to 9 degrees) to very steep (vertical in locations). Extreme tidal ranges in the Bay are up to 25 feet (7.6 meters; Sharman et al. 2002).

The coastal geomorphological structure of Glacier Bay is complex. Figure 3-11 shows the substrate type, slope, and erosion potential for 22 selected sites within Glacier Bay. The Bay's southern portions have the most beaches containing sands with small particle sizes and mature terrestrial vegetation (see figure 3-12). From an ecological and geomorphic perspective, shorelines in these areas are more mature than the remainder of the Bay. That is, areas near the mouth of Glacier Bay are older geomorphologically because they have experienced the most weathering since the glaciers retreated, and as a result, particles are smaller and soil has begun to develop. With the breakdown of particle size, plants can take root. Farther north, toward the head of the Bay, the shoreline structure is less geologically mature, with fewer beaches or only small pocket beaches; more exposed rock outcrops; and little, if any, terrestrial vegetation (see figures 3-13 and 3-14). Terrestrial vegetation found in the middle and northern portions of the Bay includes a significant component of pioneer species, those species that colonize areas after a disturbance. At the terminus of the glaciers, exposed bedrock overlain by sediment is prevalent because of recent glacial activity and the subsequent sediment deposition (see figure 3-15). The terrestrial vegetation in periglacial areas is sparse and restricted to hardy pioneer species.

The beaches of Glacier Bay's eastern shores comprise smaller particles than those of the western shores. The eastern shores contain sands, gravels, and pebbles, with shallow-sloping beaches, ranging from 3 to 9 degrees. The western shores of the Bay's main body and of the West Arm contain beaches dominated by cobbles, boulders, and bedrock, and the shoreline is steeper than the eastern shore, with typical slopes ranging from 12 to 32 degrees (Sharman et al. 2002).

Dundas Bay generally has gently sloping shores (approximately 14 degrees), but does contain some steep slopes (80 degrees). The size of sediment also tends to be smaller in Dundas Bay than in Glacier Bay, with wider beaches, especially along the far northeast and southwest shores. These wide beaches mostly comprise silt and fine sand (Sharman et al. 2002).

Biological Communities. Intertidal biological communities are exposed to the air for part of each tidal cycle, and submerged for the remainder of the cycle. Glacier Bay's shoreline habitats are a combination of rocky and soft substrates that can be separated by wave shock exposure and tidal elevation (Ricketts and Calvin 1968; O'Clair and O'Clair 1998). The shoreline community lives in the intertidal zone between the highest and lowest tides. This runs in Glacier Bay from approximately 21 feet (6.4 meters) above mean lower low water (MLLW) to approximately 5 feet (1.5 meters) below mean lower low water. Mean lower low water is the average of the lower of the two daily low tides, making it the tidal elevation below which the water surface seldom falls. Sharman et al. (1995) found that water temperature, salinity, amount of suspended sediment, and ice scour are key factors controlling intertidal biological community development, and that all of these variables are directly related to the proximity of the site to tidewater glaciers. In general, community diversity in rocky intertidal communities close to tidewater glaciers is very low. The amount of time since glacial retreat from the site appears to be of little importance.

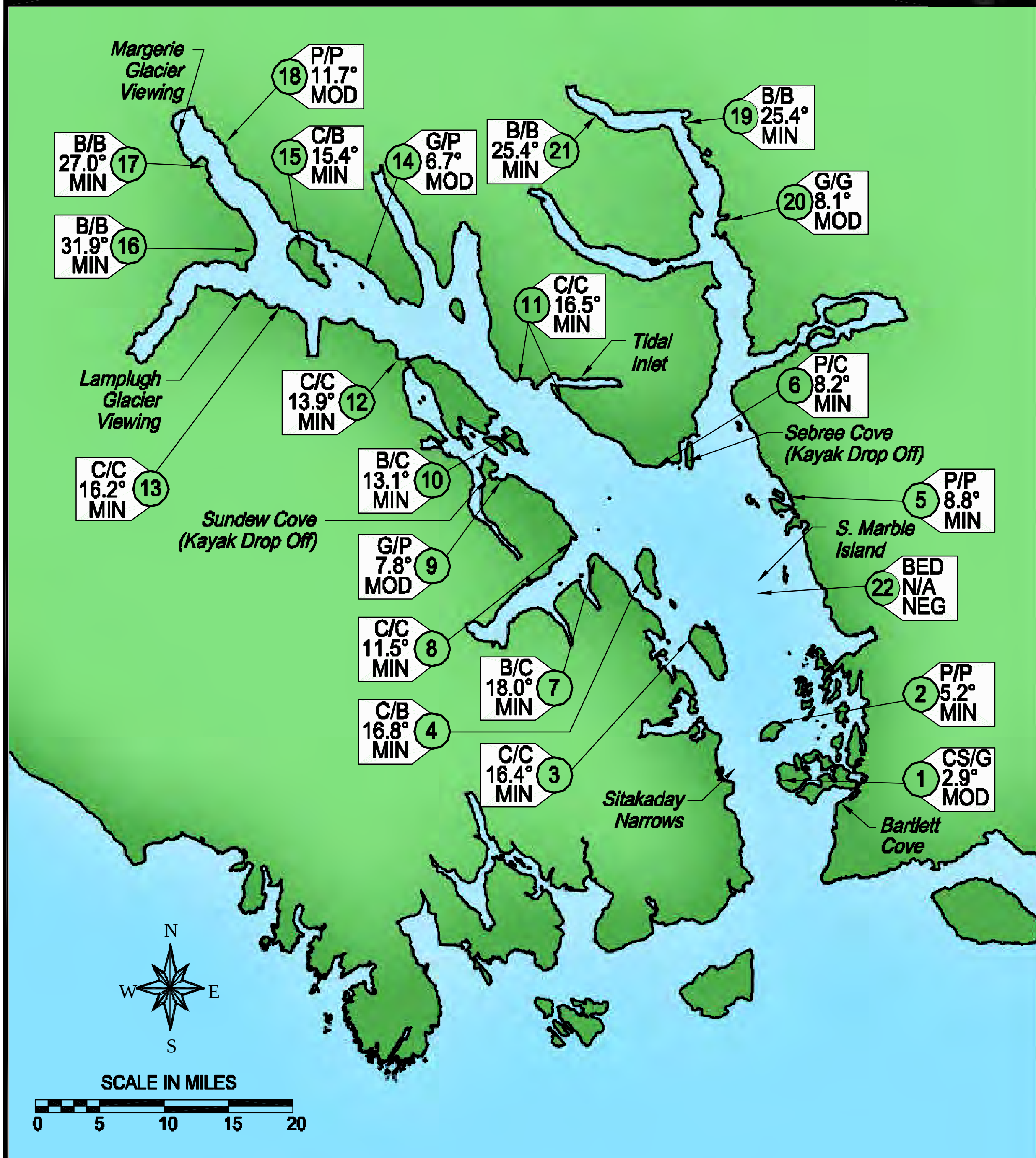
Habitat types in this discussion are limited to rocky and soft types, rather than a more elaborate separation, such as that described by Ricketts and Calvin (1968), which includes such sub-groups as mud flats and sand flats among the soft bottom types. Many of the rocky substrates have well-developed communities that are easy to recognize because they form obvious bands across a uniform tidal height. Soft substrate communities contain a predominance of infaunal organisms (organisms that live within the sediments, such as clams and worms).

Rocky intertidal — Rocky intertidal shorelines are dominated by stable rock surfaces, either bedrock or cobbles and boulders large enough to remain static during normal storm events. Rocky intertidal substrate consists of greater than 1% bedrock or greater than 75% cobble and boulders with a slope of 60 degrees or less (Irvine et al. 2001).

Shoreline Characteristics at 22 Selected Sites in Glacier Bay

Figure 3-11

National Park Service
U.S. Department of the Interior



KEY

2 P/P 5.2° MIN

- Primary Substrate/ Secondary Substrate
- Shore Slope in Degrees
- Substrate Erodability Potential
- Site Number

ABBREVIATIONS

BED	Bedrock
B	Boulder
C	Cobble
G	Granule
P	Pebble
CS	Coarse Sand
N/A	Not Available
NEG	Negligible
MIN	Minor
MOD	Moderate

Glacier Bay National Park and Preserve

Vessel Quotas and Operating Requirements
Environmental Impact Statement

Figure 3-12 Example of Mature Beach in Glacier Bay
Gravel and sand beach with mature vegetation

Figure 3-13 Example of a Less Mature Beach in Glacier Bay
Gravel and cobble beach with boulders

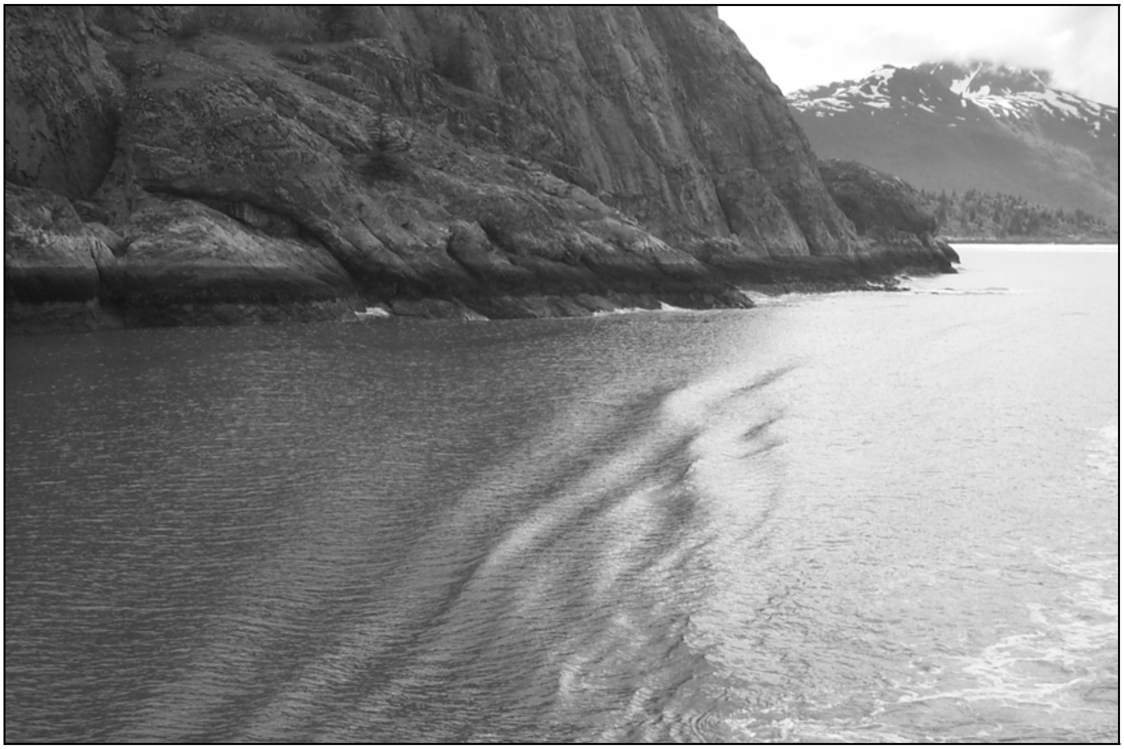


Figure 3-14 Bedrock Shoreline

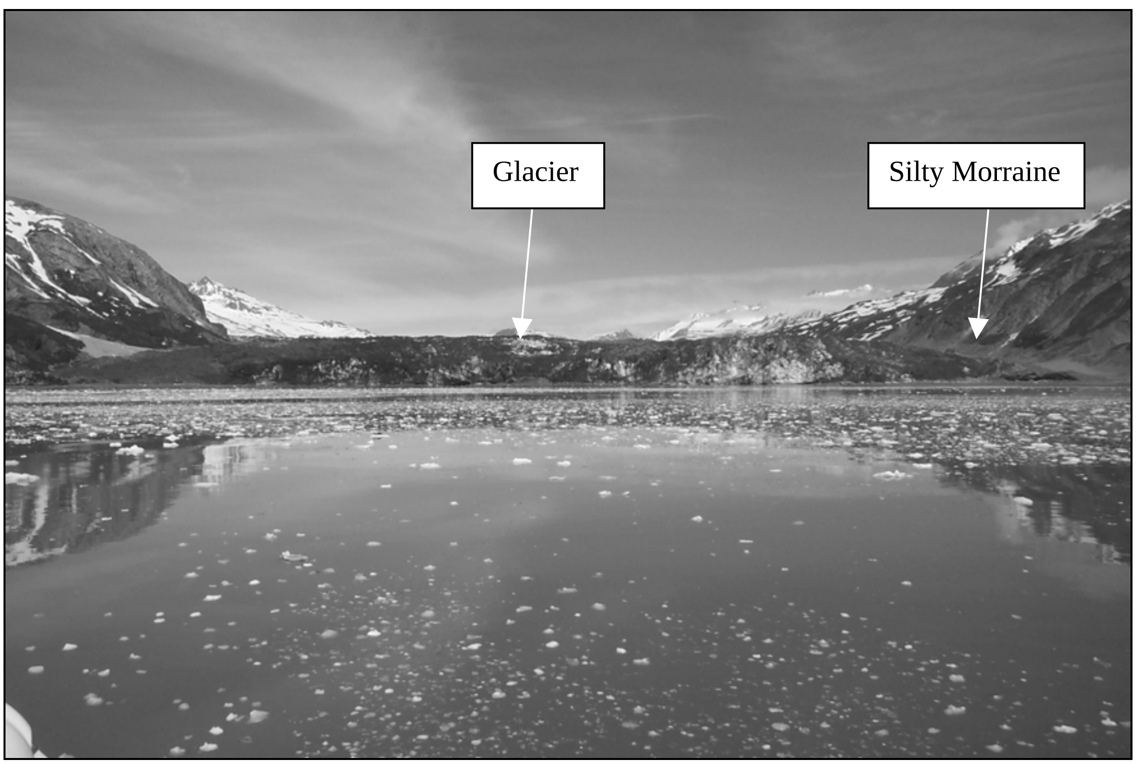


Figure 3-15 Glacier Terminus with Silty Lateral Morraines

Three intertidal levels have been identified for rocky intertidal substrates in Southeast Alaska (O'Clair and O'Clair 1998). The upper intertidal at Auke Bay, 50 miles (80 kilometers) east of the park, runs from approximately 21 feet (6.4 meters) above mean lower low water to 15 feet (4.6 meters). This elevation band is often dry because of extended periods above the tide level. The mid-intertidal range, between 15 feet (4.6 meters) above mean lower low water and 8 feet (2.4 meters) above mean lower low water, is seldom above the water surface long enough to dry completely. This zone is covered by tides regularly, with both daily high tides normally inundating it. The low intertidal level ranges from 8 feet (2.4 meters) above mean lower low water to 5 feet (1.5 meters) below mean lower low water. Moderate (neap) tides may not uncover this zone, and it is almost always wet when uncovered during the low tides. These habitats and their tidal heights are similar to those found in Glacier and Dundas Bays.

The following biological discussion of the species inhabiting Glacier Bay is based mainly on the coastal resources inventory (Sharman et al. 2002). Additional information comes from O'Clair and O'Clair (1998) and Irvine et al. (2001). Typically, few species inhabit the upper intertidal, because of the harsh conditions present, the difficulty of adapting to freshwater and seawater conditions, desiccation, and the large temperature changes that occur over the course of a typical tide change. The most common algae are the stringy green *Enteromorpha intestinalis* and encrusting "sea tar" spores of the red alga, *Mastocarpus papillatus*. The most common invertebrates are a small snail, the Sitka periwinkle *(Littorina sitkana)*, and an isopod *(Ligia pallasii)*.

Rockweed *(Fucus gardneri)*, barnacles (the common acorn barnacle, *Balanus glandula*; the northern rock barnacle, *Semibalanus balanoides*; the thatched barnacle, *S. cariosus*; and the little brown barnacle, *Chthamalus dalli*), and Pacific blue mussels *(Mytilus trossulus)* dominate the mid-intertidal shorelines of Glacier Bay (Sharman et al. 2002; Irvine et al. 2001). Barnacles were found in 97.6% of the shoreline segments of Glacier Bay that were cataloged, while mussels were identified in 95.9% of the segments. Rockweed was identified in 97% of the segments. All of these organisms permanently attach themselves to rocky substrate. Species locations across the mid-intertidal zone are controlled by the frequency with which they are wetted by the tides and by wave action. They typically form pronounced vertical bands of one or more species across the mid-intertidal zone.

Rockweed forms a short canopy that provides protection for other algae and for a wide variety of invertebrates. It is resistant to drying and can tolerate a wide salinity range from nearly fresh water to undiluted sea water. Its high tolerance to physical stressors makes rockweed particularly suitable to colonize the intertidal zone of Glacier Bay. Rockweed's most common grazers are periwinkles (*Littorina sitkana* and *L. scutulata*) and the rockweed isopod *(Idotea wosnesenskii)*. Other algae typically found in the mid-intertidal zone include several species of green algae (*Enteromorpha spp*. and *Ulva fenestrata*) and brown and red algae (sea moss, *Endocladia muricata*; rockweed brush, *Odonthalia spp.*; and Oregon pine, *Neorhodomela oregona*). Compared to rockweed, the distribution of these algae is patchy and total biomass is much less.

Barnacles are found from the upper reaches of the intertidal zone to the subtidal zone, but most commonly occur in the mid-intertidal. Species location is determined by physical conditions within their range. The common acorn barnacle is found in the high to mid-intertidal, the northern rock barnacle is found in the mid-intertidal, the thatched barnacle is found from the mid-intertidal into the shallow subtidal, and the little brown barnacle is found from the high intertidal to the low intertidal. All barnacles are active filter feeders, sweeping their cirri (feeding arms) through the water to collect minute food particles suspended in the water when covered by the tide. They are common prey for snails, sea stars, ribbonworms, and occasionally bears.

Large beds of Pacific blue mussels are found in the mid-intertidal zone. The mussel's foot produces elastic (byssal) threads that it uses to attach to rocks or other hard surfaces, such as wharf pilings. The upper edge of their vertical range is limited by water coverage and feeding time during inundation, over each tidal cycle. The lower edge is most likely limited by predators, many of which live in the low intertidal zone or even subtidally and move upward to feed during high tides. Among the mussel's predators are several sea stars (the mottled star, *Evasterias troschelii*; the six-armed star, *Leptasterias spp.*; and probably the sunflower star, *Pycnopodia helianthoides*). Other predators include snails (*Nucella lima* and *N. lamellosa*), various crabs, surfperches, diving ducks, shorebirds, gulls, crows, and mammals (sea otter, *Enhydra lutris*; river otter, *Lutris canadensis*; mink, *Mustela vison*; and occasionally black and brown bear, *Ursus americanus* and *Ursus arctos*).

The mid-intertidal zone contains a wide variety of other invertebrates. In addition to the dominant invertebrate species already discussed, the most common invertebrates found in the intertidal environment include anemones, snails, worms, crabs and other arthropods, sea stars, and clams. One anemone *(Anthopleura artemisia)* is frequently encountered. Table 3-7 lists the most common snails, worms, clams, and crustaceans.

TABLE 3-7: COMMON SNAILS, WORMS, CLAMS, AND CRUSTACEANS FOUND IN THE MID-INTERTIDAL ENVIRONMENT IN GLACIER BAY NATIONAL PARK AND PRESERVE

Common Name	Scientific Name
Snails	
Sitka periwinkle	*Littorina sitkana*
checkered periwinkle	*L. scutulata*
file dogwinkle	*Nucella lima*
frilled dogwinkle	*N. lamellose*
barnacle-eating onchidoris	*Onchidoris bilamellata*
northwest onchidella	*Onchidella borealis*
Pacific falselimpet	*Siphonaria thersites*
Worms	
many-eyed ribbonworm	*Amphiporus angulatus*
purple ribbonworm	*Paranemertes peregrine*
pileworm	*Nereis vexillosa*
scaleworm	*Harmothoe imbricate*
tuskworm	*Pectinaria granulate*
tubeworms	order *Sabellida*
Clams	
hiatella clams	*Hiatella spp.*
Pacific littleneck clam	*Prototheca staminea*
butter clam	*Saxidomus gigantean*
tellina clams	*Macoma spp.*
nuttall cockle	*Clinocardium nuttallii*
Mya clams	*Mya spp.*
Crustaceans	
crabs	*Hemigrapsus spp.*
hermit crabs	*Pagurus spp.*
isopods	*Idotea wosnesenskii*
amphipods	*Spinulogammarus subcarinatus*

The shield limpet *(Lottia pelta)* is the most common limpet. Other snails, other limpet species, top snails, whelks, and chitons may also be locally abundant. Several worms are common in the mid-intertidal zone, mostly on or in sand or gravel beneath cobbles and boulders. Worms are common and important members of the biological community. The most common echinoderm is the six-rayed sea star, *Leptasterias hexactis*. The clams are found in quiet areas with sufficient soft sediment to bury themselves.

The low-intertidal zone is dominated by encrusting coralline algae and kelps. The dominant coralline alga in the area has been tentatively identified as rock crust, *Lithothamnion phymatodeum* (O'Clair and Lindstrom 2000). Another dominant alga is *Alaria marginata*, the heavy ribbon kelp. In some areas, these two species may provide almost complete coverage of the low intertidal zone. The coralline algae directly cover most available substrate, including invertebrates and some algae, while the ribbon kelp provides an overstory that maintains habitat for many species of algae and invertebrates. Other common algae include green algae (sea lettuce, *Ulva fenestrata / Ulvaria obscura*, *Enteromorpha spp.*, and *Acrosiphonia spp.*) and red algae (*Porphyra spp.*, *Palmaria spp.*, *Neorhodomela spp.*, *Mastocarpus papillatus*, and *Polysiphonia/Pterosiphonia spp.*). Another common, but not dominant, marine plant is the red alga cup and saucer *(Constantinea rosa-marina)*, which occurs as scattered individual plants.

The most common invertebrates in the low intertidal zone include sponges, anemones, snails and other gastropods, bryozoans, worms, amphipods (beach hopper) and other arthropods (crabs and shrimps), echinoderms (sea stars, sea cucumbers, and urchins), and tunicates. The most common sponges, snails, worms, and echinoderms are listed in table 3-8.

TABLE 3-8: COMMON SPONGES, SNAILS, WORMS, AND ECHINODERMS FOUND IN THE LOW-INTERTIDAL ENVIRONMENT IN GLACIER BAY NATIONAL PARK AND PRESERVE

Common Name	Scientific Name
Sponges	
crumb-of-bread sponge	*Halichondria panice*
boring sponge	*Cliona celata*
red volcano sponge	*Acarnus erithacu*
purple encrusting sponge	*Haliclona permollis*
Snails	
black Katy	*Katharina tunicata*
lined chiton	*Tonicella lineata*
ringed blind limpet	*Cryptobranchia concentrica*
plate limpet	*Tectura scutum*
puppet margarite	*Margarites pupillus*
variegated lacuna	*Lacuna variegata*
Columbian cucumber sucker	*Vitriolina columbiana*
shag-rug aeolis	*Aeolidia papillosa*
Worms	
serpulids	*Pseudochitinopoma occidentalis*
spirorbids	*Paradexiospira vitrea*
pileworm	*Nereis vexillosa*
Echinoderms	
mottled star	*Evasterias troschelii*
morning sun star	*Solaster dawsoni*
daisy brittle star	*Ophiopholis aculeata*
green sea urchin	*Strongylocentrotus droebachiensis*
Alaska tar-spot cucumber	*Cucumaria vegae*
white sea cucumber	*Eupentacta pseudoquinquesemita*

The sponges are found in the low intertidal, especially near the lower boundary, as well as in subtidal habitats. The Christmas anemone *(Urticina crassicornis)* is the most common anemone. Of the few other anemone species that occur, most are *Anthopleura spp*. Several of the clam species also are found in the low intertidal (hiatella, Pacific littleneck, and butter clam), where there is sufficient fine sediment. Amphipods and other arthropods are represented by the pink beach hopper *(Maera danae)* and the stout coastal shrimp *(Heptacarpus brevirostris)*.

Soft substrates — The soft intertidal substrates in Glacier Bay are areas of net sediment deposition (more sediment settles than is removed by currents or wave action). These substrates occur in areas protected from strong currents or high waves and in the vicinity of stream mouths. The sediment source may be direct settling from the water column, or the sediment may arrive from longshore transport of sediments deposited elsewhere.

Invertebrates dominate the soft substrates in the intertidal zone. The lack of stable surfaces large enough for attachment severely limits the colonization of algae on these shorelines. Where present, the most common algae are rockweed and sugar kelp *(Laminaria saccharina)*. Clams and worms are typically the most common invertebrates, both groups living in the sediments. Bodkin and Kloecker (1999) reported 10 species of clams in Glacier Bay. Eight of the species identified were fairly common to abundant and are listed in table 3-9.

TABLE 3-9: COMMON CLAMS FOUND IN THE SOFT SUBSTRATE ENVIRONMENT IN GLACIER BAY NATIONAL PARK AND PRESERVE

Common Name	**Scientific Name**
heart cockle	*Clinocardium nuttallii*
Arctic niatella	*Hiatella arctica*
Macoma clam	*Macoma balthica*
Macoma clam	*M. nasuta*
softshell clams	*Mya spp.*
Pacific littleneck clam	*Prototheca staminea*
butter clam	*Saxidomus gigantean*
fuzzy clam	*Pseudopythina compressa*

Only one California sunset clam was found during the Bodkin and Kloecker (1999) study. Several of these clams, particularly the heart cockle, the butter clam, and the Pacific littleneck clam, are collected occasionally by recreational fishers in many areas because of their size; however, the *Macoma* species, which are typically much smaller, are the most abundant members of the group.

A separate study by Mueller (1973), reported in Bodkin and Kloecker (1999), listed four additional species of clams from Glacier Bay. They identified *Axinopsida serricata*, *Nuculana minuta*, *Panomya ampla*, and Greenland cockle *(Serripes groenlandica)*. Data regarding worm and other burrowing species found in the park are limited.

Robards et al. (1999) reported large catches of invertebrates in beach seine nets at several soft sediment sites within the park. They reported numerous amphipods from beach seine nets near Carroll Glacier and numerous euphausiids (krill) from the nets close to the Grand Pacific and Reid Glaciers. These crustaceans are likely to be important food sources for forage fishes and other marine fishes in upper Glacier Bay and are known to be important humpback whale prey. Eelgrass *(Zostera marina)*, which is restricted to the lower Bay, was the only vascular marine plant found on soft substrates, and it was very uncommon, occurring in only 0.3% of the sections of the cataloged shoreline.

3.4.1 Cultural Resources

3.4 HUMAN ENVIRONMENT

3.4.1 Cultural Resources

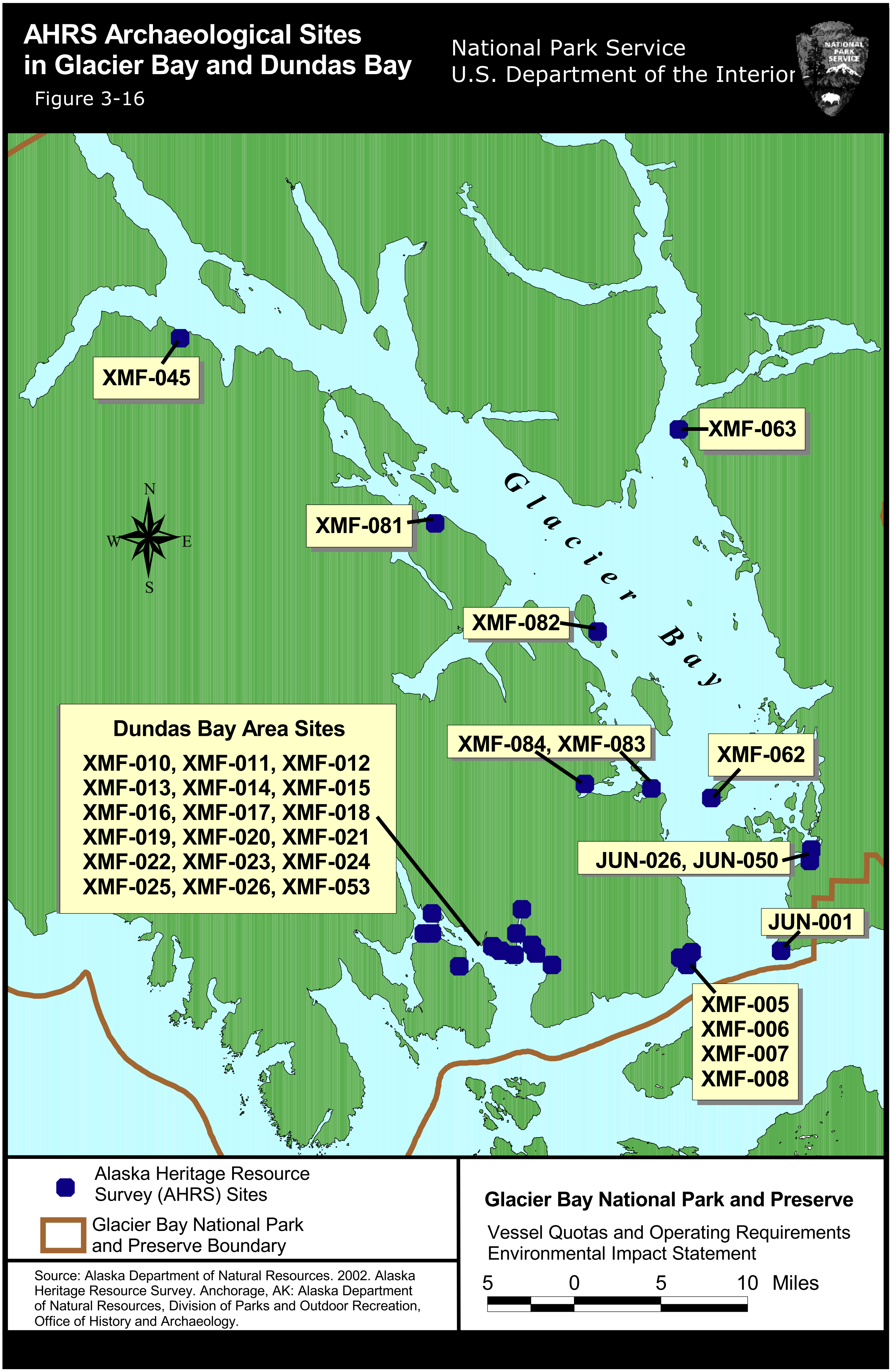
This subsection describes the cultural resources (e.g., archeological resources, historic structures ethnographic resources, and the cultural landscapes) for the park and preserve. This discussion does not represent a comprehensive description of the park, but focuses on the information necessary to assess potential effects of the alternatives on archeological sites, historic structures, ethnographic resources, and cultural landscapes in Glacier and Dundas Bays.

The administrations at all national parks, including those established mainly for their natural or recreational resources, have responsibilities to identify “historic properties” potentially affected by undertakings (NPS et al. 1995). The data regarding existing cultural resources include information from the Alaska Heritage Resource Survey (AHRS) from the Alaska Office of History and Archaeology (Alaska Department of Natural Resources [ADNR] 2002), as well as existing literature, and NPS inventories and literature.

Archeological Resources. The Park Service defines archeological resources as “the remains of past human activity and records documenting the scientific analysis of these remains” (NPS 1997a). For the purposes of this analysis, archeological resources refer to prehistoric Native American cultural resources including lithics, faunal material, and features (e.g., house pits and hearths), and historic archeological resources of Native American and Euro-American origins (e.g., the remains of Tlingit occupation, the remains of canneries or salteries and their associated artifacts [fallen structures, fish traps, pilings, and boats], the remains of homesteads and their associated artifacts [fallen cabins, stoves, and outhouses], the remains of mining and associated artifacts [fallen structures, mine shafts, and equipment], the remains of fox farming [fallen structures and fences], the remains of agriculture [garden plots or fields and equipment], and other fallen structures or cultural remains).

The locations of the archeological resources in Glacier Bay and Dundas Bay are identified in figure 3-16. Archeological resources that have been found, or can be expected to occur, in the park are diverse and include:

- petroglyphs and petrographs.
- culturally modified trees.
- rock shelters.
- villages (defensive and open layout).
- forts.
- fishing sites and weirs.
- hunting and gathering sites (e.g., camps, processing sites, lookouts, kill sites, and plant gathering areas).
- stone cairn formations.
- mining camps.
- canneries.
- trading posts.
- log cabins.
- trails.
- horticulture sites.
- buried sites.



AHRS Archaeological Sites
in Glacier Bay and Dundas Bay
Figure 3-16
National Park Service
U.S. Department of the Interior
XMF-045
XMF-063
XMF-081
Glacier Bay
XMF-082
N
W
E
S
Dundas Bay Area Sites
XMF-010, XMF-011, XMF-012
XMF-013, XMF-014, XMF-015
XMF-016, XMF-017, XMF-018
XMF-019, XMF-020, XMF-021
XMF-022, XMF-023, XMF-024
XMF-025, XMF-026, XMF-053
XMF-084, XMF-083
XMF-062
JUN-026, JUN-050
JUN-001
XMF-005
XMF-006
XMF-007
XMF-008
Alaska Heritage Resource Survey (AHRS) Sites
Glacier Bay National Park and Preserve Boundary
Source: Alaska Department of Natural Resources. 2002. Alaska Heritage Resource Survey. Anchorage, AK: Alaska Department of Natural Resources, Division of Parks and Outdoor Recreation, Office of History and Archaeology.
Glacier Bay National Park and Preserve
Vessel Quotas and Operating Requirements
Environmental Impact Statement
5 0 5 10 Miles

- major/multi-component sites.
- cemeteries or burials.
- intertidal or submerged cultural remains (Schoenberg 1999).

Geologic dynamics — glacier advance and retreat, and isostatic depression and rebound — make finding archeological sites difficult. Glacier advance and retreat (e.g., the Little Ice Age peaking in approximately 1750) have potentially removed any evidence of archeological sites before 400 years ago in Glacier Bay. Isostatic rebound (the rising of land after the removal of glacial weight as the glacier retreats) in lower Glacier Bay has resulted in the land lifting at a rate of 1.2 to 1.6 inches (3 to 4 centimeters) per year. For example, previously coastal landforms such as the "Spruce Terrace," a post-Little Ice Age beach remnant located 9 to 16 feet (2.7 to 4.9 meters) above modern sea level, are receding from the coast because of this rebound (Mann and Streveler 1997, cited in Schoenberg 1999). Many of these landforms have not been surveyed for archeological sites, but have the potential to contain sites dating from the early Holocene (e.g., 9,000 years ago) through the historic period. Dundas Bay, Icy Strait, Excursion Inlet, and the outer coast of the park were not glaciated during the Little Ice Age, and landforms that could have supported human occupation and activity in coastal areas have survived (Mann and Streveler 1997). Because of the park's maritime nature, archeological sites likely would be found along or near the coastlines. Exceptions include Tlingit ceremonial sites situated on several mountaintops (below 3,000 feet [914 meters] in elevation), Euro-American mining and fur trapping sites, and trails or trade routes.

The following discussion summarizes prehistoric Native American and historic Euro-American and Tlingit archeological resources in the park in Glacier and Dundas Bays (see table 3-10). Identified sites are followed by AHRS numbers in parentheses that, for ease of locating the sites, correspond to codes in table 3-10 and figure 3-16.

TABLE 3-10: ALASKA HERITAGE RESOURCE SURVEY AND NATIONAL PARK SERVICE ARCHEOLOGICAL SITES IN GLACIER AND DUNDAS BAYS

AHRS #	Site Name	Location	Site Type	Period/Date	Citation
JUN-001	Wuckitan Sib House	Pt. Gustavus (Strawberry Point)	reported lineage house, but not located by Ackerman	Historic, Tlingit	Ackerman 1965:1-2 Ackerman 1968:90 Crowell 1995; SAIP
JUN-026	Lester Island Village (Bartlett Cove, Bushmann Saltery, *Gatheeni*)	South shore of Lester Island	Bushmann Saltery AD1883-1910; cemetery (7 graves); village (4 rect. pits); garden plot	Historic, Tlingit/ Euro-American (AD pre-1885-1900)	Ackerman 1964:2-5 Ackerman 1968:89 Sealaska 1975:766-767 NPS Archeological Survey 002-93-GLBA Kurtz 1995:46
JUN-050	Bartlett Cove Pilings and Site	Bartlett Cove	warehouse; pilings (55); saltery installed by Bushmann (1899)-never completed	Historic, Euro-American (AD1899)	Ackerman 1968:91, Figure 25 NPS Archeological Survey 002-93-GLBA Kurtz 1995:48
XMF-005	Point Carolus	Southwest of Pt. Carolus	2 large oval pits, poss. cache pits	Historic	Ackerman 1964:17 Ackerman 1968:89
XMF-006	Carolus River Smokehouse 1	Near mouth of Carolus River	smokehouse, collapsed building	Historic, Tlingit	Ackerman 1964:14 Ackerman 1968:89
XMF-007	Carolus River Village	Carolus River	three log cabins, smokehouse, historic debris, axe-cut trees	Historic, Tlingit	Ackerman 1964:6-14 Ackerman 1968:89 Sealaska 1975:751

TABLE 3-10: ALASKA HERITAGE RESOURCE SURVEY AND NATIONAL PARK SERVICE ARCHEOLOGICAL SITES IN GLACIER AND DUNDAS BAYS

AHRS #	Site Name	Location	Site Type	Period/Date	Citation
XMF-008	Carolus River Smokehouse 2	Carolus River	smokehouse ruin on pilings w/ assoc. historic items	Historic, Tlingit	Ackerman 1964:14-17 Ackerman 1968:89
XMF-010	Harbeson Cabin 2 (Dundas Bay Cabin)	East shore of Dundas Bay	cabin (modern)	Historic	Ackerman 1964:17 Ackerman 1968:89
XMF-011	Harbeson Cabin 1	Northeast shore of Dundas Bay	cabin, mink pens, salmon smoking shed	Historic	Ackerman 1964:17 Ackerman 1968:89
XMF-012	White Cabin	Northeast shore of Dundas Bay	cabin, river punt	Historic, Tlingit	Ackerman 1964:17 Ackerman 1968:89
XMF-013	Listi (Dundas River Village) ("Tlistee" [DeLaguna])	Dundas River	outdoor fire pit; possible sweatbath; 2 houses; concrete grave capstone (AD1917); historic artifacts	Historic, Tlingit (late 1880s)	Ackerman 1968:8-11 Ackerman 1964:17, 23 Sealaska 1975:758-759 NPS Archeological Clearance Survey Form 001-87-GLBA DeLaguna, F. 1990b:Fig. 1, p. 204
XMF-014	Harbeson Trail Cabin	East bank of Dundas River (N end of XMF-013)	cabin and assoc. artifacts	Historic	Ackerman 1968:89 Ackerman 1964:17 NPS Archeological Clearance Survey Form 001-87-GLBA
XMF-015	Dundas River Cemetery (Christian cemetery)	Near mouth of Dundas River	27 graves w/ gravestones, grave fences, and collapsed grave houses	Historic, Tlingit (AD1901-1928)	Ackerman 1968:89 Ackerman 1964:21-27 Sealaska 1975:756-757
XMF-016	Tlingit Smokehouse (Dundas Bay Cemetery)	Dundas River	log pilings for a house (central hearth), historic items, burial	Historic, Tlingit (AD1900s)	Ackerman 1968:89 Ackerman 1964:17-23 Sealaska 1975:754-755
XMF-017	Olsen Cemetery	Near mouth of Dundas River	cemetery (3 burials)	Historic, AD1919	Ackerman 1968:89 Ackerman 1964:17
XMF-018	Dundas Bay Rock Shelter (Canoe Rock Shelter)	Near mouth of Dundas River	rock shelter, dugout canoe	Protohistoric/ Historic, Tlingit	Ackerman RE 1968:89 Ackerman 1964:27-30
XMF-019	Dundas Bay Fish Trap 1	Near mouth of Dundas River	floating fish trap (Dundas Bay Cannery)	Historic, Euro-American	Ackerman 1968:89 Ackerman 1964:31
XMF-020	Old Dundas River	West of Dundas River	small shack w/ wood burning stove; gasoline drum; historic litter; log foundation	Historic	Ackerman 1968:89 Ackerman 1964:29
XMF-021	Doc Silver Cabin 1	Near Dundas River	cabin and dock	Historic, Euro-American	Ackerman 1968:89 Ackerman 1964:31
XMF-022	Doc Silver Cabin 2	Near Dundas River	cabin site and flagpole	Historic, Euro-American	Ackerman 1968:90 Ackerman 1964:31

TABLE 3-10: ALASKA HERITAGE RESOURCE SURVEY AND NATIONAL PARK SERVICE ARCHEOLOGICAL SITES IN GLACIER AND DUNDAS BAYS

AHRS #	Site Name	Location	Site Type	Period/Date	Citation
XMF-023	Dundas Bay Fish Trap 2	Near Dundas River	floating fish trap and heavy pilings (Dundas Bay Cannery)	Historic, Euro-American	Ackerman 1968:90 Ackerman 1964:31
XMF-024	Dundas Bay Fish Trap 3	Near Dundas River	floating fish trap and heavy pilings (Dundas Bay Cannery)	Historic, Euro-American	Ackerman 1968:90 Ackerman 1964:31
XMF-025	Dundas Bay Cannery	West shore of Dundas Bay	cannery (sheds, docks, boilers, steamboats, company houses)	Historic, Euro-American AD1890-1930s	Ackerman 1968:90 Ackerman 1964:31
XMF-026	Beached Boats	West shore of Dundas Bay	equipment, boats (Dundas Bay Cannery)	Historic, Euro-American	Ackerman 1968:90
XMF-045	Leroy Mine (Parker Prospect, Mount Parker Mine)	East of Lampugh Glacier	Gold Mine Camp - sealed mine shaft	Historic, Euro-American AD1937-1952	ADP 3330-6N file Kurtz 1995:41-43
XMF-053	Village/Fort, Tlingit	Dundas Bay	village/fort w/ middens	Prehistoric/ historic (6420+/-120BP - 120+/-50BP)	Crowell 1995; SAIP
XMF-062	Strawberry Island Fox Farm	Strawberry Island	fox farm (frame house, log house, barn, fox pens, skinning and cooking sheds)	Historic, Euro-American AD1927	Ackerman 1964:5 Ackerman 1968:91 Kurtz 1995:57-58
XMF-063	John Muir Cabin	Muir Point, below mouth of Adams Inlet	pre-fabricated cabin John Muir research base	Historic, Euro-American AD1890	Ostrogorsky, M. AHRS Site Card Gilbert, GK 1910 (Harriman AK Series Vol. III) Kurtz 1995:20-27
XMF-081	Surveyor Camp	Hugh Miller Inlet	camp	Historic, Euro-American AD1906-1908	Howell 1997 survey, cited in Schoenberg 1999
XMF-082		Drake Island	fort platform	Historic	Howell 1997 survey, cited in Schoenberg 1999
XMF-083	Fort Tlingit (X'atadaa Noowu)	Berg Bay	fort platform	Historic	Howell 1997 survey, cited in Schoenberg 1999
XMF-084	Berg Bay Village	Berg Bay	2 houses	Historic (late 1890s-early 1900s)	Howell 1997 survey, cited in Schoenberg 1999

Sources: 1) AHRS files, Office of History and Archeology, Anchorage, Alaska
2) Schoenberg 1999 (DRAFT): Appendix

SAIP = Systemwide Archeological Inventory Program.

Prehistoric resources — Humans have occupied the Glacier Bay area for thousands of years (Ackerman 1968). The oldest dated site in the park vicinity is Ground Hog Bay. The site was occupied beginning 9,000 years ago and is located on the north shore of Icy Strait between Excursion Inlet and Lynn Canal approximately 30 miles (48 kilometers) southeast of present-day Gustavus (Ackerman 1968).

The only dated prehistoric site within the park is *Xakwnoowu* (XMF-053; see table 3-10 and figure 3-16). This site shows almost continuous occupation for the past 800 years, with one date suggesting an earlier occupation 6,400 years ago (Crowell 1995). Several fort platforms on a hill above the historic component of the village of *L'istee* (XMF-013) on the east shore of the Dundas River (see table 3-10 and figure 3-16) may be prehistoric in age, although they have not been firmly dated. Because of increased conflict in the Northwest Coast cultural area around 1,300 years ago, Tlingits began to build forts and defensive village sites in Southeast Alaska (Schoenberg 1999). Three of these types of sites in the park (a fort/village [XMF-053] and two forts [XMF-083 and XMF-082]) occurred between 200 and 400 years ago (Schoenberg 1999; see table 3-10 and figure 3-16).

Protohistoric/historic Tlingit resources — Additional coastal villages and camps are located in Glacier and Dundas Bays, range in age from protohistoric (at or before the time of European contact) to the early 20th century, and include:

- Lester Island Village/*Gatheeni* (JUN-026).
- Point Carolus (XMF-005).
- Carolus River Village (XMF-007).
- Dundas River Village/*Listi*/*Tlistee* (XMF-013).
- Dundas Bay Rock Shelter (XMF-018).
- Tlingit Smokehouse / Dundas Bay Cemetery (XMF-016).
- Berg Bay Village (XMF-084; see table 3-10).

Historic Euro-American resources —
<u>European exploration.</u> European explorers who visited the Glacier Bay region between 1741 and 1794 included Alexei Cherikof, James Cook, Jean-Francoise de Galaup, Comte Le Perouse, and George Vancouver. There are no known records of exploration in and around the waters of Glacier Bay between 1795 and 1867 (Kurtz 1995). The late 19th and early 20th centuries were a period of American exploration and scientific investigation in the Glacier Bay area. Early scientific expeditions used Huna Tlingit guides and reported Huna Tlingit subsistence camps throughout the Bays. One archeological remnant of this era of American exploration and scientific investigation is a base camp near Muir Glacier (John Muir Cabin [XMF-063]), built in 1890 by John Muir and Harry F. Reid.

<u>Resource utilization.</u> Resource utilization in Glacier Bay has included mining, commercial and subsistence fishing, hunting, plant and egg gathering, timber harvesting, fox farming / fur harvesting, and agriculture/horticulture. Hard rock gold mining within the confines of the current park occurred mainly in the area between Reid Inlet and Lamplugh Glacier. The Leroy Mine (Parker Prospect, Mount Parker Mine [XMF-045]) was operated from the mid-1930s through the 1940s (see table 3-10 and figure 3-16). In the first half of the 20th century, mining operations also occurred on Willoughby and Francis Islands, at Blue Mouse Cove, at Sandy Cove, near Beartrack Cove, and in Dundas Bay. Remnants of some of these mining operations are still visible (e.g., rusted machinery, collapsing structures, and piles of mine tailings; Kurtz 1995). Remnants of the commercial fishing industry include:

- the Bartlett Bay Packing Company (JUN-026, JUN-050) operated from 1883 to 1910.
- a cannery at Dundas Bay (XMF-025) operated from 1890 to the 1930s.
- several fish traps (XMF-019, XMF-023, and XMF-024) and boats (XMF-026) associated with the Dundas Bay Cannery that have washed ashore.

Evidence of the importance of subsistence fishing among the Huna Tlingit includes numerous smokehouses that range in age from historic to modern and include Carolus River Smokehouses 1 and 2 (XMF-006 and XMF-008).

<u>Homesteading.</u> Homesteaders settled in the vicinity of the park at either Strawberry Point (Gustavus) or Dundas Bay beginning in 1914. Homesteaders at Gustavus noted the presence of a Huna Tlingit smokehouse on the Salmon River and a ceremonial house located at Point Gustavus. Remnants of homesteads in Glacier Bay include three different homesteads used by William Horseman (Doc Silvers) and his wife from 1928 through the early 1940s (XMF-021 and XMF-022) and several structures dating from the early 1930s to 1964 used by Stanley Harbeson (XMF-010, XMF-011, and XMF-014). Remains of the Silvers and Harbeson homesteads are currently visible. Homesteaders established fox farms on Beardslee, Strawberry (XMF-062), Cenotaph, and Willoughby Islands in the 1920s. Much of the Beardslee Islands enterprise is still visible (Kurtz 1995). Homesteaders sometimes evicted Huna Tlingit from their traditional use areas. Huna Tlingit applied for more than 20 allotments in what eventually became the national monument, and they maintained cabins and smokehouses on many of them (e.g., White Cabin [XMF-012]; see table 3-10 and figure 3-16).

Historic Structures. Historic structures are the remains of material assemblies that comprised the structures that housed humans and their activities in the historic past (NPS 1997a). These resources are those buildings still standing; if collapsed or otherwise open to the elements, they fall into the archeological resources category. The park's policy on historic structures is based on the 1984 *General Management Plan* (NPS 1984). The general management plan outlines a policy of "benign neglect," directing NPS personnel to allow all historic structures in the park to deteriorate naturally, eventually to be reclaimed by the landscape. It also recommends that such sites be managed as "discovery sites" with no on-site interpretation and no reconstruction or stabilization of the structure.

There are two exceptions to this policy. One is the Cape Spencer Lighthouse located inside park boundaries at Cape Spencer (outside the planning area). Built in 1924, the lighthouse is listed on the National Register of Historic Places, and is maintained by the U.S. Coast Guard (USCG). The other exception is the Glacier Bay Lodge complex. Completed in 1966 as part of a national initiative to build visitor facilities throughout the national park system, this award-winning building is potentially eligible for inclusion on the National Register of Historic Places. The Glacier Bay Lodge complex is the core of visitor facilities in Bartlett Cove, and is maintained under conditions of the Secretaries Standards for Historic Preservation by the Park Service and the parks concessioner. The general management plan for historic structures underwent section 106 compliance review in 1984, resulting in letters of concurrence of no effect from the state historic preservation officer and the Advisory Council on Historic Preservation to validate the determination that the park was using a proper management protocol.

For all parks, the Park Service maintains a List of Classified Structures (LCS), a comprehensive inventory of all historic and prehistoric structures in each park. Structures in this inventory may individually meet the criteria of the National Register of Historic Places or may be contributing elements of sites and districts that meet the register criteria. Other structures in the inventory may not be eligible for the National Register (e.g., moved, reconstructed, and commemorative structures, and structures achieving significance within the last 50 years; NPS 1997a).

Thirteen structures are currently included on the Glacier Bay List of Classified Structures: six graves and seven architectural features (NPS 1999b). The six graves are located within the Dundas River Cemetery (XMF-015) and are listed as being in "poor" condition. The site of these graves is eligible for the national register "as the only known cemetery in Dundas Bay that illustrates the intermingling of the Tlingit, Russian Orthodox, and Anglo-American cultures" (NPS 1999b).

Three of the LCS architectural features (Dundas Bay Cannery [XMF-025] and Harbeson Cabins 1 and 2 [XMF-011 and XMF-010]) are rated in "fair" condition (e.g., are still standing; NPS 1999). The remaining four architectural features — the boiler and ramp at the Dundas Bay Cannery and the Ibach Cabin and Shed in Reid Inlet (XMF-032) — are on the LCS listing as being in "poor" and ruinous condition (NPS 1999b).

The Harbeson Cabin and Woodshed (Cabins 1 and 2 [XMF-011 and XMF-010]) are eligible for the national register "as a physical remainder of early Anglo-American settlement and exploration of Dundas Bay in Glacier Bay National Park" (NPS 1999b). The Dundas Bay Cannery building, boiler, and ramp (constructed by Western Fisheries Co. of Portland in 1900 and operated until 1931) are eligible for the national register "as the only remaining physical representative of the three canneries that operated in what is now Glacier Bay National Park and Preserve" (NPS 1999b). The Ibach Cabin and Shed are eligible for the National Register as the "physical representative of the events that opened the park to mining and for association with J.P. Ibach and Rex Beach" (NPS 1999b). Additional structures that are not included on the List of Classified Structures are discussed in the "Archeological Resources" subsection and can be found in table 3-10 and in figure 3-16.

Ethnographic Resources. Ethnographic resources are "basic expressions of human culture and the basis for continuity of cultural systems" that "encompass[es] both the tangible and the intangible" (NPS 1997a). Ethnographic resources consist of traditional arts and Native languages, religious beliefs, special places in the natural world, structures with historic associations, natural materials and subsistence activities, and traditional cultural properties (NPS 1997a). The following subsections provide ethnographic information such as Huna Tlingit social organization, territory, and sacred sites, and describe the 15 traditional cultural properties within the park that are the physical sites on the ground that anchor the ethnographic resource.

Social organization — The Huna Tlingit people occupy much of the northern portion of Tlingit territory, and constitute one of 19 tribes or Kwaans (although the Huna Tlingits prefer the term Kaawoo). Among the Tlingit, social organization revolves around the membership of every individual in one of two moieties (i.e., either of two basic units that make up a social group): Raven or Wolf (southern Tlingit territory) / Eagle (northern Tlingit territory). These moieties are matrilineal (i.e., tracing ancestral descent through the maternal line) and exogamous (i.e., marrying outside the family, clan, or other social unit). Each moiety comprises multiple clans, and each clan, in turn, comprises lineages or house groups. Five clans trace their origins to specific places within the park. The Raven moiety L'ukna.xadi Clan originates in Dry Bay at the mouth of the Alsek River. A descendant of the L'ukna.xadi clan, the Takdeintaan clan, originated on Cenotaph Island in Lituya Bay on the outer coast of the park. Three Eagle moiety clans trace their origins to Glacier Bay: the *Chookaneidi* clan to Berg Bay on the west shore of Glacier Bay, the *Wooshkeetaan* clan to the Point Gustavus area, and the *Kaagwaantaan* clan to the lower portion of Glacier Bay.

Territory — The park encompasses approximately two-thirds of the traditional territory of the Huna Kaawoo (or tribe). Glacier Bay, along with the outer coast of the park and Dundas Bay, is the epicenter for the development of Huna Tlingit culture. Tlingit clans and houses have ownership of specific territories that often coincided with preferred subsistence use areas (e.g., salmon streams, hunting areas, and berry patches) or trade routes, and each clan or house often managed resources in its territory (Schroeder and Kookesh 1990).

Huna Tlingit territory includes all of the waters of Glacier Bay, Icy Strait, Port Frederick, and Tenakee Inlet, and parts of Cross Sound and Chatham Strait. The land area includes the coastal areas between Cape Fairweather and Khaz Bay in the west, and Point Howard and Basket Bay in the east (Schroeder and Kookesh 1990; Goldschmidt and Haas 1998). Various publications recount the Huna Tlingit history in Glacier Bay (e.g., Dauenhauer and Dauenhauer 1987; Swanton 1909; Bohn 1964, as cited in Schoenberg 1999). For example, Huna Tlingit oral history tells of a primary village in Bartlett Cove that was evacuated because of glacial advance. According to Chookeneidi legend, the village consisted of five named houses — Kaawagaani Hit, Woosh Keek Hit, Eech Hit, Naanaa Hit, and Xinaa Hit of the Chookaneidi clan — and a row of Raven moiety houses, unnamed in Chookaneidi legend. After the glacier entered Bartlett Cove, these houses evolved into three distinct clans (Dauenhauer and Dauenhauer 1987). According to Huna Tlingit oral history, after the evacuation from Bartlett Cove, one Huna Tlingit group moved to Excursion Inlet, another group moved to the Ground Hog Bay area, and another group moved to Spasski (on the south shore of Icy Strait, on the north shore of Chichagof Island) and possibly other places near the entrance of Port Frederick (Schroeder 1995; Dauenhauer and Dauenhauer 1987). Many of the names for these clan houses are used for clan houses in present-day Hoonah (e.g., *Kaagwaantaan / Kaawagaani Hit* — "The House that Burned," *Wooshkeetaan / Woosh Kik Hit Taan* — "Half of a House," and *Chookaneidi* — "People of the Grass"; Schroeder 1995; Dauenhauer and Dauenhauer 1987). According to one clan legend, the origin of the clan name *Chookaneidi* came from the name of a grass (chookan) and *Chookan Heeni* ("Grassy River") at the head of Berg Bay, where women harvested subsistence foods (Schroeder 1995; Dauenhauer and Dauenhauer 1987).

Subsistence — Traditionally, the Tlingit relied on a broad range of terrestrial and marine resources for subsistence. Terrestrial mammals of importance included bear, deer, mountain goats / sheep, and birds (including eggs; DeLaguna 1990). Marine mammals of importance included the harbor seal, sea lion, sea otter, and occasionally porpoise. The Huna Tlingit were expert sealers, and often traded skins and oil to other Tlingit. Glacier Bay was an excellent sealing ground because seals often hauled up onto the ice flows to give birth (DeLaguna 1990). The Tlingit harvested five species of salmon — Chinook, sockeye, pink, coho, and chum — and these provided the bulk of the Tlingit diet. Other important species included halibut, herring (fish and eggs), eulachon (for fish and oil), crabs, cod, shrimp, rockfish, octopus, and squid. The intertidal zone also provided an abundance of foods, including a variety of seaweeds, three species of clams (a mainstay winter food), chitons, and limpets. Plant foods also constituted an important component of the Tlingit diet, and consisted of a variety of beach greens in spring months, and eight species of berries harvested throughout summer and early fall. In historic times, the inner bark of trees also was harvested for its sweet starchy cambium layer.

Each Tlingit tribal area had at least one principal winter village, typically located in a sheltered bay with a sandy beach for landing and launching canoes, and convenient access to subsistence and resource areas (e.g., salmon streams, clamming areas, berry patches, hunting areas, fresh water, and timber resources). During the summer, families scattered throughout the tribal region to their respective hunting and fishing camps. The Huna Tlingit's annual cycle involved:

- hunting for seal, fishing for halibut, and gathering eggs and plants in the spring.
- trading, harvesting berries, fishing, and hunting for seal in the summer.
- fishing, hunting, and trapping in the fall.
- returning to the village in the winter for a season of potlatches, trading expeditions, crafts, and repair of fishing gear (DeLaguna 1990).

Sacred sites — The Huna Tlingit consider many specific, discreet places within the park to be sacred sites. The physical geography of Glacier Bay is imbedded within the social fabric of Huna Tlingit culture, a social geography in which the interactions of living individuals are predetermined by the place their ancestors occupied in the ancient landscape. The Huna Tlingit clans, through the generations, became symbolically identified with the places they had come to own and occupy and with the events that had validated that ownership. The symbols and their meanings are conveyed through the concept of *at.o'ow*, which is an "owned or purchased thing" (Dauenhauer and Dauenhauer 1987). The "thing" may be land (e.g., a geographic feature such as a mountain, a landmark, or a historical site), a heavenly body, a spirit, a name, an artistic design, an image from oral literature, a story or song about an event in the life of an ancestor, or ancestors themselves. The "purchase" may be made with money or trade, as collateral on an unpaid debt, through personal action, or through human life (Dauenhauer and Dauenhauer 1987). For example, "the name of *Kaasteen*, the land of Glacier Bay, the story and the songs, and the visual image of the Woman in the Ice are the property or *at.o'ow* of the *Chookaneidi* clan," because these *at.o'ow* were "purchased with the life of an ancestor" (Dauenhauer and Dauenhauer 1987). The land of Glacier Bay is "sacred because it was purchased with the blood of the people" (Dauenhauer and Dauenhauer 1987).

The symbols (or crests), stories/legends, songs, places, and animals meld and become *at.o'ow*. Some legends extend to the mythical past and recount the activities of Raven at the time the world was created, and identify certain landforms within the park that are relics resulting from the creative act. Many legends recount clan connections to Glacier Bay at a time before the Little Ice Age. Certain clan legends recount supernatural and historical events that play prominently in establishing clan identity. Animals that played prominently in those events and the places where the events occurred have transformed into symbols that serve to this day as heraldic crests that identify Huna Tlingit clans with those events, animals, and places.

Many legends also recount the deeds of revered ancestors. It is often the sacrifice of these ancestors' lives (sometimes voluntarily) that validate the clan's claims to certain places and establish the social and spiritual link of the clan to the place. One story belonging to the *Chookaneidi* clan tells of a young woman ("Woman in the Ice") who broke a taboo, the result of which caused a glacier to advance upon the village in Bartlett Cove. The glacial advance caused the forced evacuation of the village. The young woman offered to stay behind and sacrifice her life to pay for the misfortune of her people, but her grandmother stayed instead. The sacrifice cemented the claim of the *Chookaneidi* clan to Glacier Bay (Dauenhauer and Dauenhauer 1987). Another story belonging to the *Wooshkeetaan* clan tells of a terrible inter-tribal war in which the chief of an opposing clan was killed. The chief from the *Wooshkeetaan* clan offered his life in payment for the opposing chief's death. The chief's nephew (and successor) offered to die instead. Both the chief and his nephew walked out onto the beach and were killed by the opposing clan. This sacrifice purchased for the *Wooshkeetaan* an inalienable right to this stretch of Glacier Bay landscape.

The Huna Tlingit are spiritually linked to the roots of the Glacier Bay ecosystem, embodied in the concept of *Haa Shuka*. The Huna Tlingit believe that the immortal souls of their ancestors continue to dwell in Glacier Bay. These ancestors include various species of fish and wildlife that are endemic to Glacier Bay, and that gave birth to the original human ancestors.

The Huna Tlingits believe that it is imperative that the ancestral homeland remains unpolluted and that the subsistence food base remains pure. This belief has its roots in a concept termed *Haa Shagoon,* which ties the ancestral souls to living and future generations of Huna Tlingits. For example, a child may be given the name of an ancestor, and the soul of that ancestor resides in that child. The child proceeds to learn, as he/she practices Tlingit lifeways, the social connections the ancestor occupied in the past. In addition, the child may be called upon to act out the roles of the ancestor in ritual or everyday settings. Thus, the social fabric of the ancient Glacier Bay landscape is kept alive in modern society and, if the culture remains vibrant, is projected in perpetuity into the future. For the chain to remain unbroken, however, current and future generations must know and understand the stories behind the ancestral names, and they must know the places to which the names and events are attached. Huna Tlingits believe that the best way for them to do this is to visit the sites and carry out meaningful activities that facilitate the transfer of traditional knowledge. Traditionally, much of this information sharing occurred throughout the course of the yearly subsistence cycle. Current legal restrictions on activities within the park have resulted in limitations placed on the Huna Tlingit traditional yearly subsistence cycle. While the Huna Tlingits are allowed access to the park, they participate only in those subsistence activities allowed by park regulations.

The Huna Tlingits believe Glacier Bay to be the cradle of their culture. It is the place where the animals, mountains, and ice took human form; the place that gave identity to their clans; and the place that gives order to their social relations, currently and into the distant future. Glacier Bay has sustained them nutritionally and spiritually for countless generations. The Huna Tlingits portray Glacier Bay to be their most important place and refer to it as their "Ice Box," their "Garden of Eden," and their "Holy Land." Thus, the ethnographic resource is a complex suite of tangible and intangible entities, cultural beliefs, and natural features linked in a complex living web.

Traditional cultural properties — A traditional cultural property is an ethnographic resource that is eligible for inclusion on the National Register of Historic Places because of its association with cultural practices or beliefs of a living community that are: 1) rooted in that community's history; and 2) important in maintaining the continuing cultural identity of the community (Parker and King 1998;

NPS 2001d). A suite of harvest locales, village sites, and natural features, with their associated resources, legends, stories, songs, and art, help identify the ethnographic resource on the ground. Some locations contain archeological resources (e.g., former village sites and camps), while others may be important resource gathering locales (e.g., berry patches or seabird colonies) that may lack physical indicators of cultural activity. Others may be grand geographic features (e.g., Mount Fairweather) that play prominently in clan legends and serve as anchors for group identity. Currently, formal documentation and assessment of traditional cultural properties within the park have not been completed; however, a Park Service preliminary assessment of the park has identified approximately 15 sites that may qualify as traditional cultural properties (see table 3-11 and figure 3-17).

TABLE 3-11: 15 PRELIMINARY HUNA TLINGIT TRADITIONAL CULTURAL PROPERTIES IN GLACIER BAY NATIONAL PARK AND PRESERVE

TCP ID #	TCP Name	Place-name ID #	NPS Location ID #	Tlingit Location Name	Translation	English Location Name
1	Bartlett Cove	56	GLBA-56A	Ghathéeni	Sockeye River Village	Bartlett River (and Lester Island Village)
		58	GLBA-58	L'awshaa Shakee Aan	Town on Top of the (Glacial) Sand Dunes	Bartlett Cove Area or Beardslee Islands
2	Pt. Gustavus	60	GLBA-60	S'é X'aayí Lutú	Clay Point	Point Gustavus
3	Pt. Carolus	2	GLBA-2	Yáay Shaak'ú	Whale's Little Head	Point Carolus
		3	GLBA-3	Yáay Shaak'ú Aan	Whale's Little Head Village	Point Carolus Village
		4	GLBA-4	L'awt’aak Héen	River Behind the [Glacial] Sand	Point Carolus
		5	GLBA-5	Wat'akhhéen	River Alongside the Face/Side	Carolus River
4	Berg Bay	10	GLBA-10	Xh'atadáa Noowú	Weasel(s) at the Corner(s) of the Mouth Fort	On Lars Islands
		12	GLBA-12	Chookanhéeni	Grassy Creek	Berg Bay River
5	South Marble Island	19	GLBA-19	Íxde Néixh’ X’áat’i	South Marble Island	South Marble Island
6	Sealer's Island	39	GLBA-39	Aan Adéli	Village Watchman	Sealers Island
7	Tidewater Glacier	30	GLBA-30	Sít' Tlein	Big Glacier	Grand Pacific and Marjorie Glaciers
		31	GLBA-31	Sít'k'i T'ooch’	Little Black Glacier	Rendu Glacier
		33	GLBA-33	Sít' T'ooch'	Black Glacier	Carrol Glacier
		195	GLBA-195			Johns Hopkins Glacier
		196	GLBA-196			Lamplough Glacier
		197	GLBA-197			Reid Glacier
		200	GLBA-200			McBride Glacier
		201	GLBA-201			Riggs Glacier

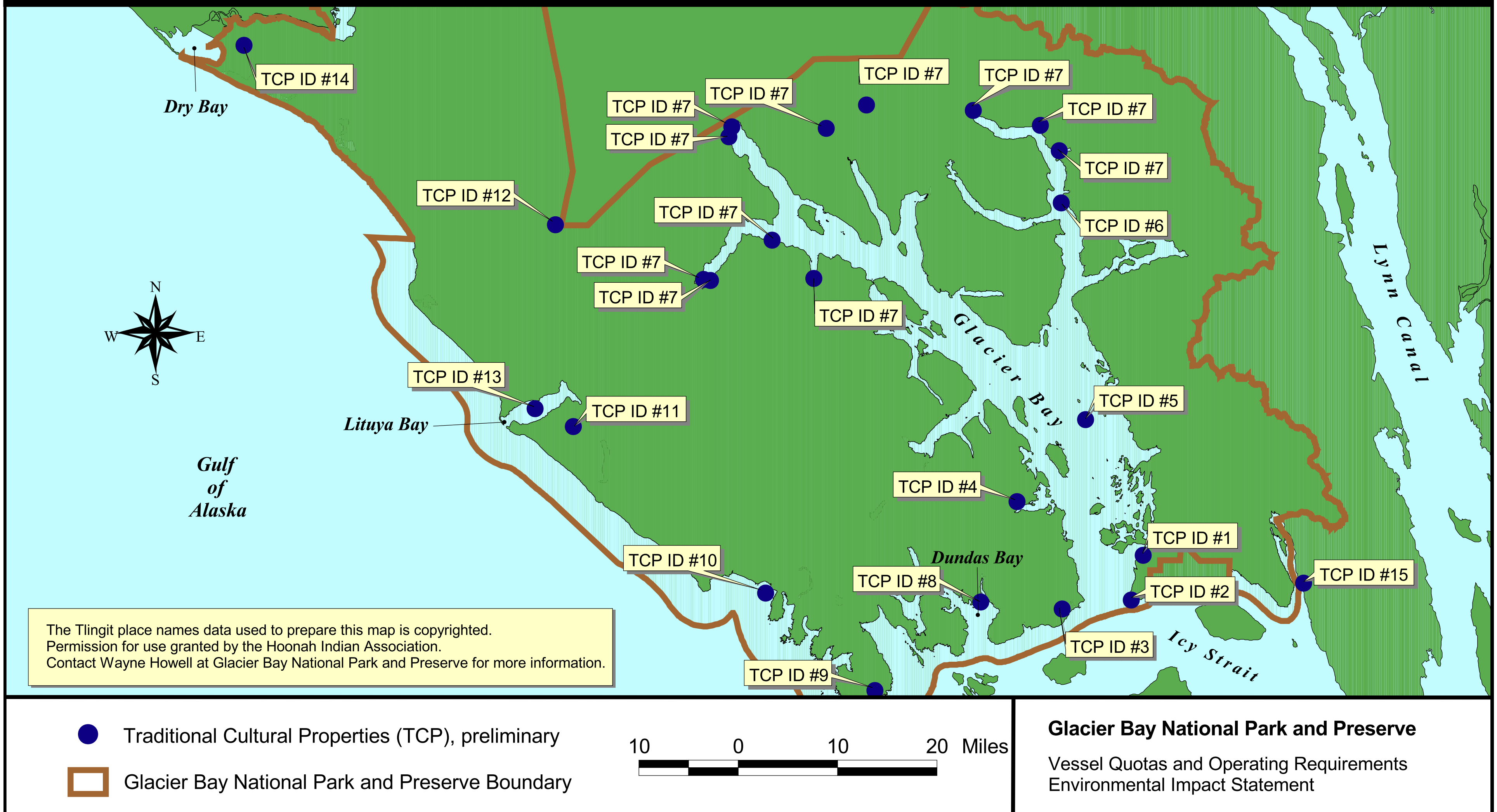
TABLE 3-11: 15 PRELIMINARY HUNA TLINGIT TRADITIONAL CULTURAL PROPERTIES IN GLACIER BAY NATIONAL PARK AND PRESERVE

8	Dundas River	94	GLBA-94	Xákwnoowú	Sandbar Fort	Mouth of Dundas River
		156	GLBA-156	L'éiw Noowú	Sand Fort	Dundas Bay Near Dundas River
		162	GLBA-162	Xunaa Kháawu Noowú	Hoonah People's Fort	West Bank of Dundas River Near Mouth
		95	GLBA-95	L'istee	Fort name in old language	East bank of Dundas River below confluence with Seclusion River
9	Cape Spencer	114	GLBA-114	Nagukh.wa.aan (Ta.aan)	Town at the Face of [Nagukh]; Sleeping Village	Head of Dicks Arm
		116	GLBA-116	Nagukh.wadaa	Shoreline Around [Nagukh][Dicks Arm/Cape Spencer]	Cape Spencer to Polka Peninsula
10	Boussole Head	121	GLBA-121	Ghaanaxháa	?	Arch at Boussole Head (Astrolabe)
11	Bald Mt.	141	GLBA-141	Yéil Nées'kuxlitashaa	Raven Sea Urchin Echo Knife Mountain	Mt Crillion or La Perouse or Bald Mt
12	Mt. Fairweather	134	GLBA-134	Tsalxhaan	Ground Squirrel Land??	Mount Fairweather
13	Lituya Bay	125	GLBA-125	Ltu.áa	Lake Inside the Point	Lituya Bay
		127	GLBA-127	Kanaxhdakhéen	Flying Over	Centopath Island
14	Dry Bay	139	GLBA-139	Ghunaaxhoo	Among the Athabaskans	Dry Bay
		150	GLBA-150	Diyáayi	Looks Like a Whale	Land East of Dry Bay or Doame River
		155	GLBA-155	Yéil Áa Ludaawdlighoowu Yé	Place Where Raven Wiped His Beak	Alsek River Near Canadian Border?
15	Excursion Inlet	68	GLBA-68	Wéitadi Noow	Fort of the Young Woman in Seclusion (in Menarche)	Head of Excursion Inlet
		72	GLBA-72	Khuyeikh'	?	Excursion Inlet

Map of 15 Preliminary Huna Tlingit Traditional Cultural Properties in the Park

Figure 3-17

National Park Service
U.S. Department of the Interior



Glacier Bay National Park and Preserve

Vessel Quotas and Operating Requirements
Environmental Impact Statement

Cultural (or Ethnographic) Landscapes. The cultural landscape is an extension of the ethnographic resource. Cultural landscapes are a geographic area, including natural and cultural resources, associated with historic events, activities, or people. Landscapes are "intertwined patterns of things both natural and constructed," and are a "reflection of human adaptation and use of natural resources which are often expressed in the way land is organized and divided, patterns of settlement, land use, systems of circulation, and the types of structures that are built" (NPS 1997a). At the broadest scale, the ethnographic resource encompasses entire landscapes. A landscape may be one of many component landscapes such as that of Dundas Bay or Bartlett Cove. In the case of Dundas Bay and Bartlett Cove, pre-Little Ice Age and post-contact oral and written histories can be linked to specific sites, places, and historical trends to provide a diachronic perspective of Tlingit culture in those places. A landscape also could be the entire landscape of the Glacier Bay region, which serves as a vast container of all that is Huna Tlingit culture.

The Glacier Bay cultural landscape is a compilation of all the landscape features and cultural and natural resources that provide meaning and significance to the Huna Tlingit people. The landscape features may be landforms that contain archeological resources marking the locations of former villages, or natural features (e.g., seabird colonies or mountains) that may lack evidence of cultural activity but comprise some of the most important cultural sites in the park. The ethnographic landscape also includes the plants and animals, terrestrial and marine, that inhabit the park and have sustained the Huna Tlingit people for countless generations. The Huna Tlingit recognize these plants and animals as direct ancestors to the human lineage of Glacier Bay. In the Glacier Bay ethnographic landscape, human activity has been an integral part of the ecosystem for generations.

The Glacier Bay ethnographic landscape is well defined by the Huna Tlingit place name map that contains approximately 200 traditional Huna Tlingit place names for the region. These place names depict legend sites, village sites, subsistence areas, landforms, water bodies, and historical events. The glue that holds the diverse elements of the ethnographic landscape together and gives it meaning is the information (e.g., stories, songs, legends, and art) that is shared and valued by successive generations of Huna Tlingit people. By incorporating this information in culturally appropriate ways within their culture, Huna Tlingits also manifest another vision to the Glacier Bay ethnographic landscape — the geography of Glacier Bay that is imbedded within the social fabric of Huna Tlingit culture.

The Park Service maintains a Cultural Landscapes Inventory (CLI) for all parks. The Cultural Landscapes Inventory is a "comprehensive inventory of all historically significant landscapes within the National Park System" that "identifies and documents each landscape's location, physical development, significance, National Register of Historic Places eligibility, condition, integrity, and current management" (NPS 1997a, 2001e). The Park Service has compiled Cultural Landscapes Inventories for Bartlett Cove and Dundas Bay (NPS 2001e, 2002d). A Cultural Landscapes Inventory has not been conducted for Glacier Bay.

Bartlett Cove is an area rich in Tlingit place names and oral history. It lies within the *Wooshkeetaan* clan territory of the Huna Tlingit. Huna Tlingit oral history tells of occupation of Bartlett Cove before the Little Ice Age, with a large village of many houses built atop a glacial moraine, as its name implies, L'awshaa Shakee Aan — Town on Top of the Sand Dunes. Sometime after the ice retreated from Glacier Bay in the early 1800s, Bartlett Cove was reoccupied, and by the 1880s, a second village, Gatheeni, had been established. A trading post, a fish saltery, and later a cannery, came to reside next to the village. Following the decline of the cannery operation after the turn of the 20th century and move of the village, several Native allotments with fish camps maintained the Huna Tlingit presence in Bartlett Cove. In the 1940s, when anthropologists visited Hoonah in conjunction with a land claim study, Huna Tlingit people identified Bartlett Cove as the most important food-gathering locale in Glacier Bay (Goldschmidt and Haas 1998). With the establishment of the Park Service administrative and visitor service functions in Bartlett Cove beginning in the 1950s, the Native presence declined; however, the Huna Tlingit people rejuvenated their connections to Bartlett Cove in the late 1980s. In 1992, they conducted a demonstration that emphasized their claim and deep cultural connection to Bartlett Cove. The CLI study for Bartlett Cove states that the general landscape characteristics include natural systems and features, land use, spatial organization, cultural traditions (rooted in pre-Ice Age legends), a cemetery, and archeological sites. The Bartlett Cove ethnographic landscape may be eligible for listing on the National Register of Historic Places.

Dundas Bay contains the archeological remains of two Huna Tlingit villages with accompanying oral history and other cultural resources (e.g., cemetery, house pilings, smokehouse debris, and fragments of a dugout canoe). Stone cairns (believed to be Tlingit shrines) have been found near the summit of White Cap Mountain and atop Point Dundas. Dundas Bay is renowned for its traditional berry-picking areas (one Native name for the area translates as “Berry Land”) where nagoonberries “appear in sufficient quantities to engender property rights” (Thornton n.d., as cited in NPS 2002d), and was known historically as a place for harvesting seals and salmon. *Xakwnoowu* (XMF-053), an important place name that appears in several legends, was described in Vancouver’s account of the exploration of Icy Strait, and “is the place of important clan songs and stories.” Another important site is the village of *L’istee* (XMF-013), which was the site of a potlatch (circa 1909) that validated *T’akdeintaan* clan ownership of the site (NPS 2002d). Non-Native cultural resources include the remains of several cabins (XMF-010, XMF-011, XMF-014, XMF-021, and XMF-022) and a cannery (XMF-025; see table 3-10 and figure 3-16). It was partly through interaction with the Dundas Bay cannery — first by learning to negotiate resource allocation, and later by learning to seine fish and do cannery work — that Huna Tlingits adapted to the 20th century. The period of significance for Dundas Bay is 800 years ago to the present. The Cultural Landscapes Inventory states that “the general landscape characteristics relevant to this inventory unit include natural systems and features, land use, spatial organization, buildings and structures, cultural traditions (including Huna Tlingit legends) and archaeological sites” (NPS 2002d). The Park Service states that the Dundas Bay ethnographic landscape is potentially eligible for listing on the National Register (NPS 2002d).

3.4.2 VISITOR EXPERIENCE

3.4.2 Visitor Experience

One of the main purposes of all national parks is the enjoyment and understanding of park resources and values by the people of the U.S. NPS policies for visitor use, including the policies of the park and preserve, promote visitor experiences that, on the whole, reflect the overall purposes and values of the park. The 1984 *General Management Plan*, which provides the overall direction for supporting park purposes and values, identifies the following management objectives specific to visitors:

- ensure patterns of use that enable visitors to enjoy and understand the natural features.
- provide recreational opportunities consistent with preservation of ongoing natural processes.
- balance forms of access and use to obtain a feeling of the ruggedness and wildness of this dynamic landscape and the solitude that early inhabitants found.
- witness the interrelated stories of geology, climate, glaciation, and biological communities of land and sea.
- appreciate the dynamic natural forces still at work.

This subsection describes park visitors and visitation numbers, followed by the different visitor experiences and opportunities available at the park.

Visitor Use and Experiences. Based on the 1999 *Bartlett Cove Visitor Study* (Littlejohn 2000), some of the most important reasons people visit the park are to:

- visit a national park.
- enjoy scenic beauty.
- view wildlife.
- view glaciers.
- visit Alaska.
- pursue recreational opportunities.
- experience wilderness.
- enjoy solitude/quiet.

Visitor experiences are a function of expectations and conditions encountered. Such expectations may vary by particular places visited within Glacier Bay. For example, backcountry visitors camping in Adams Inlet, within designated wilderness and non-motorized waters, may have higher expectations for solitude than when camping elsewhere in Glacier Bay. The backcountry visitor studies reviewed do not differentiate expectations by region. Also, wilderness areas within the park are not zoned for different standards of solitude and quiet. A person may leave the park dissatisfied because of inappropriate expectations or because conditions experienced did not allow for the realization of expected outcomes. These experiences can be influenced by:

- the quality of vessel and shore-side facilities and services utilized, including lodging, food/amenities, interpretive services, and trails.
- weather and visibility.
- vessel and aircraft traffic.
- the number, nature, and quality of human interactions.

- feeling of safety and security.

Visitors can be grouped by the way they travel and experience the park. For this environmental impact statement, five major visitor groups are defined: 1) cruise ship passengers; 2) tour vessel passengers; 3) charter vessel passengers; 4) private vessel visitors; and 5) backcountry visitors. Generalizations about visitors have been made based on the vessel class by which they are visiting the park. There is a broad spectrum of values, expectations, and opinions among visitors in each group. Simply because a visitor is on a cruise ship does not mean that he or she cannot view the park from a window or from the deck as a “wilderness” or a wild or pristine landscape; be awed by wildlife or a calving glacier; or that his or her experience cannot be diminished by the presence of other vessels, including other cruise ships, air pollution, or lack of wildlife sightings. Also, it cannot be assumed that because a visitor is on a charter vessel or private vessel that he or she will be disappointed by seeing another vessel or having to anchor near another one. In 2002, over 386,000 visitors traveled through Glacier Bay aboard cruise ships, tour vessels, charter vessels, or private vessels (NPS 2003a, Nemeth 2003), and other modes. Motorized vessel passenger traffic peaked in 1999 at over 382,000 (see table 3-12 and figures 3-18 through 3-21).

TABLE 3-12: GLACIER BAY VISITOR TRAFFIC, 1997-2002

	2002	2001	2000	1999	1998	1997[b]
Cruise Ship Passengers (all year)	364,794	336,582	342,462	356,220	339,406	304,586
Cruise Ship Passengers (June-Aug.)	232,321	217,611	227,779	228,654	215,366	198,528
Day Tour Vessel Passengers[a]	16,694	19,522	22,176	23,125	24,888	20,427
Overnight Tour Vessel Passengers[b]	1,760	2,022	1,236	1,164	739	2,343
Charter Vessel Passengers	1,044	1,743	1,782	1,046	391	981
Private Boaters	1,734	1,806	1,236	1,343	2,279	2,050
Total Motorized Vessel Visitors	386,026	361,675	368,892	382,898	367,703	330,387
Backcountry Visitors	1,307	1,643	1,577	1,642	1,800	1,887
Total Glacier Bay Visitors[c]	**387,333**	**363,318**	**370,469**	**384,540**	**369,503**	**332,274**

Source: NPS 2003a, Nemeth 2003.

a. Day tour vessel data includes camper drop-off passengers.

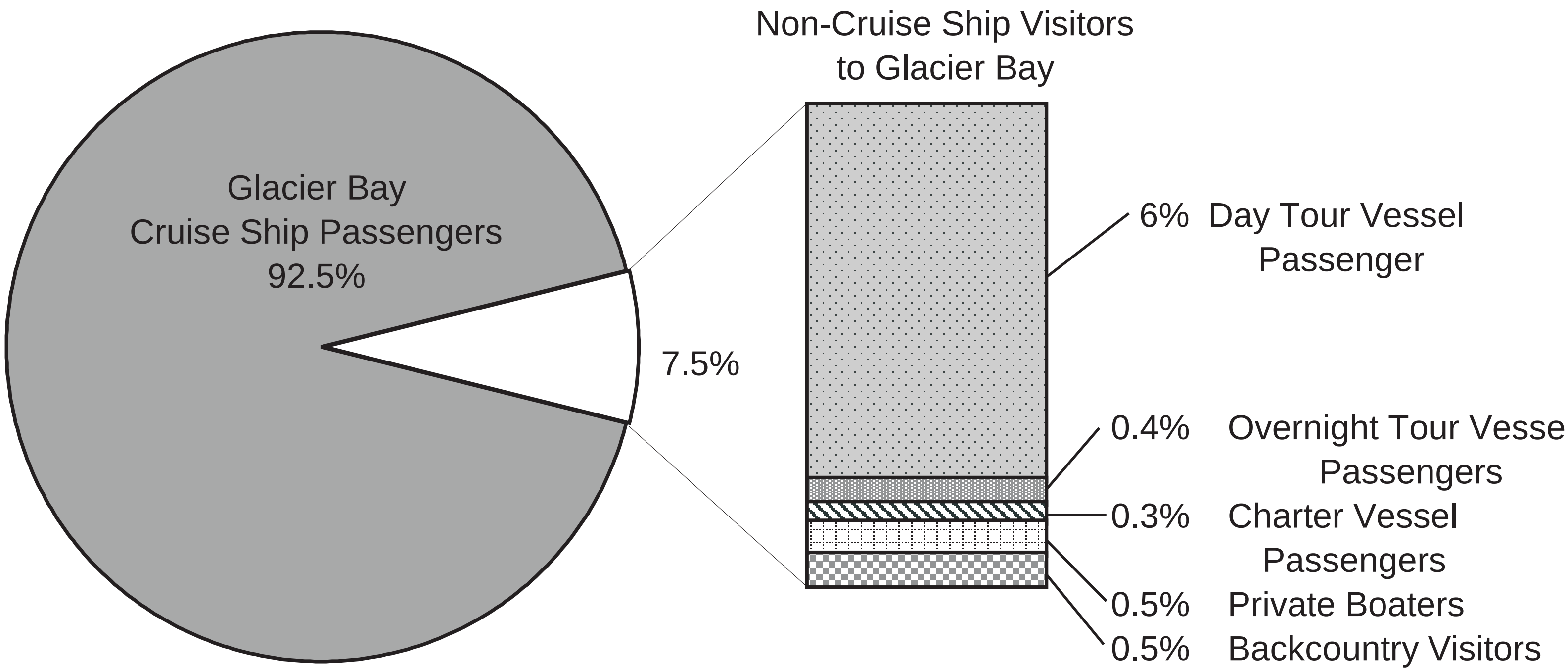
b. The source document indicates some uncertainty as to the distribution of traffic between day and overnight tour vessels in 1997.

c. Does not include other visitors such as Bartlett Cove campground visitors and visitors to other parts of the park.

Cruise ship visitors — More than 90% of park visitors experience Glacier Bay aboard a cruise ship. These passengers typically travel on seven-day Inside Passage or cross-Gulf cruises or cruise/tours that may include stops in Ketchikan, Juneau, Skagway, Sitka, and/or Haines, as well as Seward. In 2002, 364,794 cruise ship passengers visited Glacier Bay. A total of 211 cruise ships entered Glacier Bay, including 135 during June, July, and August. Cruise ships carried an average of 1,729 passengers into Glacier Bay each day (including a June/July/August average of 1,721; Nemeth 2003).

Cruise ship visitors spend 8 to 9 hours in Glacier Bay, with their main destination being the West Arm and Margerie Glacier. Large cruise ships may have staggered entry times, but their presence in the Bay can overlap. Since cruise lines want to provide the best possible experience for their passengers, cruise ship operators often communicate with each other while in the Bay to ensure that only one cruise ship at a time is in the popular viewing areas. Typically, a ship will enter the park between 7 and 8 A.M. and exit between 3 and 4 P.M. Another ship may enter the park at mid-day. A Park Service ranger naturalist, who provides an interpretive program, is brought onboard shortly after the ship enters the Bay. For cruise ship passengers, glacier viewing and wildlife sightings are a highpoint of their time in the park. Glacier Bay provides these passengers with the widely marketed "glacier day" on their Alaska cruise.

FIGURE 3-18: PERCENT OF ANNUAL VISITATION BY VISITOR CATEGORY (BASED ON 1997-2002 AVERAGE)



Average Visitation to Glacier Bay (1997-2002): 367,906

FIGURE 3-19: GLACIER BAY VISITOR TRAFFIC BY VISITOR CATEGORY 1997-2002: CRUISE SHIP PASSENGERS

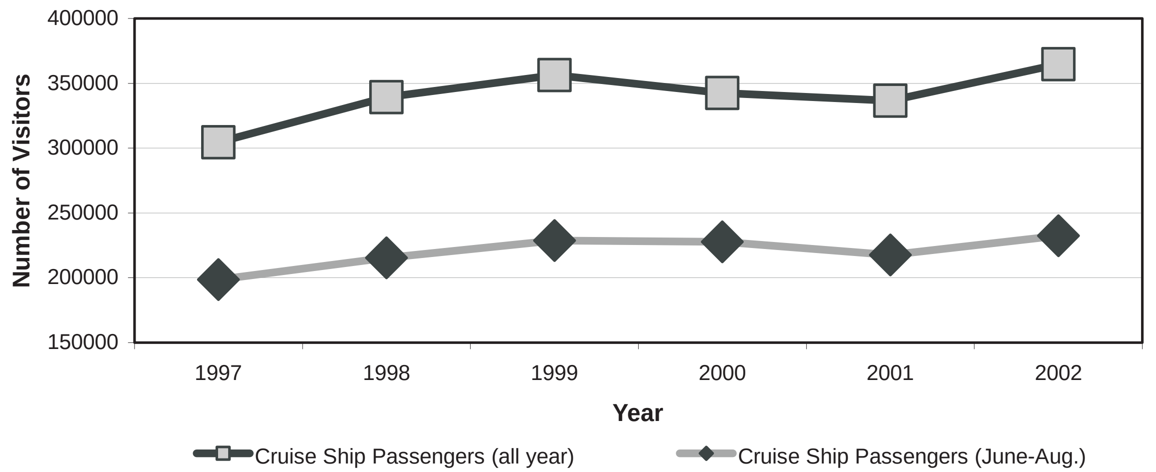


FIGURE 3-20: GLACIER BAY VISITOR TRAFFIC BY VISITOR CATEGORY 1997-2002: TOUR VESSEL PASSENGERS

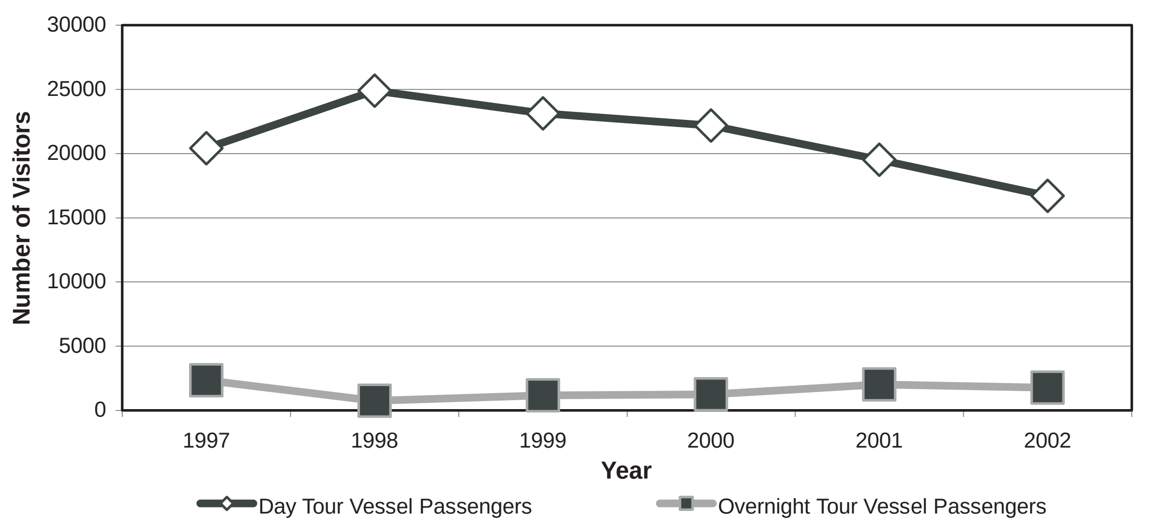
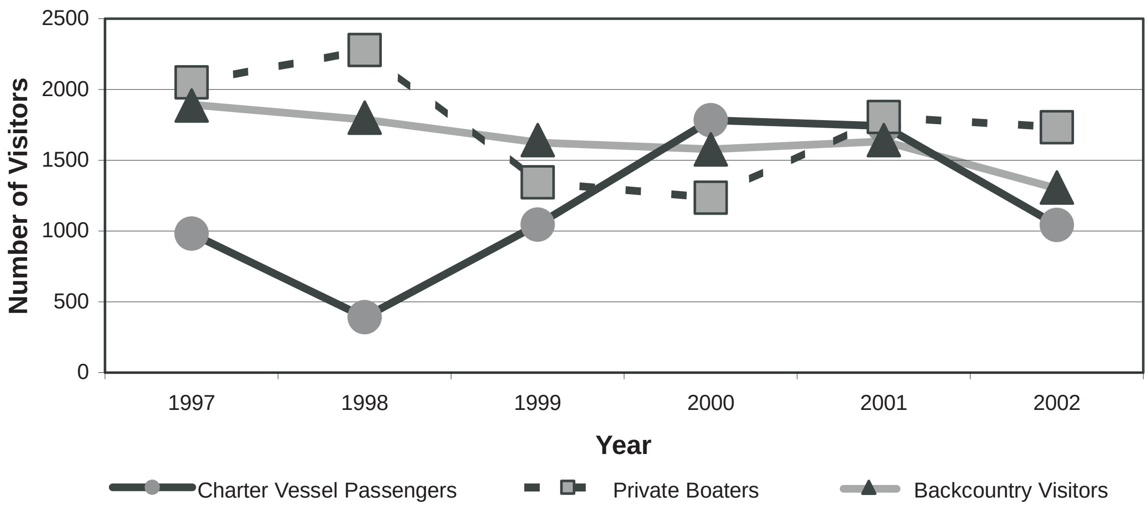


FIGURE 3-21: GLACIER BAY VISITOR TRAFFIC BY VISITOR CATEGORY 1997-2002: CHARTER VESSEL PASSENGERS, PRIVATE BOATERS AND BACKCOUNTRY VISITORS



Cruise ships provide a means by which thousands of people can experience the park. They also provide the main mechanism for the Park Service to define and explain park resources to visitors. The variety of opportunities to experience the park that are available to people who visit the park aboard cruise ships is limited, however, because these visitors have little control over a visit that is scheduled, planned experience as offered by the operators and NPS interpretive staff. Most cruise ship travelers do not set foot ashore in the park.

Tour vessel passengers — In 2002, 18,454 visitors experienced Glacier Bay on a tour vessel. There were 265 tour vessel entries, including 210 during June, July, and August, with an average of 67 passengers per vessel entry. A moderately small number of tour vessel visitors (1,833 in 2002) travel on four- to seven-day cruises on vessels with overnight accommodations (Nemeth 2003).

About half of tour vessel passengers arrive to the park by either flying or ferrying to Gustavus (usually from Juneau), then boarding the park concession’s day tour vessel for an approximately 8-hour tour of the Bay. These passengers typically spend at least one night in the Gustavus area, either at the Glacier Bay Lodge or at one of the area’s bed and breakfast or lodging facilities. Recent demographic data regarding tour vessel visitors are not available; however, a 1989 survey provides some insight into these visitors’ experience at the park (Johnson 1990):

- Viewing glaciers is the single most important activity motivating tour vessel visitors to travel to Glacier Bay, followed by viewing wilderness scenery (Johnson 1990; Littlejohn 2000).
- Seeing and photographing glaciers was a highlight of the trip for most tour vessel visitors.

Tour vessels provide a slightly different visitor’s experience than cruise ships. Like cruise ships, they follow a rather standardized schedule and routing, however, tour vessel routes are often more variable than those of cruise ships. This is because tour vessels tend to travel closer to shorelines and due to smaller size and draft constraints, they are able to spend time in inlets, coves, and at islands that are not typically visited by cruise ships. The NPS ranger naturalists provide commentary throughout the day onboard all tour vessels so that visitors can learn about and understand park resources. The more intimate setting afforded by the tour vessels allows for greater opportunity for one-on-one interaction with the ranger naturalists. Many tour vessel visitors stay at or visit the Glacier Bay Lodge, where they have additional opportunities to interact with NPS interpreters stationed at the visitor’s center.

Charter vessel visitors — Charter vessels are available for hire on an unscheduled basis, although charter vessels that provide drop-off services are allowed to operate on a scheduled basis (NPS 1997b). Charter vessels offer a range of Glacier Bay experiences. Operators with charter vessel concession permits include residents of Gustavus, Elfin Cove, and Pelican operators that bring guests to Glacier Bay and Dundas Bay for sightseeing, sport fishing, or wildlife viewing.

Charter vessels provide opportunities for visitors who prefer smaller groups and less structure in their days. Also, because charter vessels are typically smaller than cruise ships and tour vessels, visitors on charter vessels can enter and explore areas of shallow waters and many of the smaller coves. Charter vessels also provide opportunities for off-vessel experiences, including kayaking and shore visits.

Private vessel visitors — Private vessels range from yachts of 100 feet (30.5 meters) and more to smaller vessels carrying one to two people from the nearby communities of Gustavus, Hoonah, Elfin Cove, or Juneau. Private vessel visitors may be in Glacier Bay for a variety of reasons, including glacier sightseeing, wildlife viewing, and sport fishing. The definition of private vessels does not include vessels used for commercial fishing.

In 2002, approximately 1,700 visitors arrived in Glacier Bay on a private vessel. Visitors aboard private vessels can experience solitude and quiet and are able to visit the most remote areas of the park.

Backcountry visitors — The term "backcountry visitors" refers to those individuals who seek a non-motorized outdoor recreational experience with wilderness qualities. Backcountry visitors include those visitors, mainly campers and kayakers, who use the drop-off service provided by tour and charter vessels to reach backcountry locations in Glacier Bay. Backcountry overnight trips in and around Glacier Bay have shown an overall upward trend since 1970 (NPS 1995a), although the last few years have shown a slight decrease from this trend (NPS 2001g). Since 1997, on average, 1,711 people per year have visited the backcountry (see table 3-13). Private groups tend to be small (an average of 2.5 people). Commercially guided groups average 10.8 people.

TABLE 3-13: BACKCOUNTRY VISITATION IN GLACIER BAY NATIONAL PARK AND PRESERVE, MAY THROUGH SEPTEMBER (AVERAGE) 1997–2001

	Groups[a]	Individuals[a]	Nights[b]	Visitor-Use Nights[b]	Mean Trip Length (# nights)[b]	Mean Group Size[b]
Private groups	561	1,448	1,371	3,527	4.0	2.5
Commercial groups	24	263	96	1,013	4.6	10.8
Total	**585**	**1,711**	**1,467**	**4,540**		

Source: Kralovec 2002.

a. Data were derived from the Backcountry Permit database.
b. Data were derived from the Backcountry Visitor Survey database.

Many individuals plan their backcountry camping trips to experience a variety of recreational activities, such as whale watching and kayaking. Travel to Glacier Bay occurs at times when these activities are most desirable, mainly during June through August, with the highest use occurring in July. This time period coincides with the peak for cruise ship and other vessel traffic (Kralovec 2002).

Access to the Glacier Bay backcountry is mainly via commercial transportation, generally by tour vessel, charter vessel, or float plane. Commercially guided groups usually begin their trips in Bartlett Cove or by chartering a vessel or plane that transports them directly to the East or West Arm (Kralovec 2002). Those visitors not wishing to hire a commercial guide also can begin their trip from Bartlett Cove, where they can charter either a vessel or airplane to take them into the backcountry to a starting point or to one of the three or four designated day tour drop-off locations. Another option for visitors is to begin their trip by paddling directly from Bartlett Cove (these visitors usually limit their trip to the Beardslee Islands area). Since 1997, the number of backcountry visitors starting their trip from Bartlett Cove has steadily increased.

More than 90% of backcountry visitors to the park camp on the shoreline in designated wilderness. Nearly all the marine shoreline that is flat enough can be or has been used as a campsite. Figure 3-22 shows the locations of campsites used during the period of 1997 to 2001. Shoreline wilderness camping is exposed to a variety of intrusions, mainly the sights and sounds of human activity, including the sight of motorized vessels, aircraft, and other groups camping in the backcountry. These types of intrusions can negatively affect the quality of a visitor's experience.

The backcountry wilderness experience — People often visit wild places because of a desire to escape the pressures and stresses of civilization; to learn about and appreciate nature; and to experience solitude, adventure, and wildness with the companionship of friends and family (Driver et al. 1987; Brown and Haas 1980). The National Park Service Act of 1916 (Organic Act, section 1), the Wilderness Act of 1964 (section 2c), and the Alaska National Interest Lands Conservation Act


Backcountry
Use Locations
Figure 3-22
National Park Service
U.S. Department of the Interior
NATIONAL PARK SERVICE
Tarr Inlet
Muir Inlet
Johns Hopkins
Inlet
Adams
Inlet
Hugh Miller Inlet
Scidmore Bay
Charpentier Inlet
Glacier Bay
N
W
E
S
Geikie Inlet
Beardslee
Islands
Backcountry Camp Sites and
Daily Kayak Drop-off / Pick-up Locations
Dundas Bay
Kayak & Camper Drop-off
and Pick-up Locations
Camp Sites (1996-2001)
Park Boundary
Glacier Bay National Park and Preserve
Vessel Quotas and Operating Requirements
Environmental Impact Statement
5 0 5 10 Miles

(section 101) call for providing recreational opportunities that emphasize viewing scenery or experiencing solitude, or that are primitive and unconfined. Management of wilderness provides "visitors with opportunities to experience solitude in a relatively unmodified natural environment with few management restrictions and facilities" (Lawson and Manning 2001).

The park is remote from the rest of the U.S. Even by Alaska standards it is remote, with no roads leading to either Gustavus or Bartlett Cove (the starting point for nearly all visitors). This sense of remoteness is generally a leading factor for visitors wanting a truly wild experience. Although Glacier Bay is not accessible by road, numerous vessel routes exist for boats and flight paths for aircraft. The degree to which boats access Glacier Bay may limit the perception of remoteness by backcountry visitors.

Kayakers, hikers, and some boaters who camp on land are within sight, sound, and sometimes smell of motorized vessels, including vessels that travel outside wilderness. A study by Salvi and Johnson (1985) shows that the mean number of sightings of motorized watercraft, as reported by the respondents, totaled 9.8. This was before the increases in cruise ships and tour vessels authorized in the 1985 regulations. As additional motorized vessel use is permitted and as backcountry use increases or otherwise changes, research (Johnson 1990) has noted the possibility that some users' tolerance for seeing other people in the backcountry may be exceeded and that these users either may be displaced (not return to the area again) or may simply change their expectations regarding wilderness and solitude in Glacier Bay. Kralovec's report (2001) on backcountry visitor use showed more than 200 visitor complaints regarding motorized vessels and aircraft use in the backcountry. These complaints reflect intrusion into an experience where such use is not expected.

Glacier Bay's backcountry experiences are mainly water based. Only a few wildernesses within the National Wilderness Preservation System (NWPS) are so characterized, and many of those, such as the Boundary Waters Canoe Area Wilderness in Minnesota, are heavily used and regulated. The affected environment, therefore, exists within a social context that is growing in scarcity. Glacier Bay plays an important role in providing marine-oriented backcountry opportunities because it is relatively easier to access than other Alaskan marine wilderness areas.

A survey of park visitors was conducted during summer 1999, from July 23 to August 1 (Littlejohn 2000). A total of 666 questionnaires were distributed to visitors at Bartlett Cove; 545 respondents returned completed surveys, for an 82% response rate. The survey did not include visitors traveling to Glacier Bay on a cruise ship.

The survey asked respondents about their visit to Glacier Bay, including how they received information about the park, modes of transportation, participation in activities, reasons for visiting, length of stay, use of park services, satisfaction levels, interest in various educational subjects, and demographics. In addition, the survey asked backcountry visitors and vessel passengers how they were affected by the sightings of other park users, such as cruise ships, kayaks, and airplanes. Respondents also were asked about how their park experience was affected by other types of visitor-related effects, such as vessel stack emissions and aircraft noise.

Most survey respondents (84%) traveled into the Bay either by tour, charter, or private vessel. When asked about sightings of other visitor groups, most of these respondents said that they had seen at least three kayaking/camping groups per day, at least one cruise ship per day, and at least three other vessels per day. For most of these visitors, the sighting of other visitor groups had no detrimental effect. About one-fourth (24%) of the respondents said that seeing cruise ships detracted from their experience, while 11% said it enhanced their experience. Seeing airplanes detracted from the experience for 17% of respondents; seeing other vessels, 8%; and seeing kayakers/campers, 2%.

Nearly one-fourth (23%) of respondents said that they kayaked, hiked, or camped in the backcountry during their visit. When asked about daily sightings of other visitors, most backcountry visitors said that each day they had seen at least one other kayaking/camping group, at least one cruise ship, at least one other vessel, and at least one airplane.

3.4.3 Vessel Use and Safety

3.4.3 Vessel Use and Safety

This subsection discusses vessel use and management in the park. Vessel safety under the current vessel quotas and operating requirements is discussed in subsection 4.4.3.

Appendix E contains records related to the numbers of vessels using Glacier Bay based on vessel entry permits. This information includes a summary of the 2001 and 2002 Outer Waters Vessel Activity Surveys and presents vessel sightings from June to September of those years (NPS 2002j).

Cruise ships. Cruise ships that enter Glacier Bay generally follow a predictable pattern. The first ship typically enters Glacier Bay at 6 or 7 A.M. A second ship may arrive at about the same time, but usually several hours later, at about 10 A.M. Upon entering Glacier Bay, each cruise ship slows to about 6 knots near the entrance of Bartlett Cove to allow two park rangers to board the vessel. These rangers deliver interpretive presentations to the passengers. Virtually every cruise ship makes the 55-mile (88.5-kilometer) voyage to Tarr Inlet to provide passengers a view of Margerie and Grand Pacific Glaciers. The ships then proceed south, departing Glacier Bay between 4 and 8 P.M. (Eley 2000). If the next destination is Seward, Yakutat, or Sitka, the ships turn west to transit Cross Sound; if the destination is Skagway, Juneau, or Ketchikan, they turn east once clear of the mouth of Glacier Bay. Figure 3-23 shows the typical cruise ship routes and major destinations.

Table 3-14 describes the typical itineraries followed by the early and mid-morning arriving cruise ships visiting Glacier Bay. This schedule has proven effective in providing opportunities for cruise ship visitors to enjoy, appreciate, and learn about the park.

TABLE 3-14: OPTIMAL TIMETABLES FOR CRUISE SHIP ENTRIES

Example of Optimal Itinerary for a 7 A.M. Arrival		Example of Optimal Itinerary for a 10 A.M. Arrival	
Time	**Activity**	**Time**	**Activity**
7 A.M.	Arrive Glacier Bay	10 A.M.	Arrive Glacier Bay
9 A.M.	Queen Inlet, begin commentary	10:30 A.M.	Interpretive presentation
10:30–11:30 A.M.	View Margerie and Grand Pacific Glaciers	11:15 A.M.	Second interpretive presentation, if needed
12:30–1:30 P.M.	View Lamplugh Glacier (Jaw Point / Johns Hopkins, if appropriate)	12 P.M.	Queen Inlet, begin commentary
2 P.M.	Reid Inlet	1:30–2:30 P.M.	View Margerie and Grand Pacific Glaciers
2 P.M.	Interpretive presentation	3:30–4:30 p.m.	View Lamplugh (Jaw Point / Johns Hopkins, if appropriate)
2:45 P.M.	Second interpretive presentation, if needed	5 P.M.	Reid Inlet
4 P.M.	Depart Glacier Bay	7 P.M.	Depart Glacier Bay

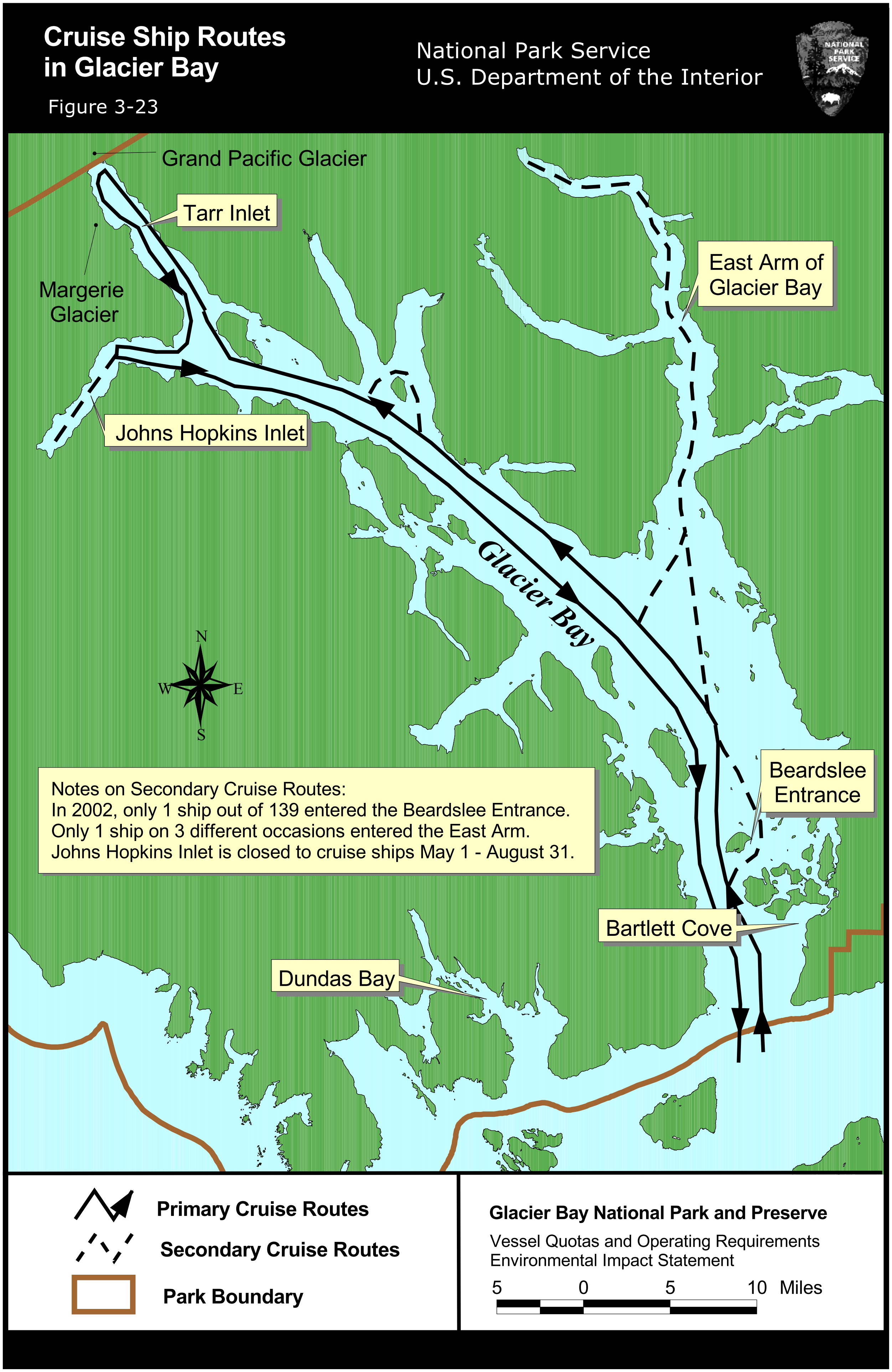
Notes:

Muir Inlet is not part of the optimal itinerary because the Park Service believes that the transit time needed for traveling to the East and West Arms of Glacier Bay could diminish the time spent at tidewater glaciers and thus diminish passenger enjoyment and understanding of the park.

Johns Hopkins Inlet is a not a preferred cruise ship destination because of seasonal area closures, high concentrations of harbor seals, and other factors that will often prevent going beyond, or even approaching, Jaw Point.

Other bays and inlets of the park (such as Dundas Bay and Lituya Bay) are not included because of potential conflicts between cruise ship activities and existing visitor uses.

Transit through park marine waters outside headlands — Icy Strait, Cross Sound, and the outer coast open waters (the park boundary extends 3 miles [4.8 kilometers] offshore) — is considered an incidental use of the park at this time. The Park Service encourages cruise ship operators to develop appropriate ship-board programs to further passenger knowledge and appreciation of these remote areas of the park.


Cruise Ship Routes
in Glacier Bay
Figure 3-23
National Park Service
U.S. Department of the Interior
Grand Pacific Glacier
Tarr Inlet
Margerie
Glacier
East Arm of
Glacier Bay
Johns Hopkins Inlet
Glacier Bay
N
W
E
S
Notes on Secondary Cruise Routes:
In 2002, only 1 ship out of 139 entered the Beardslee Entrance.
Only 1 ship on 3 different occasions entered the East Arm.
Johns Hopkins Inlet is closed to cruise ships May 1 - August 31.
Beardslee
Entrance
Bartlett Cove
Dundas Bay
Primary Cruise Routes
Secondary Cruise Routes
Park Boundary
Glacier Bay National Park and Preserve
Vessel Quotas and Operating Requirements
Environmental Impact Statement
5 0 5 10 Miles

Tour, charter, and private vessels. Tour, charter, and private vessels are capable of entering remote inlets and harbors within Glacier Bay because of their smaller size and shallow draft compared to those of larger ships (see routes, major destinations, and anchorages illustrated in figure 3-24).

Tour vessel excursions are typically focused on sightseeing and attempt to provide passengers with an opportunity to see the tidewater glaciers, as well as other scenery and wildlife. These vessels often travel close to shore to provide passengers with a better view of bears, seals, eagles, and other wildlife, and can more freely maneuver about in smaller inlets and bays than those which larger ships can enter. Tour vessels that offer overnight excursions usually carry a USCG-licensed master (captain) and two to three licensed mates.

Because an individual or group "hires" the vessel for the day, charter vessels often have a flexible schedule and route to accommodate the desires of the customer(s). An individual or group might hire a charter vessel to take them sightseeing or kayaking in a remote location, or to provide access to a remote shoreline for hiking or wildlife viewing. Some charter vessel customers simply wish to cruise to a remote anchorage to enjoy the scenery, the solitude, and a meal. According to Eley (2000), many small vessels anchor to provide kayaking directly from the vessel. Several are capable of "soft grounding" at the shoreline for deploying a bow gangway, thus allowing passengers to disembark directly to shore.

Private vessels are the least regulated and restricted class of vessels that operate in Glacier Bay. Within the limits of the park regulations, private vessels have total flexibility. Private vessels can visit any area of the park open to motorized vessels. Private vessels that are small can transit into smaller and more restricted inlets than other vessels. Like charter vessels, private vessels are used to take their occupants sightseeing, kayaking, hiking, wildlife watching, or just to anchor in a quiet cove.

Table 3-15 summarizes the number of entries into the park by private and charter vessels from 1998 to 2001.

TABLE 3-15: PRIVATE AND CHARTER VESSEL ENTRIES INTO GLACIER BAY NATIONAL PARK AND PRESERVE — 1998 TO 2001

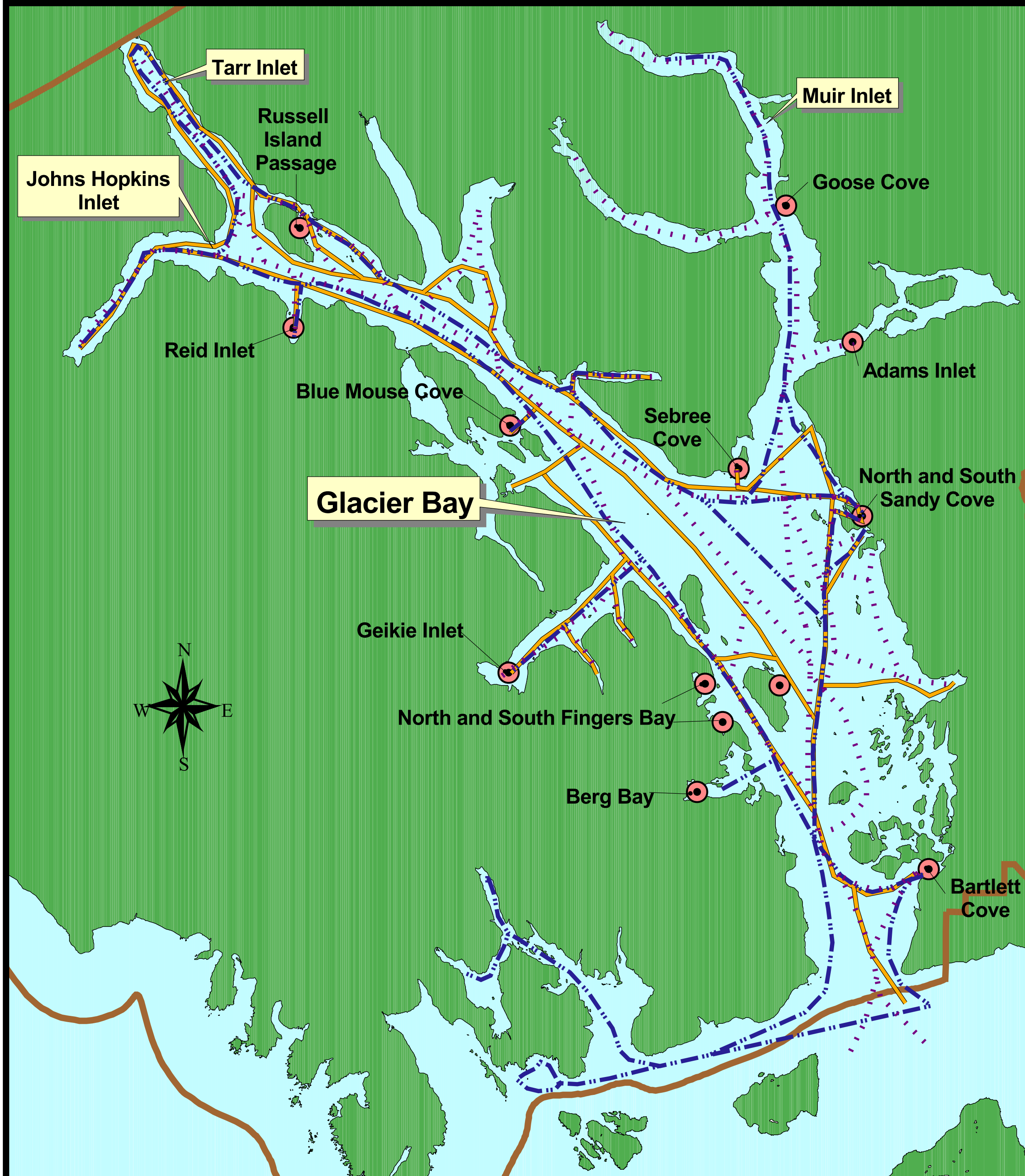
	Private Vessels			Charter Vessels			
Year	Total Entries (Sum of General and Local Entries)	General Entries	Local Entries	June-to-August Entries	Glacier Bay	Other Marine Waters	Off-Season Entries
1998	**412**	348	64	**125**	67	58	18
1999	**418**	331	87	**191**	115	76	24
2000	**414**	356	58	**262**	173	89	38
2001	**385**	323	62	**273**	166	107	48

Administrative vessel traffic. With the exception of non-motorized waters, administrative vessels travel throughout the waters of Glacier Bay to fulfill park management responsibilities, including park research and patrol; operational responsibilities, including official government vessels other than Park Service; and transfer of personnel onto cruise ships; and emergency response. Access to seasonally-closed non-motorized waters by administrative vessels is approved by the superintendent and granted on a case-by-case basis. The number of administrative vessels transiting the park is not restricted to a daily or seasonal limit, to allow necessary flexibility in accomplishing these tasks. In addition, all requests for resource monitoring or research activities within the park go through a research permit process. Research permit applications are reviewed by park staff, who recommend that the superintendent either approve, partially approve, or deny a research permit, based on several factors. All applicable federal and state regulations are considered during this review. Research permits can be issued for the entire study or only a portion, and may include specific mitigation measures to protect park visitors and resources.

Tour, Charter, and Private Vessel Routes and Anchorages In Glacier Bay

Figure 3-24

National Park Service
U.S. Department of the Interior



- Anchorages
- Primary Tour Vessel Routes
- Primary Charter Vessel Routes
- Primary Private Vessel Routes
- Park Boundary

Glacier Bay National Park and Preserve

Vessel Quotas and Operating Requirements
Environmental Impact Statement

5 0 5 10 Miles

Commercial fishing traffic. Commercial fishing is authorized in perpetuity within the non-wilderness marine waters outside of Glacier Bay, and is being phased out within the non-wilderness waters inside Glacier Bay. The wilderness waters of Dundas Bay and Glacier Bay are closed to commercial fishing.

The three types of commercial fishing currently authorized in the non-wilderness waters of Glacier Bay are longline fishing for halibut, pot and ring fishing for tanner crab, and trolling for salmon. Fishing by lifetime-access permit holders will continue in Glacier Bay until all the current permit holders cease to fish. Vessel traffic associated with commercial fishing is not addressed directly in this environmental impact statement, but is considered in the assessment of cumulative effects.

Ferry. In 2002, a ferry service was offered from Juneau to Bartlett Cove four days per week. Public Law 105-83, section 127, provides for a daily ferry service:

> *For the sole purpose of accessing park or other authorized visitor services or facilities at, or originating from, the public dock area at Bartlett Cove, the National Park Service shall initiate a competitive process by which the National Park Service shall allow one entry per day for a passenger ferry into Bartlett Cove from Juneau: Provided, That any passenger ferry allowed entry pursuant to this Act shall be subject to speed, distance from coast lines, and other limitations imposed necessary to protect park resources: Provided further, That nothing in this Act shall be construed as constituting approval for entry into the waters of Glacier Bay National Park and Preserve beyond the immediate Bartlett Cove area as defined by a line extending northeastward from Point Carolus to the west to the southernmost point of Lester Island, absent required permits.*

The future schedule of the ferry service is subject to change.

Hoonah access. Visitation to Glacier Bay by members of the Hoonah Indian Association has been relatively low in relation to other local private boaters, despite the deep cultural connection that the Huna Tlingit people have to Glacier Bay. One explanation for this is derived from consultation between park staff and tribal members, and can be attributed to the current need to obtain permits to visit the Huna Tlingit ancestral homeland, a requirement disapproved by most Huna Tlingits and actually deemed insulting to many. This lack of visitation to the park by many Huna Tlingits, particularly the youth, has led to a decline in direct knowledge of Glacier Bay and its cultural traditions. In a joint effort between the Park Service and the Hoonah Indian Association to devise ways to retain a vital ethnographic resource, a procedure has been developed through an existing Memorandum of Agreement between the park and the Hoonah Indian Association. Access for members of the Hoonah Indian Association may increase somewhat as a result.

3.4.4 WILDERNESS RESOURCES

3.4.4 Wilderness Resources

This subsection describes the park's wilderness resources as a component of the human and natural environment and includes a brief definition of wilderness as a resource. It then identifies the locations of wilderness areas within the park, and discusses the status of wilderness within the park, including the relative contribution of the park's wilderness to the National Wilderness Preservation System.

Wilderness is unlike other components of the affected environment. Wilderness is a holistic concept, and the notion of it as a resource is different from that of individual attributes such as wildlife, water, and scenery. It does not represent a particular biophysical attribute, but rather a sense of naturalness that occurs within a pristine environment that is largely unaffected by human activity. Under the Alaska National Interest Lands Conservation Act, 2,658,186 acres (1,075,730 hectares) of the park's total of 3,283,168 acres (1,328,651 hectares) are congressionally designated as part of the National Wilderness Preservation System (see table 3-16).

TABLE 3-16: DESIGNATIONS WITHIN GLACIER BAY NATIONAL PARK AND PRESERVE

Designation	Acres (hectares)	Percentage of Total
Land		
Wilderness land	2,610,548 (1,056,451)	97.7%
Non-wilderness preserve land	54,811 (22,181)	2%
Non-wilderness land	8,504 (3,441)	0.3%
Total Land Acreage	**2,673,863 (1,082,073)**	**100%**
Water		
Non-wilderness waters	559,418 (226,388)	92%
Wilderness waters	47,638 (19,278)	8%
Total Water Acreage	**607,056 (245,666)**	**100%**

Source: NPS 2002g.

Note:

Non-wilderness preserve land includes a large contiguous area south and west of Dry Bay, incorporating most of the park. Non-wilderness park land is located mostly at and near Bartlett Cove.

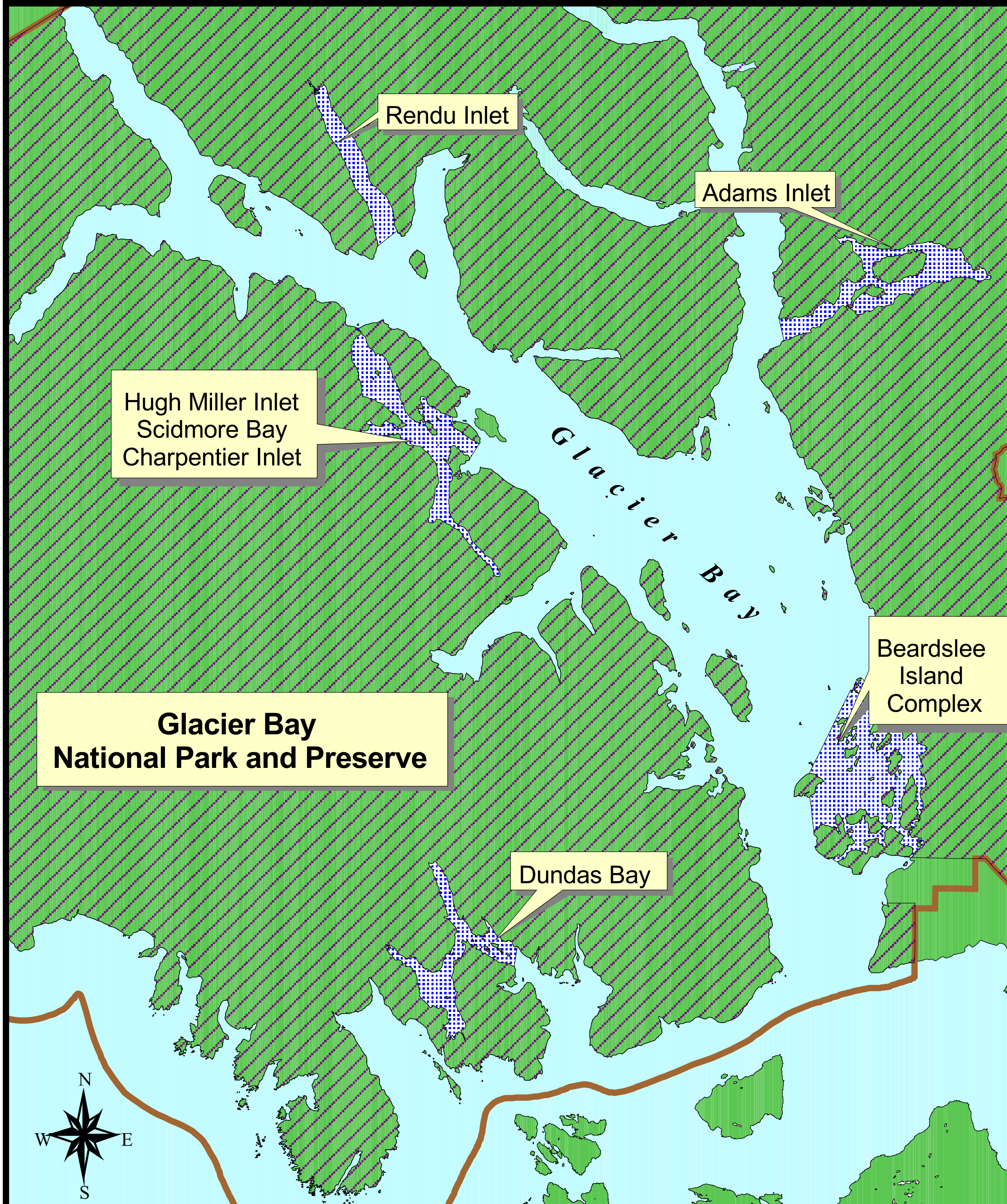
The acreage totals in table 3-16 differ from those listed in section 701 of the Alaska National Interest Lands Conservation Act because of the use of more exact mapping techniques and isostatic rebound (see subsection 3.3.5). These wilderness resources include most of the land in the park and five marine wilderness waterways: the Beardslee Islands, Dundas Bay, the Hugh Miller / Scidmore complex, Adams Inlet, and Rendu Inlet (see figure 3-25). These marine wilderness waterways comprise 47,638 acres (19,278 hectares) or about 8% of the total marine waters in the park (see table 3-16 and figure 3-25).

Much of the designated terrestrial wilderness in Glacier Bay and Dundas Bay consists of ice and rock outcroppings. Land cover near the coastal environment includes coniferous or hardwood forests at various stages of succession, depending on their proximity to the glaciers. Some old-growth forests occur in designated wilderness. While Glacier Bay and Dundas Bay contain a large amount of designated wilderness, backcountry visitation is largely restricted to the narrow belt of shoreline throughout the Glacier Bay National Park and Preserve. Unless within designated wilderness waters, land below Mean Higher High water is not designated wilderness. The steep topography and dense vegetation of the coastal zone limits the area available for camping by backcountry visitors. Use is further concentrated, because visitors mainly are attracted to tidewater glacier areas and campsites

Wilderness Land and Water

Figure 3-25

National Park Service
U.S. Department of the Interior



Wilderness Park Land

Wilderness Park Water

Boundary of Glacier Bay National Park & Preserve

Glacier Bay National Park and Preserve

Vessel Quotas and Operating Requirements
Environmental Impact Statement

5 0 5 10 Miles

along the shoreline. Administrative closures of certain beaches due to bear concerns or for wildlife protection have added to camper congestion on the remaining suitable beaches.

Park Wilderness in Relation to the Entire National Wilderness Preservation System. Currently, Alaska has 48 congressionally designated wilderness areas. With the passage of the Alaska National Interest Lands Conservation Act, eight additional areas were designated as wilderness under NPS management. Those eight wilderness areas comprise nearly 34 million acres (13.7×10^6 hectares), or 32% of the total wilderness acreage in all of the U.S. In Alaska, the Glacier Bay wilderness represents nearly 6% of the total NPS wilderness and nearly 2.5% of the total acres of wilderness for all agencies that manage wilderness (Wilderness Information Network 2002).

More important than its size, the Glacier Bay wilderness offers some of the most unique resources in all of the National Wilderness Preservation System. With its calving tidewater glaciers, temperate rainforest, plant diversity, and terrestrial and marine wildlife, including threatened and endangered species, the Glacier Bay wilderness is an unparalleled intact ecosystem.

Glacier Bay is one of the most pristine units in the National Wilderness Preservation System. A survey of backcountry visitors to Glacier Bay in 1984 (Salvi and Johnson 1985) showed that 68.8% of respondents did not see any evidence of litter and that 90.1% of respondents saw no cut branches or trees. During a reconnaissance backcountry sea kayak wilderness trip to the Hugh Miller / Scidmore area by one of the EIS team members in June 2001, very little evidence of human pollution or impact was detected along shorelines or within the water. The pristine qualities of wilderness, along with opportunities to experience solitude and other characteristics that attract backcountry visitors, are addressed in subsection 3.4.2, "Visitor Experience."

3.4.5 LOCAL AND REGIONAL SOCIOECONOMICS

3.4.5 Local and Regional Socioeconomics

This subsection addresses the baseline socioeconomic environment of the communities neighboring Glacier Bay and Dundas Bay, and those communities affected by visitor traffic to Glacier Bay. Baseline data are presented for Gustavus, Elfin Cove, Hoonah, Pelican, Haines, Yakutat, Juneau, Skagway, and Sitka, Alaska. This subsection also provides baseline information regarding the role of the tourism industry in Southeast Alaska and the role that Glacier Bay plays in the industry.

Community baseline data addressed in this subsection include such factors as population, employment, and per capita and household income. The baseline analysis includes an assessment of economic connections or links between communities and Glacier Bay. These links include cruise ships that visit a community and Glacier Bay, local businesses with Glacier Bay permits, and geographic proximity to Glacier Bay.

There are two types of Glacier Bay business permits: concession contracts and incidental business permits (IBP). Concession contracts are awarded through a competitive process. Eight cruise ship companies have permits to enter Glacier Bay: Carnival Cruise Line; Celebrity Cruises, Inc.; Crystal Cruises Inc.; Holland America Line, Inc.; Princess Cruises, Inc.; World Explorer Cruises; Cruise West; and Norwegian Cruise Lines. Tour vessel operators with concession permits include Cruise West; Clipper Cruises; Glacier Bay Adventures; Glacier Bay Park Concessions, Inc. (a subsidiary of Juneau-based Goldbelt, Inc.); and Lindblad Expeditions.

In addition to cruise and tour vessel services, other concessions for Glacier Bay include 13 Glacier Bay charter vessels, one kayaking guide service, and one kayak rental concession. Glacier Bay Park Concessions, Inc., holds the lodging and food service concession contract for the government-owned Glacier Bay Lodge in Bartlett Cove. Lodging and hunting guide permits for Dry Bay, as well as several Alsek River rafting permits, also have been granted.

An incidental business permit authorizes services (NPS 2002h):

- for which no fixed commercial facilities are used or required within the park.
- for which the commercial activity originates outside the park.
- for which no money changes hands on park lands.
- for which no commercial solicitation occurs on park lands.
- that are appropriate in the park area.

Incidental business permits are issued for one-year terms. The types of services using these permits include charter vessel services in park waters outside Glacier Bay and Dundas Bay (which are open to concession permit holders only, May 16 through September 30), and kayaking in park waters outside Glacier Bay (open only to concession permit holders, June 1 through September 10). Backcountry guiding and air taxi operations are also authorized, with specific restrictions, with an incidental business permit. Approximately 40 incidental business permits are issued annually for Glacier Bay; however, there is no limit on the number of incidental business permits that can be issued.

Gustavus. Gustavus is a town of 429 residents located on the north shore of Icy Passage, at the entrance to Glacier Bay (Alaska Department of Labor and Workforce Development [ADLWD] 2000). The community is bordered on three sides by park and preserve land.

Local economy — Gustavus's economy (see table 3-17) is largely driven by the town's proximity to the park, which attracts large volumes of visitors to the area annually. The Park Service is by far the largest employer in the community. Glacier Bay Lodge, other area lodges, bed and breakfasts, and charter and tour companies provide additional local employment. Historically, fishing has been another important part of the economy. In 1997, 24 fishers fished 46 permits and earned $970,000. Because of Gustavus's reliance on the visitor and fishing industries, employment is largely seasonal. In 2001, 19 residents fished 29 permits, earning approximately $490,000 (Alaska Commercial Fisheries Entry Commission [ACFEC] 2002); however, participation and local earnings from fisheries have dropped in recent years, due in part to the Glacier Bay commercial fishing closures and restrictions. The Gustavus Public School and the Park Service provide some year-round stability. Construction projects also have contributed to the local economy in recent years. Gustavus, with its large base of private land, has benefited significantly from real estate sales in recent years, and many summer homes help support local businesses and maintain a steady construction industry.

TABLE 3-17: ECONOMIC INDICATORS — GUSTAVUS, ALASKA

Population 2000	429
Population Change 1990–2000	+66.3%
Percent Alaska Native	4.2%
Percent Employed Workers	54.6%
Number Employed	190
Percent Unemployed	8.9%
Percent Not in Labor Force	36.5%
Median Household Income	$34,766
Per Capita Income	$21,089
Percent Employed in Visitor-Affected Businesses[a]	45.3%

Source: ADLWD 2000.

a. These businesses include retail trade, transportation/warehousing/utilities, and arts/entertainment/recreation/accommodation/food services.

Gustavus's economic links with the park and preserve — Park management, park visitation, and commercial fishing accounted for most of the Gustavus area economic activity. Historically, commercial fishing in Glacier Bay has played an important role in the local economy. This has changed, however, with commercial fishing restrictions and closures in the Bay. For example, the Dungeness crab fishery was the most important fishery for the local economy five years ago; however, today, Dungeness fishing in the Bay is closed entirely, resulting in the loss of several hundred thousand dollars in annual gross income for local fishers and processors. The federal government bought out local Dungeness fisheries permit holders. Other fishers and processors have received compensation for impacts associated with commercial fishery closures. Local fishers who qualify for the lifetime-access permits can continue to fish in parts of the park waters.

Visitor travel to Glacier Bay is an important part of the Gustavus economy. Gustavus is served by daily jet service from Juneau in the summer, and commuter service year-round. In 2002, a ferry from Juneau arrived in Bartlett Cove four times weekly in the summer, and departed from Gustavus for the return trip. (In the past, this ferry ran daily trips between Juneau and Gustavus.) In a summer 2001 survey of visitors exiting Alaska at the Juneau Airport, 10% of respondents had spent at least one night in Gustavus or Glacier Bay (McDowell 2002a). Providing access to the park is Gustavus's major tourism asset. A Gustavus visitor information website bills Gustavus as the "Gateway to Glacier Bay National Park" and the "starting point to experiencing Glacier Bay" (Gustavus Internet Group 2002). As the website indicates, nearly all of Glacier Bay's non-cruise visitors must transit Gustavus at some point.

Although most of Gustavus's visitors are attracted to the area by the park, they usually spend at least some of their time in Gustavus. Only one lodging facility is located within the park, so many visitors who travel to Gustavus stay in Gustavus's local inns and bed and breakfasts. Along with trips into the

Bay aboard kayaks, charter vessels, and day tour vessels, visitors participate in many Gustavus-based activities, including kayaking, mountain biking, hiking, golfing, sport fishing, and wildlife viewing.

Gustavus-based businesses with concession permits to operate charter vessels in the park include Glacier Bay Country Inn, Grand Pacific Charters, Gustavus Marine Charters, and Sea Wolf Wilderness Adventures. Whisper Marine, True North Charters, Whale Bay Charters, and Cross Sound Express have incidental business permits. Glacier Bay Sea Kayaks and Alaska Discovery have concession permits for kayaking, Glacier Bay Adventures has a concession permit for a tour vessel, and TLC Taxi has an incidental business permit for a taxi service. Air Excursions has an air taxi permit.

It should be noted that not all visitation to Gustavus is park related. Some regional residents (Juneau residents, in particular) use Gustavus as a weekend getaway destination, and some have summer homes in the area. Other visitors come to Gustavus for the sole purpose of sport fishing.

The Gustavus economy has never been sufficiently modeled to quantify the park's role in terms of local personal income; however, for the purposes of this study, it is assumed that about one-half of all local personal income is directly or indirectly linked to park visitation. This includes income related to visitors traveling to the area to see Glacier Bay on tour and charter vessels.

Elfin Cove. Elfin Cove's population is seasonal, with just a handful of winter residents and up to approximately 70 summer residents. The community is located on the northern coast of Chichagof Island (ADLWD 2000) and lies less than 25 miles (40 kilometers) southeast of the entrance to Glacier Bay.

Local economy — Elfin Cove's economy (see table 3-18) revolves around the fishing industry. Twenty-seven year-round or seasonal residents hold commercial fishing permits, and 10 local lodges cater to sport-fishing visitors (Alaska Department of Community and Economic Development [ADCED] 2002). Nearly all employment is seasonal. Elfin Cove also serves as a vital service center for commercial and recreational vessels. The principal commercial fishery based in Elfin Cove is the salmon troll fishery. Elfin Cove also is the closest community to the principal trolling areas in the Inain Islands and Cross Sound, and has fuel, ice, and a fish buyer. These reasons made Elfin Cove a hub for the commercial fishing industry. In addition to the 27 permit holders who list Elfin Cove as home, fishers from throughout the region have traditionally made Elfin Cove their port of call during the summer troll season.

TABLE 3-18: ECONOMIC INDICATORS — ELFIN COVE, ALASKA

Population 2000	32
Population Change 1990–2000	-43.9%
Percent Alaska Native	0%
Number Employed	10
Percent Unemployed	11.1%
Percent Not in Labor Force	51.9%
Median Household Income	$33,750
Per Capita Income	$15,089
Percent Employed in Visitor-Affected Businesses[a]	70.0%

Source: ADLWD 2000.

a. These businesses include retail trade, transportation/warehousing/utilities, and arts/entertainment/recreation/accommodation/food services.

Tourism — Elfin Cove's economy is heavily reliant on the sport-fishing industry, with 10 lodges. Occasionally, small cruise ships stop in Elfin Cove. In 2001, the *Yorktown Clipper* made 13 calls at

Elfin Cove, with approximately 1,500 total passengers. The availability of fuel, groceries, a public dock, and a restaurant draws visitors aboard sport-fishing or tour vessels.

Elfin Cove's economic links with the park and preserve — Local economic links with Glacier Bay include commercial fishing and relatively limited visitor traffic. Some Elfin Cove lodges use access to Glacier Bay in marketing to clients. They include sightseeing tours to Taylor Bay. Two Elfin Cove area businesses have concession permits to operate in the park as charter vessels. Six businesses have incidental business permits to operate as charter vessels. (Several of these businesses have additional incidental business permits that allow them to take clients hiking and kayaking along the park's outer coast, with the exception of Dundas Bay.) For the purposes of this study, it is assumed that less than 10% of local personal income is directly or indirectly linked to park visitation aboard motorized vessels.

Hoonah. Hoonah is a predominantly Alaska Native community of 860 located on the northeast shore of Chichagof Island (ADLWD 2000). It is approximately 30 miles (48 kilometers) from the mouth of Glacier Bay.

Local economy — Hoonah's economy (see table 3-19) is centered around commercial fishing, logging, and government. Commercial fishing provides much of the employment, with 117 residents holding permits (ADCED 2002). Two fish processing plants account for additional seafood-related employment. Commercial fishing restrictions in the park and preserve, and the associated compensation program, also will affect Hoonah's economy. Logging historically has been an important part of the economy, although timber activity in Hoonah (and throughout Southeast Alaska) has declined in recent years. USFS, municipal, and tribal government jobs help provide year-round stability to the economy. The Alaska Native Claims Settlement Act (ANCSA) village corporation, Huna Totem, also creates jobs for many local residents. Many residents depend on subsistence hunting and fishing as a food source.

TABLE 3-19: ECONOMIC INDICATORS — HOONAH, ALASKA

Population 2000	860
Population Change 1990–2000	+8.2%
Percent Alaska Native	60.6%
Number Employed	317
Percent Unemployed	12.5%
Percent Not in Labor Force	39.2%
Median Household Income	$39,028
Per Capita Income	$16,097
Percent Employed in Visitor-Affected Businesses[a]	24.2%

Source: ADLWD 2000.

a. These businesses include retail trade, transportation/warehousing/utilities, and arts/entertainment/recreation/accommodation/food services.

Tourism — Presently, Hoonah offers limited tourist attractions. A few businesses cater to sport-fishing visitors and one fishing lodge and a couple of bed and breakfasts provide some tourism-related employment. In addition, several hunting guides live in Hoonah and one major cruise line has employed local residents to provide onboard presentations. Although no cruise ships currently stop in Hoonah, the development at nearby Point Sophia will provide a cruise ship port of call which will result in economic benefits to Hoonah. Point Sophia will likely provide additional employment to Hoonah residents who provide flightseeing, whale watchers, and charter fishing services.

Hoonah's economic links with the park and preserve — Hoonah's economic links to the park have included commercial fishing (and related seafood processing) and a limited amount of visitor traffic.

Of more importance to Hoonah residents are their long-standing cultural links to Glacier Bay and Dundas Bay. The village's original location in Glacier Bay was destroyed by a glacial advance. Hoonah residents historically have participated in subsistence activities in the Bay, including fishing, seal hunting, and gull egg harvesting.

Currently, a very small portion of local personal income is linked to Glacier Bay visitation; probably no more than 2% or 3%, based on study team estimates.

Pelican. Pelican is a small community of 163 residents located on Lisianki Inlet, on Chichagof Island (ADLWD 2000). Pelican lies about 50 air miles (80 kilometers) south of the park and preserve.

Local economy — Pelican's economic activity (see table 3-20) centers around fishing and seafood processing, because of the proximity to fishing grounds on the Pacific Gulf Coast. Forty-one residents hold commercial fishing permits (ADCED 2002). The largest local employer is Pelican Seafoods. Government and transportation jobs provide some employment, while tourism adds a small amount of economic activity.

TABLE 3-20: ECONOMIC INDICATORS — PELICAN, ALASKA

Population 2000	163
Population Change 1990–2000	-26.6%
Percent Alaska Native	21.5%
Number Employed	81
Percent Unemployed	5.5%
Percent Not in Labor Force	29.1%
Median Household Income	$48,750
Per Capita Income	$29,347
Percent Employed in Visitor-Affected Businesses[a]	12.3%

Source: ADLWD 2000.

a. These businesses include retail trade, transportation/warehousing/utilities, and arts/entertainment/recreation/accommodation/food services.

Tourism — Because of its remoteness, Pelican generally receives relatively little tourism-related traffic. An Alaska Marine Highway System ferry service visits Pelican just twice monthly in summer, and once monthly in winter. Regularly scheduled float plane service from Juneau has three arrivals daily in the summer, and one arrival daily in the off-season. Most visitor activity is centered on several sport-fishing lodges and bed and breakfasts. Local lodging and charter businesses also advertise kayaking, hiking, wildlife viewing, and visiting local hot springs. Some kayakers use Pelican as a stop or jumping-off point for exploring Chichagof and Yakobi Islands. An annual music festival draws more than 100 visitors for one weekend in spring.

Pelican's economic links with the park and preserve — Although Pelican is geographically close to Glacier Bay, its economy currently is not closely linked to the park (commercial fishing and seafood processing have represented an economic link between Pelican and Glacier Bay). There is no direct, regular ferry service or air service between Pelican and Gustavus. Pelican's visitor website makes no mention of Glacier Bay as a nearby attraction, nor do the websites of several local visitor-oriented businesses (Pelican Convention and Visitors Bureau 2000). One local sport-fishing lodge has a concession permit to operate in the park, while another charter service has an incidental business permit. Currently, very little local personal income has a link to Glacier Bay visitation (probably no more than 2% or 3%, based on study team estimates).

Haines. Haines is a town of 2,392 residents located on the Chilkat Peninsula in northern Southeast Alaska (ADLWD 2000). Geographically, Haines is situated close to the park; the western border of the Haines Borough abuts the park's eastern border in the Chilkat Mountains.

Local economy — The Haines economy (see table 3-21) comprises mainly tourism, commercial fishing, construction, and government. Because of the seasonal nature of these industries (except government), a large portion of local employment is seasonal. The commercial fishing industry accounted for an estimated annual equivalent of about 90 jobs, or 10% of total employment, in 2000 (McDowell 2002b). The construction industry accounted for an average of 58 jobs in 2000, with peak employment at about 99 jobs, according to ADLWD data. Together, local, state, and federal government account for 190 year-round jobs, or 20% of local employment. Some government jobs result from Haines's status as a major trans-shipment point; it has an ice-free, deep-water port and dock, and year-round road access to Canada and Interior Alaska on the Haines and Alaska Highways.

TABLE 3-21: ECONOMIC INDICATORS — HAINES BOROUGH, ALASKA

Population 2000	2,392
Population Change 1990–2000	+13.0%
Percent Alaska Native	11.5%
Number Employed	992
Percent Unemployed	8.4%
Percent Not in Labor Force	38.4%
Median Household Income	$40,772
Per Capita Income	$22,090
Percent Employed in Visitor-Affected Businesses[a]	33.2%

Source: ADLWD 2000.

a. These businesses include retail trade, transportation/warehousing/utilities, and arts/entertainment/recreation/accommodation/food services.

Tourism — As several of Haines's industries, including fishing, timber, and mining, have declined over the last decade, its reliance on tourism has grown. In a 2002 study for the City of Haines, the employment attributed to the visitor industry in 2001 accounted for 26% of all wage and salary employment in Haines (20% being direct employment and 6% being indirect employment; McDowell 2002b). Visitor industry personal income accounted for 14% of all Haines employment-related personal income in 2001.

Approximately 200,000 visitors traveled to Haines in 2002. The bulk of these visitors were cruise passengers — 80,000 passengers off ships docked in Haines, and 40,000 off fast ferries from Skagway. Between 50,000 and 60,000 visitors arrived by highway and ferry. In 2003, cruise passenger volume from ships docked in Haines is expected to drop to 21,500 (McDowell 2002b).

Haines's economic links with the park and preserve — Haines's economic links to Glacier Bay have included commercial fishing and visitor travel. Most of the direct, visitor-industry economic links between Haines and the park exist in Haines-based flightseeing tours that fly over the park. In addition, two local air carriers offer regularly scheduled service between Haines and Gustavus, and several other carriers will schedule flights as needed. There is no direct, regular ferry service between Haines and Gustavus. Most of Haines's independent visitors travel by highway or by the Alaska Marine Highway System, neither of which are connected to Gustavus. Some independent travelers visit both communities; 12% of visitors who spent at least one night in Haines also spent at least one night in Gustavus (McDowell 2002a).

Chilkat Guides, a company that runs rafting trips down the Alsek River, is the only local business with a concession permit for the park. Three other businesses — Alaska Mountain School, Earthcenter Adventures, and Mountain Flying Service — have incidental business permits.

An indirect economic connection between the park and Haines exists through the cruise industry. Of the 80,000 passengers off large cruise ships docked in Haines in 2002, 60% of them visited the park (McDowell 2002a). A significant portion of Skagway cruise passengers who travel by fast ferry to Haines also visit the park on their cruises, because Skagway sees 88% of all Alaska cruise traffic. Haines is also important in its role as an itinerary option for ships that do not have park permits. It shares this role with other southeast ports.

Approximately 5% of total personal income in Haines is directly or indirectly linked to Glacier Bay visitation, based on study team estimates. This includes income generated by cruise ship passengers who visit Haines (and spend money while in town) and Glacier Bay, as well as flightseeing and air taxi service to Gustavus. Haines recognizes its proximity to the park as a marketing asset. On the Haines Convention and Visitors Bureau website, the park and preserve is mentioned as being nearby and accessible by airplane (Haines Convention and Visitors Bureau 2002).

Yakutat. Yakutat is a community of 808 residents located at the mouth of Yakutat Bay on the Gulf of Alaska (ADLWD 2000). The Yakutat Borough shares its eastern border with the park and preserve.

Local economy — Yakutat's economy (see table 3-22) depends on commercial fishing, fish processing, and government. A cold storage plant has been the major private employer, and 162 residents hold commercial fishing permits (ADCED 2002). Of the 390 year-round jobs in 2000, 104 (27%) were government-related (ADLWD 2002). The service and retail sectors also constitute a large percentage of local employment (34%). Most residents depend on subsistence hunting and fishing as a food source.

TABLE 3-22: ECONOMIC INDICATORS — CITY AND BOROUGH OF YAKUTAT, ALASKA

Population 2000	808
Population Change 1990–2000	+14.6%
Percent Alaska Native	39.6%
Number Employed	440
Percent Unemployed	6.0%
Percent Not in Labor Force	22.2%
Median Household Income	$46,786
Per Capita Income	$22,579
Percent Employed in Visitor-Affected Businesses[a]	29.1%

Source: ADLWD 2000.

a. These businesses include retail trade, transportation/warehousing/utilities, and arts/entertainment/recreation/accommodation/food services.

Tourism — Tourism plays a moderate role in Yakutat's economy. Tourism activity is driven mainly by sport fishing. Several lodges are located in the area, offering world-class saltwater and freshwater fishing. Hunting also draws a few visitors every year. Yakutat also serves as a popular access point for guided and unguided rafting and kayak adventures. Alaska Discovery, for example, runs a trip that includes a night in Yakutat before and after a kayak trip in nearby Icy Bay. Climbers use Yakutat as a base for ascents of Mount St. Elias, Mount Fairweather, and Mount Logan. Other businesses catering to the visitor industry include a rental car agency, several restaurants, a kayak rental business, and a surf shop. According to 2000 U.S. Census data, nearly 30% of jobs are in visitor-affected businesses.

Yakutat's economic links with the park and preserve — Yakutat's economy has several links to the park, though very little, if any, is related to motorized vessel visitation. The town sees some visitor activity from river rafters who have descended down the Alsek and Tatshenshini Rivers, through the park into nearby Dry Bay. Climbers of Mount Fairweather, located in the park, use Yakutat as a base. Several local hunting guides take visitors into the park.

Three lodging facilities at Dry Bay have concession permits for lodging at Dry Bay Preserve: Johnny's East River Lodge, Northern Lights Haven, and Alsek River Lodge. Two hunting guides, Gary C. Gray and John H. Latham, have concession permits to hunt in Dry Bay Preserve. Gary C. Gray also has a concession permit for Alsek River rafting. The other Yakutat-based businesses operating in the park have incidental business permits. These include Brabazon Expeditions (sport fishing, guided hiking, sightseeing, and walking tours), See Alaska with Jim Keeline (sport fishing at Dry Bay), and Alsek Air Service.

Although cruise ships do not stop in Yakutat, they do pass by the community on their way to Hubbard Glacier; in 2001, 150 large cruise ships included the glacier on their itinerary (McDowell 2002c). Hubbard Glacier is affected by Glacier Bay cruise activity in that it is an alternative glacier-viewing spot. If a cruise itinerary does not include a Glacier Bay tour, the ship likely will stop at Hubbard Glacier instead. The local government has attempted to tax the cruise lines for entering Yakutat Bay; however, cruise lines are as yet declining to pay the tax. Two other enterprises in Yakutat service the cruise ships. A shuttle service boats pilots to and from cruise ships, and another enterprise provides interpretive guides for Hubbard Glacier.

Yakutat's visitor-oriented website does not mention the park and preserve, although its proximity is apparent on an online map of the area (Greater Yakutat Chamber of Commerce 2002).

Juneau. Juneau, the state capital, is a city of 30,711 people, located on the mainland of Southeast Alaska (ADLWD 2000). It lies about 50 air miles (80 kilometers) southeast of the park. Juneau is Southeast Alaska's largest city and is the service, supply, and transportation center for northern Southeast Alaska.

Local economy — Government is the mainstay of Juneau's economy (see table 3-23), with local, state, and federal employment constituting nearly 45% of all employment (7,000 jobs) in the community (ADLWD 2002). The seafood and mining industries, along with tourism (see below), also play important roles in the local economy. A total of 541 Juneau residents held commercial fishing permits in 2000, according to the Alaska Commercial Fisheries Entry Commission, and 412 Juneau residents purchased crew licenses in 2000 (ACFEC 2002). In 2001, seafood processor employment totaled an estimated 65 jobs. The mining industry employed an average of 291 workers in Juneau in 2000. The Greens Creek Mine, with about 265 employees, accounts for most of the mining employment in Juneau. Health care and social services are minor, but important, parts of the Juneau economy.

TABLE 3-23: ECONOMIC INDICATORS — CITY AND BOROUGH OF JUNEAU, ALASKA

Population 2000	30,711
Population Change 1990–2000	+14.8%
Percent Alaska Native	11.4%
Number Employed	16,537
Percent Unemployed	4.0%
Percent Not in Labor Force	24.5%
Median Household Income	$62,034
Per Capita Income	$26,719
Percent Employed in Visitor-Affected Businesses[a]	23.7%

Source: ADLWD 2000.

a. These businesses include retail trade, transportation/warehousing/utilities, and arts/entertainment/recreation/accommodation/food services.

Tourism — The visitor industry employs more Juneau residents than either seafood or mining. The most recent, comprehensive study of the economic effect of tourism on Juneau was prepared in 1996. That study found that, as of 1994, the visitor industry employed an annual average of 1,460 workers and generated $24 million in annual payroll (McDowell 1996a). This visitor industry employment included 630 jobs created as a result of cruise ship passenger spending and 830 jobs stemming from independent visitor spending (including convention visitors).

Since that study was completed, only the economic effect of the cruise industry has been re-examined. One study found that the cruise industry generated 748 jobs and $15.2 million in payroll in Juneau in 1999 (McDowell 2000a). In general, the independent market has been flat in Southeast Alaska over the last several years; however, some growth in Juneau's visitor industry has occurred. For example, employment in hotels increased by about 40 jobs between 1994 and 2000 (ADLWD 2002). Assuming modest growth in the independent market, in addition to the 118 new cruise-related jobs, current employment in Juneau's visitor industry can be estimated at about 1,650 jobs. Current payroll is estimated at approximately $30 million.

Visitors to Juneau arrive most often by cruise ship; 700,000 cruise passengers arrived in Juneau in 2002 (Juneau Convention and Visitors Bureau 2002). A recent study estimated annual non-cruise traffic (generally traveling by airplane or ferry) at 157,000 (Egret Communications / ARA Consulting 2002).

Juneau's economic links with the park and preserve — Approximately 5% of total personal income in Juneau is directly or indirectly linked to Glacier Bay visitation, based on study team estimates. The largest share of this is personal income generated by local spending by cruise ship passengers who also visit Glacier Bay. It also includes personal income generated by local businesses with links to Glacier Bay visitation, as described below.

As the southeast region's transportation hub, and with its location only 50 miles (80.5 kilometers) from Gustavus, Juneau has strong links with the park through its visitor industry. Every cruise ship that enters the Bay, large and small, includes Juneau on its itinerary. Of all cruise ships visiting Juneau in 2001, more than half (53%) visited Glacier Bay (McDowell 2002a).

Most independent visitors to the park must stop in Juneau, if only briefly. All jet flights and most commuter flights to Gustavus originate in Juneau. The ferry to Gustavus leaves from Juneau. Juneau is a logical spot for private boaters to stop on their way to or from the Bay. Exceptions are visitors flying in commuter aircraft from other southeast towns and some private vessel visitors. Also, there are some independent visitors who may only pass through the Juneau Airport on their way to and from the Bay. In a 2001 survey of visitors at the Juneau Airport who were exiting the state, 10% had spent at least one night in Gustavus or Glacier Bay and only a few of these visitors did not spend at least one night in Juneau (McDowell 2002a).

Several Juneau businesses have permits to operate in Glacier Bay. The largest of these is Goldbelt, Inc. Goldbelt, Inc., is an ANCSA corporation, owned by Alaska Natives, most of whom reside in Juneau. Goldbelt, Inc.’s, interests in Glacier Bay include:

- the Glacier Bay Ferry, a fast catamaran that runs between Juneau and Gustavus / Bartlett Cove four times per week.
- a day cruise vessel that takes visitors into the Bay for glacier and wildlife viewing, with daily departures from Bartlett Cove.
- the Glacier Bay Lodge, the only overnight lodging operation in the park.
- Glacier Bay Cruises, a cruise line with three small cruise ships that tour the park and waters outside the park throughout the summer.

Another Juneau-based business with interests in Glacier Bay is Alaska Discovery, the main adventure tour operator in the park. In addition to operating a five-bedroom bed and breakfast in Gustavus, the business runs one-day sea kayaking tours out of Bartlett Cove and 24 multi-day kayaking trips in Glacier Bay each summer.

Several smaller-scale permit holders in the park are based in Juneau. These include Admiralty Tours, Seawind Charters, and Marine Adventure Sailing Tours.

Glacier Bay clearly has a role in attracting visitors to Juneau, although the extent is difficult to identify. On the Juneau Convention and Visitors Bureau website (www.traveljuneau.com), the park and preserve is highlighted frequently. It is mentioned on the “Welcome to Juneau” page in reference to glacier viewing, and again on the “All About Juneau” page as conveniently accessible from Juneau. On the “Nearby Areas” page, “Glacier Bay National Park & Gustavus” is the first area listed (followed by other communities such as Skagway, Haines, Yakutat, and Sitka). It is also in the “Ask the Locals” section, in which a two-day trip is recommended.

Skagway. Skagway is a community of 862 residents located on the northernmost end of Lynn Canal (ADLWD 2000). Skagway is 40 air miles (64 kilometers) from the park’s border in the Chilkat Mountains, and 150 miles (240 kilometers) by water from the mouth of the Bay.

Local economy — Skagway’s major industry is tourism. Retail, dining, lodging, and tour companies aimed at the visitor industry provide the bulk of Skagway’s jobs, leading to a highly seasonal employment situation. Unlike other southeast towns, Skagway has virtually no fishing industry; two residents fished three permits in 2001 (ACFEC 2002). Because of its access to the highway system, Skagway serves as a trans-shipment point for freight. State and local governments provide some year-round employment.

TABLE 3-24: ECONOMIC INDICATORS — CITY OF SKAGWAY, ALASKA

Population 2000	862
Population Change 1990–2000	+24.6%
Percent Alaska Native	3%
Number Employed	475
Percent Unemployed	11.1%
Percent Not in Labor Force	21.1%
Median Household Income	$49,375
Per Capita Income	$27,700
Percent Employed in Visitor-Affected Businesses[a]	53.9%

Source: ADLWD 2000.

a. These businesses include retail trade, transportation/warehousing/utilities, and arts/entertainment/recreation/accommodation/food services.

Tourism — The visitor industry plays an enormous role in Skagway's economy (see table 3-24). In 2002, approximately 612,000 cruise passengers visited Skagway, according to the Skagway Convention and Visitors Bureau. They also estimate about 170,000 independent visitors (ADCED 2002). According to a 2000 study, the visitor industry injects approximately $60 million into the economy annually, and provides 450 jobs (Southeast Strategies and Dean Runyan Associates 2000). Skagway's Gold Rush heritage (particularly its historic White Pass and Yukon Route railroad tours) is its major visitor asset. Skagway's role as a northern terminus for the Alaska Marine Highway System is a further draw for ferry and highway travelers. In addition, the Chilkoot Trail attracts a substantial number of hikers; the trail is part of the Klondike Gold Rush National Historic Park.

Skagway's economic links with the park and preserve — Skagway's strongest link to the park is with the cruise industry. Many cruise ships that stop in Skagway also visit the Bay. In addition, several local air carriers offer visitors flightseeing tours of the park. While daily air service between Skagway (through Haines) and Gustavus is offered, no regular ferry service runs between the two communities. Most of Skagway's independent visitors travel by highway and by the Alaska Marine Highway System, neither of which are connected to Gustavus. Skagway's visitor website does not mention Glacier Bay (Skagway Convention and Visitors Bureau 2000).

One Skagway-based business has a permit to operate in waters outside Glacier Bay. Packer Expeditions has an incidental business permit to provide kayak touring services. Based on study team estimates, about one-third of Skagway area personal income has an indirect link to Glacier Bay visitation, almost all related to spending by cruise ship passengers who also visit Glacier Bay.

Sitka. Sitka is a community of 8,835 residents located on the western side of Baranof Island on Sitka Sound (ADLWD 2000). It lies approximately 100 air miles (160 kilometers) southwest of Glacier Bay.

Local economy — Sitka's major industries are commercial fishing, seafood processing, tourism, government, and health care. Southeast Alaska Regional Health Corporation is the largest employer in the community, with 367 full-time-equivalent jobs in 2000 (McDowell 2002). The two largest seafood processors provided 241 jobs combined. Also in 2000, 583 Sitka resident permit holders fished 880 permits, generating about $23 million in ex-vessel value (the value of fish sold to processors). The federal government, notably the U.S. Coast Guard and U.S. Forest Service, which together accounted for 301 jobs in 2000, is also an important part of the economy (see table 3-25).

TABLE 3-25: ECONOMIC INDICATORS — CITY AND BOROUGH OF SITKA, ALASKA

Population 2000	8,835
Population Change 1990–2000	+2.9%
Percent Alaska Native	18.6%
Number Employed	4,352
Percent Unemployed	5.5%
Percent Not in Labor Force	26.4%
Median Household Income	$51,901
Per Capita Income	$23,622
Percent Employed in Visitor-Affected Businesses[a]	24.6%

Source: ADLWD 2000.

a. These businesses include retail trade, transportation/warehousing/utilities, and arts/entertainment/recreation/accommodation/food services.

Tourism — The visitor industry is vital to Sitka's economy. In 2001, 206,000 cruise passengers visited Sitka, in addition to approximately 75,000 visitors who arrived by ferry and airplane (McDowell 2002d). Many of these non-cruise visitors come for Sitka's sport fishing. Others are drawn by the area's kayaking opportunities, Russian heritage, and Native culture. Based on a 1996 study, Sitka's visitor industry generates approximately 500 annual jobs in the local economy, out of the total employment of 4,000 (McDowell 1996b, 2002d).

Sitka's economic links with the park and preserve — Sitka's economy has few links to the park. There is no direct, regular ferry service or air service between Sitka and Gustavus. Glacier Bay is too far away to be included in Sitka's flightseeing itineraries. In a 2001 survey of visitors exiting Alaska from Sitka's airport, only 3% of respondents had spent one or more nights in Gustavus or at the park (McDowell 2002a).

No Sitka-based businesses have permits to operate in the park. Sitka's visitor website makes no mention of Glacier Bay (Sitka Convention and Visitors Bureau 2000). An indirect link between Sitka and Glacier Bay exists in the cruise industry. In 2001, several large cruise ships included Sitka and Glacier Bay in their itineraries. Geographically, the route between Sitka and Glacier Bay is convenient for cruise ships. In addition, Sitka is an alternative destination for ships that do not have permits to enter the Bay and those that have extra time for a port call.

A small percentage (2% to 3%) of Sitka area personal income has an indirect link to Glacier Bay visitation, based on study team estimates, with almost all related to spending by cruise ship passengers who also visit Glacier Bay.

Southeast Alaska's Regional Visitor Industry. This subsection provides baseline information about the visitor industry (particularly the cruise industry) in Southeast Alaska and its effects on the regional economy. This information is critical to understanding the park's role in Southeast Alaska.

According to the Alaska Visitor Statistics Program, a statewide visitor survey project administered by the State of Alaska, approximately 1,202,000 out-of-state visitors came to Alaska in summer 2001, with 81% (or 974,000) visiting Southeast Alaska (Northern Economics 2002). Cruise Line Agency of Alaska (CLAA) data show that 691,000 of these visitors participated in a cruise, leaving approximately 280,000 non-cruise visitors to Southeast Alaska in summer 2001.

A 1999 statewide economic impacts study estimated that in 1998, visitors spent $949 million and the visitor industry created 20,300 jobs with $390 million in earnings (McDowell 1999). Including indirect effects, visitor-related spending totaled $2.6 billion, visitor-related employment totaled 30,700 jobs, and visitor-related earnings totaled $640 million. In Southeast Alaska, the visitor industry accounted for 4,400 jobs and $86 million in earnings.

The cruise industry in Southeast Alaska has maintained strong growth throughout the last decade, with passenger traffic increasing from 265,000 in 1992 to 719,000 in 2002 (CLAA 2002; see table 3-26). In the last five years alone, traffic has grown by 26%. A 2000 study estimated the economic effects of the cruise industry on Southeast Alaska for 1999. They included $193 million in purchases by cruise passengers, 1,990 average annual jobs, $40.2 million in payroll, and $7.8 million in total sales tax revenues.

TABLE 3-26: SOUTHEAST ALASKA CRUISE TRAFFIC, 1992–2003

Year	Number of Cruise Passengers
1992	265,000
1993	306,000
1994	379,000
1995	383,000
1996	464,000
1997	525,000
1998	569,000
1999	596,000
2000	640,000
2001	691,000
2002	719,000
2003 (projected)	813,000

Source: CLAA 2002.

Over the last 10 years, the cruise industry has played an increasingly important role in Southeast Alaska's economy. Cruise traffic, as stated above, has experienced strong and steady growth. In the meantime, according to data from the Alaska Department of Labor and Workforce Development, employment in Southeast Alaska's traditional basic industries has either stayed steady or declined over the past decade. These industries include seafood processing (0% growth), forest products (66% decline), state government (5% decline), and federal government (14% decline). Employment in these four industries, as a group, has declined by 23% since 1990, a loss of nearly 3,000 jobs. As a result, tourism — cruise travel, in particular — is playing an increasingly important role in the Southeast Alaska regional economy. Tourism is now the region's largest private sector industry in terms of employment.

While the events of September 11, 2001, and other factors have caused a slump in domestic and international travel, long-term projections show relatively quick recovery and long-term growth. The World Travel and Tourism Council (WTTC) expects 4.5% annual growth in travel and tourism between 2002 and 2012 (Weinstein 2002). Cruise ship capacity is expected to increase as well. Cruise passenger growth has increased annually at an average rate of about 7% since 1981. This growth rate is expected to continue over the next five years, according to the Cruise Lines International Association (CLIA 2002).

The Alaska cruise market is expected to experience its share of this growth. A study by Miami-based cruise industry consultant Bermello Ajamil & Partners predicts that the home port market from the combined ports of Seattle and Vancouver will grow from an estimated 1.2 million passengers to 2.2 million by 2010 (Vancouver Sun 2002). Alaska cruises now account for about two-thirds of the Vancouver/Seattle home ports.

The Park's Role in Southeast Alaska's Visitor Industry. Market research indicates that the opportunity to visit the park and other national parks in Alaska plays an important role in drawing visitors to the state. Research funded by the Alaska Travel Industry Association (ATIA) includes measures of prospective visitors' interest in visiting Glacier Bay. "Visiting Glacier Bay National Park" and "seeing the glaciers and fjords of Alaska" received the highest measures of interest (GMA Research Corporation 2001). Ninety-three percent of the prospective Alaska visitors surveyed expressed interest in visiting Glacier Bay. Part of the reason for the park's high level of recognition and interest among potential Alaska visitors is the cruise industry's national advertising campaigns, which often highlight the kinds of attractions found in the park. In fact, about one-third (32%) of Alaska's 1.2 million visitors total visited Glacier Bay in 2001, with most seeing the Bay from cruise ships (88% of the park's 383,000 visitors experienced Glacier Bay on a cruise ship in 2001). About half of Alaska's 700,000 cruise ship visitors visited Glacier Bay. Only 4% of the state's non-cruise visitors traveled to the Bay (McDowell 2002a).

While the kind of experience offered by Glacier Bay is in high demand among Alaska visitors, limitations on access to the Bay (regulatory and economic) apparently have not constrained growth in Alaska's visitor industry. For example, the number of June, July, and August cruise entries into Glacier Bay has been limited at 139 since 1996. During this time, cruise ship passenger traffic to Glacier Bay increased 28%, as a result of some shoulder-season growth and an increase in the passenger capacity of the ships visiting the Bay. Meanwhile, since 1996, the number of visitors traveling to or from Alaska on cruise ships has grown from 464,000 to 719,000, an increase of just more than 50%.

ENVIRONMENTAL CONSEQUENCES

GLACIER BAY
NATIONAL PARK AND PRESERVE, ALASKA

VESSEL QUOTAS AND OPERATING REQUIREMENTS • FINAL ENVIRONMENTAL IMPACT STATEMENT

CHAPTER 4. ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

This chapter evaluates the environmental consequences of the six alternatives presented in chapter 2. Each alternative specifies quotas (limits) and operating requirements for cruise ships, tour vessels, charter vessels, and private vessels in Glacier Bay and Dundas Bay. The potential effects associated with each alternative are analyzed and compared to the existing (baseline) conditions of each environmental resource topic identified in chapter 3.

The effects analysis (sections 4.2 through 4.4) is organized by resource topic and includes subsections corresponding to the following:

- issues raised during scoping.
- the regulatory framework, if appropriate.
- the methodology and assumptions.
- the direct and indirect effects analysis for each alternative.
- the cumulative effects analysis for each alternative.
- the impairment analysis for each alternative.
- mitigation measures, if relevant, for each alternative.

Sections 4.5 through 4.7 discuss any unavoidable adverse effects that would result with the alternatives considered in this EIS, along with sustainability and long-term management. These topics must be addressed in any EIS.

4.1.1 Overview of Methodology and Threshhold Criteria

4.1.1 Overview of Methodology and Threshold Criteria

In accordance with the NEPA and its implementing regulations, this EIS considers direct, indirect, and cumulative effects:

- **Direct effects** are those that result from the action and occur at the same time and place. Dispersion of air pollutants from a vessel stack into the atmosphere is an example of a direct effect.
- **Indirect effects** are those reasonably foreseeable effects that are caused by the action but that may occur later and not at the location of the direct effect. For example, an indirect effect of reducing vessel traffic in Glacier and Dundas Bays may be an increase in demand for use of other areas.
- **Cumulative effects** are the incremental effect of the proposed action when added to the effects of past, other present, or reasonably foreseeable future actions. Cumulative effects can result from individually minor, but collectively significant, actions taking place over time.

Effects Thresholds. Thresholds provide an overall measurement of how the proposed action would influence the existing environment. The regulations issued by the Council on Environmental Quality to implement NEPA define significance of effects in terms of context and intensity. Context refers to the geographic area of effect, which varies with the physical setting of the proposed action and with each element of the environment analyzed. Intensity refers to the severity of the effect. Duration also must be considered in the assessment of effects and effects must be quantified as much as possible. For this EIS, effects thresholds are defined using four categories of significance:

- **Negligible** effects may or may not cause observable changes to natural conditions; regardless, they do not reduce the integrity of a resource.
- **Minor** effects cause observable and short-term changes to natural conditions, but they do not reduce the integrity of a resource.
- **Moderate** effects cause observable and short-term changes to natural conditions, and/or they reduce the integrity of a resource.
- **Major** effects cause observable and long-term changes to natural conditions, and they reduce the integrity of a resource.

Each resource topic discussion includes a threshold effects determination.

Methodology of the Impairment Evaluation. An impairment is an effect that “would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values” (NPS 2000b). An effect may constitute an impairment “to the extent that it affects a resource or value whose conservation is necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park; key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; identified as a goal in the park’s general management plan (NPS 1984); or other relevant NPS planning documents” (NPS 2000b). To judge whether a resource is impaired “depends on the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts” (NPS 2000b). Ultimately, the impairment determination rests with the park superintendent, subject to the approval of the regional director. The impairment determinations in this EIS are considered to be recommendations to the park superintendent, not absolute findings of impairment.

Mitigation Measures. This chapter also identifies and discusses mitigation measures. Mitigation measures are specific methods for avoiding, minimizing, rectifying, reducing, or compensating for an alternative's adverse effect(s). For each resource and alternative, a mitigation measures subsection identifies reasonable measures that could alleviate any adverse environmental effects. Any adverse effects of the mitigation measures and their appropriateness are discussed. Although mitigation measures are identified, the Park Service will select the specific mitigation measures to be taken when a decision regarding a preferred alternative is made.

In addition, there are also in-place mitigation measures associated with each alternative. These in-place mitigation measures include existing regulations primarily associated with vessel operating requirements. These regulations will remain in effect regardless of the alternative selected as a result of this EIS. In addition, a number of operating requirements proposed for change in alternatives 4, 5, and 6 may also serve to mitigate adverse environmental effects. An evaluation of the effects of these actions is included in the analysis of alternatives.

Conclusions. Following the effects analysis and mitigation measures, a conclusion section integrates these evaluations. Each analysis of the effects of an alternative on a resource finishes with an overall summary regarding whether the effects are negligible, minor, moderate, or major.

Sustainability and Long-Term Management. The analysis of sustainability and long-term management (section 4.7) focuses on the following three concepts:

- the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity (NEPA section 102[c][iv]).
- any irreversible or irretrievable commitments of resources that would be involved if an alternative were implemented (NEPA section 102[c][v]).
- any adverse impacts that could not be avoided if an action were implemented (NEPA section 101[c][ii]).

4.1.2 Major Assumptions for the Effects Analysis

4.1.2 Major Assumptions for the Effects Analysis

The effects analysis is built upon several assumptions regarding the existing situation in Glacier Bay and Dundas Bay, as well as conditions that may be expected to occur in the future. Most of these assumptions are resource-specific and are discussed under the effects methodology description for each resource area; however, other assumptions apply to many or all topics. These assumptions are summarized below.

Visitor Use and Demand. This analysis assumes that the demand to experience Glacier and Dundas Bays will continue to increase in concert with growth in population (Alaska and the U.S. as a whole) and the Alaska tourism industry. Visitor travel to Alaska is expected to increase over the long-term. Cruise ship passenger traffic has been projected to grow to between 1.2 million and 1.5 million passengers over the next ten years (Bermello, Ajamil & Partners 2003). This forecast reflects market trends and assumes that adequate infrastructure will be in place to accommodate this traffic. With cruise ship dock planning and development efforts underway in Ketchikan, Sitka, Juneau, and Hoonah, new infrastructure should support this growth. Growth of the independent visitor market (non-cruise ship) has been flat in recent years, but is expected to grow slowly over the long term (McDowell Group, Calvin, electronic mail, September 18, 2003). In Glacier Bay this growth market is reflected in increased cruise ship traffic in May and September when seasonal limits do not apply. To establish a basis for comparison among alternatives for vessel activity during May and September, average daily vessel-use statistics were generated for these months. Table 4-1 provides the numbers that were used to compare vessel use levels between the alternatives in May and September.

TABLE 4-1: ASSUMPTION OF DAILY VESSEL USE LEVELS IN MAY AND SEPTEMBER, GLACIER BAY AND DUNDAS BAY

Vessel Class	Alternatives 1, 2, and 3		Alternative 4		Alternatives 5 and 6	
	Glacier Bay	Dundas Bay	Glacier Bay	Dundas Bay	Glacier Bay	Dundas Bay
Cruise Ship	Up to 2[a]	0	Up to 2[a]	0	Up to 2[a]	0
Tour Vessel	Up to 3[a]	Up to 2, average 0.5	Up to 2[a]	0	Up to 3[a]	Up to 2, average 0.5
Charter Vessel	Up to 6	Up to 8, average 3	Up to 5[a]	Up to 3[a]	Up to 6	Up to 8, average 3
Private Vessel	Up to 25	Up to 8, average 4	Up to 22[a]	Up to 8, average 4	Up to 25	Up to 8, average 4

a. This is the daily vessel quota specified under this alternative; it represents the maximum consideration (the actual numbers usually drop off significantly during these months).

For each alternative, it is assumed that vessel entries to the park would eventually reach maximum allowable levels in the peak period spanning May through September. Currently, cruise ship entries often reach maximum levels in the off-season, May and September, and during the peak period, June through August. Actual use, however, may be at lower levels, because the park experiences no-shows and demand sometimes has been lower than established quotas. Entries into the park during other times of the year are generally expected to reflect lower demand and, therefore, be at levels less than maximum entry limits. Cruise ships and tour vessels are assumed to be absent from park waters from November through March.

Effects of Vessels. For the purposes of analysis, it is also assumed that all vessels within each vessel class produce the same types and intensities of environmental effects. This assumption is based on the similar use patterns within each vessel category, as well as the general size of each vessel category. Size is accounted for in alternatives 4, 5, and 6 in which vessel speed restrictions are defined according to vessel size rather than vessel category. In addition, effects related to vessel presence in the park are assumed to be directly proportional to the number of vessels. In other words, twice as many vessels of any particular category would be assumed to cause twice the level of effects, in terms of intensity.

Two changes in the quota system under alternatives 4, 5, and 6 would change vessel use patterns in the lower Bay. By eliminating the “based in Bartlett Cove” exemption, current, unregulated use of the lower Bay would be eliminated. However, by changing the quota system to allow a vessel to enter, leave, and reenter Glacier Bay when a permit is issued, some private and charter vessels are expected to visit the lower Bay as part of excursions throughout the Icy Strait area, thereby increasing vessel traffic somewhat in the lower Bay. It is assumed in the analysis that the effects of these two changes are offsetting and, therefore, do not substantially alter environmental effects and are not evaluated in the EIS.

Another change that is scheduled to occur, with all of the alternatives, is a revision to the park prospectus to allow currently unutilized charter vessel permits to be redistributed. Although this is not directly addressed in the alternative it is assumed that as a result of this redistribution of permits, charter vessel use in Glacier and Dundas Bays is likely to increase up to the allowable entry level. Therefore, the maximum number of charter vessels is assumed in the analysis of each alternative.

4.1.3 Assumptions for the Cumulative Effects Analysis

4.1.3 Assumptions for the Cumulative Effects Analysis

Projects and actions assumed to contribute to cumulative effects in this analysis are listed below. These projects and actions are likely to affect several or all resources evaluated in this EIS:

- The Glacier Bay National Park and Preserve Backcountry Management Plan.
- commercial fishing activities.
- *The Master Memorandum of Understanding between the Park Service and Alaska Department of Fish and Game regarding management of fish and wildlife in the park.*
- commercial and private vessels in waters outside Glacier Bay and Dundas Bay.
- increases in tourism and the population of Southeast Alaska.
- natural phenomena.
- non-motorized vessel use in Glacier Bay and Dundas Bay.
- flightseeing.
- administrative vessel traffic.
- the Bartlett Cove ferry.
- Point Sophia development at Hoonah.

The following subsections describe these projects and actions.

Glacier Bay National Park and Preserve Backcountry Management Plan. The Glacier Bay National Park and Preserve backcountry management planning process is under way, and an environmental impact statement will be developed to present alternatives for managing the park's wilderness and backcountry. The environmental impact statement will address visitor use of wilderness and non-wilderness waters and land, especially shorelines. It likely will consider use via non-motorized vessels (mainly kayaks), as well as some aspects of recreational boating, camper vessel drop-offs, and off-vessel activities. The planning process and EIS will result in a record of decision that will direct the course of the park's backcountry management.

Commercial Fishing Activities. Commercial fishing vessel activities are not included in the proposed action and alternatives presented in this EIS; however, the effects of commercial fishing must be considered as part of the cumulative effects analysis. Commercial fishing is currently being phased out of Glacier Bay. Commercial fishing is not authorized within the wilderness waters of Glacier Bay and Dundas Bay. Commercial fishing in other areas of the park is authorized to take place in perpetuity.

Currently, three main types of commercial fishing are authorized, but are being phased out, in the non-wilderness waters of Glacier Bay: longline fishing for halibut, pot and ring fishing for tanner crab, and trolling for salmon. Fishing by lifetime-access permit holders will continue in Glacier Bay until all the current permit holders cease to fish.

The halibut fishery is managed on a limited-entry, quota-share basis. The fishing season typically runs from March 15 to October 15. Individual fishers are assigned Individual Fishing Quotas (IFQ), which apportion their share of the total annual commercial harvest. Halibut fishing was closed in Glacier Bay in November 1999, except for certain "grandfathered" fishers who are permitted to continue fishing non-wilderness portions of the Bay during their lifetime (NPS 1999d). Participation in the halibut fishery in 2001 (the most recent year for which data are available) was approximately 37 vessels in Glacier Bay (area 184) and 93 vessels in Dundas Bay and Icy Strait from Elfin Cove to the area north of Point Augusta (area 182; International Pacific Halibut Commission [IPHC], Kong, electronic mail, February 25, 2003).

Under federal law, the commercial Dungeness crab fishery was completely closed in Glacier Bay as of September 30, 1999. In 2002, eight permit holders fished for tanner crab in Glacier Bay (statistical area 114-70), and none in Dundas Bay. The tanner crab fishery lasted six days from February 15 to 21, 2002 (ADFG, Rumble, electronic mail, February 27, 2003).

Commercial salmon trolling was closed in Glacier Bay in June 1999, except for certain “grandfathered” fishers who are permitted to continue fishing non-wilderness portions of the Bay during their lifetime (NPS 1999d). During 2002, participation in the salmon troll fishery was as follows:

- Winter (October 11, 2001–April 14, 2002): Five hand-trollers and fewer than three power-trollers in the main portion of the Bay, and fewer than three hand-trollers in the West Arm.
- Spring (April 15–June 30, 2002): No participation.
- Summer (July 1–September 30, 2002): Fewer than three hand-trollers and four power-trollers in Dundas Bay (ADFG, Johnson, electronic mail, February 25, 2003).

The Master Memorandum of Understanding between the Park Service and Alaska Department of Fish and Game regarding Management of Fish and Wildlife in the Park. The Master Memorandum of Understanding between the National Park Service and the Alaska Department of Fish and Game recognizes that the State of Alaska has the primary responsibility of managing fish and wildlife in Alaska. This assessment considers the cumulative effect of ADF&G management outside of Glacier and Dundas Bays and the collective management efforts of the Alaska Department of Fish and Game and the National Park Service within park waters.

Commercial and Private Vessels in Waters outside Glacier Bay and Dundas Bay. Glacier Bay is part of a greater ecosystem that encompasses the waters surrounding the park. Commercial and private vessels traversing in waters outside of Glacier Bay and Dundas Bay could have an effect on the resources that move between Glacier and Dundas Bays and Icy Strait.

Increases in Tourism and the Population of Southeast Alaska. Increases in tourism and the population of Southeast Alaska will continue to increase demand to visit the park, and to increase vessel and other recreational activities in this part of the state. It is assumed that, over time, vessel quotas (limits) would be reached as demand increases. Development of a new visitor’s center in Glacier Bay and the Point Sophia cruise ship port in Hoonah, as well as population growth throughout Southeast Alaska, could result in increasing demand to visit Glacier Bay by cruise ship, tour vessel, charter vessel, or private vessel.

Natural Phenomena. Many forces acting on the marine environment (e.g., global climate change, sea otter recolonization of portions of Glacier Bay, or disease or parasite epidemics) may be responsible for increases or decreases in the population and distribution of marine species.

Non-Motorized Vessel Use in Glacier Bay and Dundas Bay. Visitors often use kayaks and canoes to access many areas of the park where motorized vessels are prohibited. Although these modes of travel do not cause the same types of disturbances as motorized vessels, they can create disturbances that may contribute to effects.

Flightseeing. Aircraft overflights, regulated by the Federal Aviation Administration (FAA), create noise and can be seen.

Administrative Vessel Traffic. The Park Service operates 12 vessels, on average, out of Bartlett Cove. NPS vessels include one naturalist transfer vessel (*M/V Serac*) that transports naturalists to and from cruise ships as the ships enter and exit Glacier Bay. Typically, two round trips are made for every cruise ship entry (one drop-off and one pickup). The Park Service also regularly operates four patrol vessels, five resource management vessels, and two fisheries research vessels throughout the park. Park Service patrol vessels often are used in the lower Bay and in Bartlett Cove. All vessels are based at Bartlett Cove and therefore transit concentrated whale-use areas to reach other locations in the park. The Park Service also operates vessels along the outer coast (NPS, Kralovec, pers. comm., September 13, 2003) Also included as part of administrative traffic are vessels associated with the Memorandum of Agreement between the Park Service and the Hoonah Indian Association to allow vessel access to Glacier Bay for traditional activities.

Bartlett Cove Ferry. The Bartlett Cove ferry is a passenger ferry that travels between Juneau and Bartlett Cove usually four times a week.

Point Sophia Development at Hoonah. The Huna Totem Corporation has developed a cruise ship “port of call” near the town of Hoonah at Point Sophia. This facility is expected to increase cruise ship presence in the Icy Strait area and, in particular, increase whale watching activities near Point Adolphus, flightseeing activities over Icy Strait and Glacier Bay, and charter fishing operations in Icy Strait.

Actions considered but eliminated from the cumulative analysis. Several projects and actions were reviewed for inclusion in the cumulative analysis but were found to not contribute to cumulative effects when assessed in combination with the actions assessed as part of this EIS. These projects and actions are:

- the USFS *Draft Supplemental Environmental Impact Statement (May 2002) for the Tongass Land Management Plan Revision — Roadless Area Evaluation for Wilderness Recommendations.*
- Alaska Marine Highway ferry to Gustavus.
- Falls Creek hydroelectric project.
- *USFS Tongass Shoreline Outfitters/Guide Draft Environmental Impact Statement*.

The U.S. Forest Service *Draft Supplemental Environmental Impact Statement (May 2002) for the Tongass Land Management Plan Revision — Roadless Area Evaluation for Wilderness Recommendations*. The Tongass National Forest abuts the park in several locations. The preferred alternative in the Tongass draft supplemental environmental impact statement is the no-action alternative (which is the existing 1997 Tongass forest plan revision). The U.S. Forest Service’s reason for selecting no action as the preferred alternative is that the 1997 revision was the result of a significant collaborative effort to seek a balance for protecting and managing the Tongass National Forest. The areas directly adjacent to the park are designated as “Mostly Natural Setting” and are further categorized in the plan/preferred alternative as one of the following:

- **Land Use Designation II Wilderness**. Areas that are congressionally designated as roadless and that permit fish and wildlife improvements and primitive recreation facilities.
- **Semi-Remote Recreation**. Areas where recreation and tourism are in natural-appearing settings and where moderate to high opportunities for solitude and self-reliance are provided.
- **Remote Recreation**. Areas for recreation in remote natural settings outside wilderness, where opportunities for solitude and self-reliance are high.

Areas for “Intense Development,” including timber harvest and mineral exploration, are not located adjacent to the park; however, recreational activities in the Tongass National Forest adjacent to the park could contribute to cumulative effects on park resources.

Alaska Marine Highway – Ferry to Gustavus. The Alaska State Ferry (Alaska Marine Highway) wants to add Gustavus and the park to their schedule. Two options exist for a docking facility: the public dock in Gustavus or the Bartlett Cove dock within the park. The Alaska State Ferry is not being considered as part of the current decision, and consultations between the State of Alaska and the National Park Service are not at the point to consider use of Glacier Bay by the Alaska Marine Highway as a “reasonably foreseeable” action and, therefore, is not considered as a cumulative action in this EIS.

Falls Creek Hydroelectric Project. The National Park Service is considering a land exchange with the State of Alaska as part of the proposed construction, operation, and maintenance of a privately owned hydroelectric facility at Falls Creek, located on Icy Passage east of the Gustavus Airport. The Falls Creek Hydroelectric project EIS will include an analysis of the removal of land from Glacier Bay National Park and transfer to the State of Alaska in the Falls Creek area and the transfer of State of Alaska lands to the National Park Service.

U.S. Forest Service *Tongass Shoreline Outfitters/Guide Draft Environmental Impact Statement*. The U.S. Forest Service is establishing quotas and guidelines for outfitter/guide use of the Tongass National Forest shoreline zone. This action is needed to meet the forest plan goals and objectives related to recreation, tourism, and economic support to communities; and meet the increased demand for guided recreation while protecting the ecosystem. The analysis area covers approximately 7,018,700 acres of the Admiralty Island National Monument, and the Hoonah, Sitka, and Juneau Ranger Districts on the northern half of the Tongass National Forest. The shoreline zone includes approximately 5,300 miles of shoreline and extends one-half mile inland from the mean high tide.

The U.S. Forest Service has prepared a NEPA DEIS regarding this action. However, the DEIS considers only on-shore effects. Marine vessel use was determined to be outside of the scope of the EIS and, therefore, this action and the associated EIS are not considered as part of the cumulative effects analysis. However, general vessel traffic, including outfitter and guide use on the Tongass National Forest, are considered in some of the cumulative effects analyses.

4.2.1 SOUNDSCAPE

4.2 PHYSICAL ENVIRONMENT

4.2.1 Soundscape

This section evaluates the effects of cruise ship and tour, charter, and private vessels in Glacier and Dundas Bays on the natural soundscape. Effects of noise on fish and wildlife are described under Section 4.3, Biological Environment. Effects of noise on visitors are described under "Visitor Experience."

The natural soundscape refers to naturally generated sounds in the absence of human-caused sounds. Natural soundscapes are typically anything but quiet, and include such sounds wind, rain, streams, and rivers; glaciers calving; and bird, whale, and wolf calls. For this analysis, the natural soundscape in the park has been divided into surface soundscape and the underwater soundscape.

Issues of Concern Raised during Scoping. The primary concern for this topic is how sounds resulting from vessel quotas and operating requirements might intrude upon the natural soundscape Glacier and Dundas Bays.

Regulatory Framework.

The current regulations at Glacier Bay National Park and Preserve have the following noise restrictions:

> June 1 through August 31, except on vessels in transit or as otherwise permitted by the superintendent, the use of generators or other non-propulsive motors (except a windless) is prohibited from 10:00 p.m. until 6:00 a.m. in Reid Inlet, Blue Mouse Cover, and North Sandy Cove.

Thirty-six CFR 2.12 specifies NPS regulations for "audio disturbances."

In the Omnibus Parks and Public Lands Management Act of 1996 (Public Law 104-333), Congress emphasized park values and resources when it limited the authority of the Park Service to set operating conditions related to noise in the park. Specifically, this act states that:

> *No operating conditions or limitations relating to noise abatement shall be imposed unless the secretary determines, based on the weight of the evidence from all available studies including verifiable scientific information from the investigations provided for in this subsection, that such limitations or conditions are necessary to protect park values and resources.*

Methodology and Assumptions. The basis for determining effects on the natural soundscape is included in section 1.4 of NPS policies (NPS 2001b) and Director's Order 47 (NPS 2001c). Because Glacier Bay National Park and Reserve is a marine-oriented park, soundscape was evaluated for both the surface environment and the underwater environment. The first step in the effects analysis was to identify the types of sounds that cruise ships, tour vessels, charter vessels, and private vessels generate in Glacier Bay and Dundas Bay (see subsection 3.2.2). Vessel noise, as used in this final environmental impact statement, refers to all sounds generated from cruise ships and tour, charter, and private vessels, and includes such things as engine and propeller noise, voices, public address systems, bow wave noise, and wakes breaking onshore. Other human-made sounds considered include noises made by off-vessel uses, such as kayak drop-offs from vessels. This evaluation considers sounds generated from NPS facilities at Bartlett Cove only as they might interfere with the natural soundscape outside of the developed area. The second step in the effects analysis was to identify how the soundscape might change among the alternatives due to changing vessel quotas and operating requirements.

The existing surface soundscape was defined through interviews with NPS staff knowledgeable of where vessel noises are most common, based on direct experience and on the comments heard from visitors.

The underwater soundscape effects analysis is based primarily on the findings of several studies (Wenz 1982; Unick 1983; Miles and Malone 1983; NSWC 2002). Vessel-generated noise effects are described in terms of frequency of occurrence (i.e., the relative number or amount of sound intrusions), magnitude (loudness), and duration.

Sounds predicted under each alternative were based on how existing use might change, either by different vessel quotas or operating requirements.

The significance of effects were evaluated using the criteria listed in Table 4-2. The primary factor of significance used was "dominance" of sound. Dominance was determined through considering the combination of the frequency of occurrence, magnitude (loudness), duration, and extent of human-caused sound resulting from each alterative. Extent was considered for specific areas where human sound might be broadcast (e.g. a cove or inlet) as well as the number and distribution of such areas throughout Glacier and Dundas Bays.

TABLE 4-2: THRESHOLD CRITERIA FOR EFFECTS ANALYSIS OF THE SOUNDSCAPE

Negligible	Human-made sounds rarely intrude upon the natural soundscape. Natural sounds dominate.
Minor	Human-made sounds intrude upon the natural soundscape once or twice during a day and for short periods of time (less than an hour each day), but do not intrude over a broad area, such as an inlet or passage. Natural sounds dominate most areas.
Moderate	Human-made sounds are present in most areas and dominate at some locations, such as certain inlets or passages. Natural sounds dominate in most areas.
Major	Human-made sounds regularly intrude upon the natural landscape and dominate in most areas.

Alternative 1 (No Action) — Effects on the Surface Soundscape.

Frequency of Occurrence. Under current management conditions, the sound of motorized vessels regularly carries over the waters of Glacier and Dundas Bays and adjacent shorelines, sometimes including non-motorized waters that are not sufficiently distant from a particular noise source. Vessel noise has been reported as far as three miles inland and is also reflected back in enclosed inlets and near steep rock walls and cliffs.

In Glacier Bay, assuming vessel use reaches the maximum quotas allowed under alternative 1, and that all of these vessels travel up and down Glacier Bay in a single day (an unlikely occurrence), up to 67 vessel passes would cross an imaginary line extending from the east to west shores of the Bay. Cruise ships can make a minor excursion through Tarr Inlet, Johns Hopkins Inlet, and Reid Inlet, and near South Marble Island, exposing these water bodies to human-made noise up to four times per day (two vessels in and out) from June through August, roughly five days per week.

Cruise ships would produce the fewest number of sound intrusions on shorelines due to their relatively low numbers. Charter and tour vessels have a combined quota of nine, so shorelines would be expected to be exposed to human-made noise from these vessels up to nine times per day (both tour and charter vessels tend to tour different areas on return trips versus trips up the Bay). Private vessels would contribute the most sound events along most shorelines, with the potential up to 25 a day, but often much lower, since all private vessels do not travel to the same places.

The Bartlett Cove Dock and the Bartlett Cove Campground are both subject to heavy vessel traffic and vessel noise dominates the soundscape much of the time there. Other locations where human-caused sound may dominate during certain times in the day are:

- The "central channel route" of the West Arm
- Lower Glacier Bay through Sitakaday Narrows
- Gloomy Knob
- South Marble Island
- North Sandy Cove
- McBride Inlet
- Tarr Inlet
- mouth of Johns Hopkins Inlet
- Whidbey Passage

Locations where vessel noise is occasionally present include:

- Blue Mouse Cove
- Reid Inlet
- mouth of East Arm
- North Sandy Cove

Locations where vessel noise is infrequently present include:

- Upper Muir Inlet
- Wachusett Inlet
- Adams Inlet
- Geikie Inlet
- Queen Inlet
- Tidal Inlet
- Rendu Inlet
- Fingers and Berg Bay
- Hugh Miller Inlet

In Dundas Bay, intrusions of human-made sounds on the surface would be most common in the upper portions of the Bay, where tour and charter vessels go so visitors may view wildlife and enjoy the scenery of this area. Under existing conditions, cruise ships do not visit Dundas Bay. Although no vessel quotas currently are established for Dundas Bay, it is expected that charter vessel use of Dundas Bay, over time, will increase by two to three times. Assuming that future charter entries will reach five per day during June through August, and one per day for May and September, a maximum of 15 charter vessels in a peak season, the frequency of occurrence of charter vessel noise could be up to 30 exposures. Tour vessels would create noise in this area as well, with the existing frequency of occurrence in the range of three visits per week during peak seasons.

Magnitude. The magnitude of vessel-caused sound depends on the distance of the vessel from potential listeners, sound generating from the vessel, and activity of the vessel. As stated previously, cruise ships mainly travel up the center of Glacier Bay and do not frequent Dundas Bay, so in most places along shorelines, the surface sound magnitude from cruise ships is low. On the water near the cruise ships, the sounds can be heard more clearly. The loudest sound from a cruise ship is its public address system, which can be heard for several miles. This may be one of the loudest sounds generated from any of the four vessel categories, although no measurements are available.

Tour, charter, and private vessels would travel much closer to shorelines throughout Dundas and Glacier Bays, so the magnitude of surface sounds from these vessels is greater than that of cruise ships (with the potential exception of cruise ship public address systems at or near the tidewater glaciers). Tour vessels also use public address systems and, because they may be closer to shorelines, the noise near shorelines is expected to be relatively loud. Tour vessels, as well as charter vessels, that drop off kayakers would generate additional noises at specific locations. Drop-offs of kayakers can create noise due to the visitors' excitement and necessary communication among a large group. Private vessels also generate noise from dropping off kayaks and people on shore.

Operators of cruise ships and tour vessels and some charter vessels often coordinate their visits to destinations to avoid crowding. This reduces the potential for noise from several vessels to combine and increase the overall magnitude of the sound.

Duration. During the peak use periods of mid-summer, vessel noise may be relatively constant at popular destinations during certain portions of the day, as vessels that leave are quickly replaced by other vessels. Times when this situation occurs would most typically be once in the morning and once later in the day at southern locations and mostly during the midday period at northern locations (e.g., the tidewater glaciers). This is because the most common use pattern for a one-day visitor is to arrive in Glacier Bay in the morning, travel up to the tidewater glaciers (stopping at or passing by popular destinations), and return to exit in the late afternoon or evening.

The duration of exposures to the sound of any particular passing vessel in the Bays is expected to be in the range of five to 20 minutes, but the drone of engine noise could last longer. At close distances, vessel bow wakes can be heard for up to several minutes. Vessels generally remain near the tidewater glaciers for approximately one hour and other destinations in the range of a half hour or less.

Direct and indirect effects on the underwater soundscape — alternative 1 —

Frequency of occurrence. As documented in the *Underwater Noise Interim Report* (NSWC 2002), vessel noise is common underwater in Glacier Bay. Sound travels very well underwater, and vessel noise, particularly in well traveled areas, is expected to be regularly present during daylight hours for the peak use period of mid-summer. The percentage of samples (one, 30-second sample taken every hour) in which vessel noise was detected at the hydrophone recording station near Bartlett Cove ranged from nearly 70% in August to 7% in December. Vessel noises were identified in 60% of readings taken during June, July, and August; in 40% of readings in May and September; and in 10% of readings in October through April. While no studies have been conducted in Dundas Bay, vessel noise also is expected to be a regular element of the underwater soundscape there.

Magnitude. Under the existing vessel-use levels, vessel noise levels would be expected to be similar to the results found in the *Underwater Noise Interim Report* (NSWC 2002). The report indicates that the average vessel noise level registered 94 decibels, while natural sources of noise — wind and rainfall — are 83 and 89 decibels, respectively.

Note that the hydrophone used in that study is within designated whale waters. Designated whale waters require lower speeds and, therefore, vessel noise is not as loud. The study found that noise levels dropped considerably when vessel speed limits in whale waters were set at 10 knots, rather than at 20.

The magnitude of vessel-caused sound on the underwater soundscape depends on vessel size and the distance of the affected environment from the vessel. Cruise ships create the most sound disturbance underwater, but are much less common than tour, charter, and private vessels. Based on the

Underwater Noise Interim Report (NSWC 2002), all vessel sizes create underwater noise at a level that is greater than the average noise level of wind and rainfall, the primary components of the natural underwater soundscape.

Based on calculations using vessel signatures recorded by Kipple (2002), cruise ships traveling at 10 knots projected noise at or above 130 decibels for about 0.30 mile (500 meters; LGL 2003). Based on the one sound sample of a cruise ship traveling at 19 knots, LGL predicted that it projected noise at or above 130 decibels for up to 3 miles (5,000 meters). The 130-decibel level is at or near the level where marine mammals might react to sound. While the distance that sound projected is an estimation, it demonstrates that cruise ships can generate loud noises underwater when traveling near 20 knots, a prevalent speed at which cruise ship travel in Glacier Bay (peak speeds are in the 25-knot range).

Duration. As stated under frequency of occurrence, vessel noise is nearly constantly present underwater during the daylight in the peak mid-summer season throughout much of Glacier Bay. At any given point, the sound of a vessel in transit may last an hour or more. The underwater noise study found several cases where the same vessel was heard on samples collected one hour apart. The time that noise dominates the natural soundscape may be less. For a ship traveling 19 knots, the estimated maximum time a stationary object would be exposed to 130 decibels or more is approximately 17 minutes.

Cumulative effects on soundscape — alternative 1 — Administrative traffic also create noise that intrudes on the natural soundscape. Administrative vessels include skiffs, which can be very loud both on the surface and underwater. Petroleum powered generators at Bartlett Cove generate noise that intrudes well beyond NPS facilities, including into non-motorized areas of the Beardslee Islands.

Other than vessels, the most notable surface sound source within Glacier Bay and, to a lesser degree, Dundas Bay, is aircraft. Aircraft landing in the park are infrequent, averaging fewer than one per day in Glacier Bay. Scenic flights also add to noise levels. Tourism development at Point Sophia near Hoonah could increase flight traffic over Glacier Bay. As a port of call for cruise ships, the operation there could develop a scenic flight program that would increase human-caused sound into the soundscape at Glacier Bay. This could eventually generate excessive noises near popular destinations, including the tidewater glaciers. The extent of this effect is unknown and cannot be predicted, but could become major.

The effects of other sources of sound, considered collectively in the absence of cruise ships and tour, charter, and private vessels, would likely be in the moderate category. This is because the combined noise from administrative traffic, potential future flight seeing, and generators of Bartlett Cove would result in regular intrusions of human-caused noise over a broad area.

The total cumulative effect on soundscape of other actions and alternative 1 would still be in the moderate range because noise would frequently intrude over broad areas. Flight seeing could trigger major effects near the tidewater glaciers.

Impairment analysis on soundscape — alternative 1 — Under alternative 1, effects on the soundscape are expected to be in the moderate range, and an impairment of the park's natural soundscape would not be expected. Glacier Bay and Dundas Bay provide many opportunities to experience natural soundscapes.

Conclusion, soundscape — alternative 1 —Effects are occurring within the moderate range, since human-made sounds are present in most areas and dominate several times a day during the peak summer season at several locations. Human-caused noise is present in the surface environment throughout Glacier and Dundas Bays. The Bartlett Cove Dock and the Bartlett Cove Campground, both of which are subject to heavy vessel traffic. Other areas where human-caused sound may dominate during certain times in the day are the same mentioned above under frequency:

- The “central channel route” of the West Arm
- Lower Glacier Bay through Sitakaday Narrows
- Gloomy Knob
- South Marble Island
- North Sandy Cove
- McBride Inlet
- Tarr Inlet
- mouth of Johns Hopkins Inlet
- Whidbey Passage

In the remaining areas of Dundas and Glacier Bay, human-caused sound is present but rarely dominant. Therefore, the overall effect of alternative 1 on the surface soundscape is considered moderate. Human-made sounds are present in most areas and dominate at some locations, such as certain inlets or passages, but natural sounds would still dominate in most areas.

Vessel noise is expected to remain present underwater throughout all waters open to motorized vessels and also within most non-motorized waters, since sound travels very well underwater. During peak summer use periods, human-caused sound is expected to dominate regular stops several times a day. Areas where this would occur include South Marble Island, upper Tarr Inlet, the lower Bay (mouth of bay thru Sitakaday Narrows and including Bartlett Cove), and the “central channel route” of the West Arm. The extent is still considered within the moderate range because sound would not dominate most areas underwater. However, the effect could be near the major level due to the extent of sound proliferation underwater.

Alternative 2 — Effects on Soundscape.

Surface Sounds

Overall effects on the surface soundscape would be similar to those identified under alternative 1, although overall frequency of occurrence, magnitude, and duration of sound generated would be lower in proportion to reduced vessel numbers (see chapter 2 for quota numbers). Vessel sounds would still regularly carry over the waters of Glacier and Dundas Bays, to the adjacent shorelines, and well inland. Some non-motorized waters and adjacent shorelines are sufficiently distant from motorized waters and would not be subjected to motorized vessel noise. Popular stops along the route to the upper Bay would be the locations where intrusions of human-made sounds on shorelines would be most frequent and of greatest magnitude and duration. Peak season frequency of occurrence of charter vessel noise would be the same in Dundas Bay, with up to 30 exposures.

Underwater Sounds

Underwater sounds would also decrease in proportion to reduced quotas, but underwater noise would still be common. The magnitude of each vessel-noise event (such as the passing of a vessel or a vessel visit to a destination) would be the same, but the frequency of occurrence of such events would decline. By reducing cruise ships by 23% from June through August, the frequency of occurrence of cruise ship sound “events” underwater would also decline.

Cumulative effects on the surface soundscape — alternative 2 — The cumulative effects of all human-caused sound would be within the moderate range.

Administrative traffic and floatplane traffic and landings would contribute to noise that intrudes on the natural soundscape. The development at Point Sophia near Hoonah could increase flight traffic over Glacier Bay. Petroleum powered generators at Bartlett Cove generate noise that intrudes well beyond NPS facilities, including into non-motorized areas of the Beardslee Islands. Vessel traffic under alternative 2 would still be the greatest single source of human-made sound both on the surface and underwater and would create moderate effects due to the regular intrusion of noise onto the natural soundscape and would contribute a major portion of all human-caused sounds in Glacier and Dundas Bays. The total cumulative effect on soundscape of other actions and alternative 1 would still be in the moderate range because noise would frequently intrude over broad areas. Flight seeing could trigger major effects near the tidewater glaciers.

Impairment analysis for the surface soundscape — alternative 2 — Effects on soundscape would be moderate and therefore would not be considered an impairment of the park's natural soundscape.

Conclusion, surface soundscape — alternative 2 — Effects within the moderate range would still occur, since human-made sounds would be present in most areas and dominate several times a day during the peak summer season at several locations. Human-caused noise would remain present in the surface environment throughout Glacier and Dundas Bays, and would dominate the soundscape at he Bartlett Cove Dock and the Bartlett Cove Campground, both of which are subject to heavy vessel traffic. Other areas where human-caused sound may dominate during certain times in the day are the same mentioned above under frequency:

- The "central channel route" of the West Arm
- from the mouth of Glacier Bay north through Sitakaday Narrows
- South Marble Island
- Gloomy Knob
- South Marble Island
- North Sandy Cove
- McBride Inlet
- Tarr Inlet
- The Mouth of Johns Hopkins Inlet
- Whidbey Passage

In the remaining areas of Dundas and Glacier Bay, human-caused sound is present but rarely dominant. Therefore, the overall effect of alternative 2 on the surface soundscape is considered moderate. Human-made sounds would be present in most areas and dominate at some locations, such as certain inlets or passages, but natural sounds would still dominate in most areas.

Vessel noise is expected to remain present underwater throughout all waters open to motorized vessels and also within most non-motorized waters, since sound travels very well underwater. During peak summer use periods, human-caused sound is expected to dominate regular stops several times a day. Areas where this would occur include South Marble Island, upper Tarr Inlet, the lower Bay (mouth of bay thru Sitakaday Narrows and including Bartlett Cove), and the "central channel route" of the West Arm. The extent is still considered within the moderate range because sound would not dominate most areas underwater. However, the effect could be near the major level due to the extent of sound proliferation underwater.

Alternative 3 — Effects on Soundscape.

Under this alternative, cruise-ship-related sounds could increase up to two times per day every day. Effects would include an increase in loud noise throughout the underwater soundscape and more public address system intrusions into the surface soundscape. Sound from other vessel classes would not change from that which would occur under the existing situation.

Surface Sounds

Overall effects on the surface soundscape would be similar to those identified under alternative 1. Vessel sounds would regularly carry over the waters of Glacier and Dundas Bays, to the adjacent shorelines, and well inland. Some non-motorized waters and adjacent shorelines are sufficiently distant from motorized waters and would not be subjected to motorized vessel noise. Popular stops along the route to the upper Bay would be the locations where intrusions of human-made sounds on shorelines would be most frequent and of greatest magnitude and duration. The number of charter vessel noise intrusions during the peak season would be the same in Dundas Bay, with up to 30 exposures.

Underwater Sounds
Underwater sounds would increase should cruise ship numbers be increased. The frequency of occurrence would be up to four events each day, every day, from May through September (two events for each cruise ship – one ingress and the other egress).

Cumulative effects on the surface soundscape — alternative 3 — The cumulative effects would be similar to those under alternative 1, with moderate effects. Administrative traffic and floatplane traffic and landings would contribute to noise that intrudes on the natural soundscape. The development at Point Sophia could increase flight traffic over Glacier Bay. Petroleum powered generators at Bartlett Cove generate noise that intrudes well beyond NPS facilities, including into non-motorized areas of the Beardslee Islands.

Potential future flight seeing and current use of the generators of Bartlett Cove would result in regular intrusions of human-caused noise. Vessel traffic under alternative 3 would be the greatest single source of human-made sound both on the surface and underwater and would create moderate effects due to the regular intrusion of noise onto the natural soundscape and would contribute a major portion of all human-caused sounds in Glacier and Dundas Bays. The total cumulative effect on soundscape of other actions and alternative 3 is expected to remain within the moderate.

Impairment analysis for the surface soundscape — alternative 3 — Effects on soundscape would be moderate and therefore not considered an impairment of the park's natural soundscape.

Conclusion, surface soundscape — alternative 3 —

Increasing cruise ship visits from June through July would increase intrusions onto shoreline areas due to cruise hips public addresses systems. This effect would be in the high-moderate level of effect. Vessel noise is expected to remain present underwater throughout all waters open to motorized vessels and also within most non-motorized waters, since sound travels very well underwater. During peak summer use periods, human-caused sound is expected to dominate regular stops several times a day. Cruise ship related noise could would increase the frequency of cruise ship intrusions underwater. This would push effects to the upper end of the moderate range and could conceivably place effects on under water soundscape within the major level. Particularly along the central channel route of the West Arm. portion of Glacier Bay, in upper Tarr Inlet, and in the lower Bay (mouth of bay thru Sitakaday Narrows and including Bartlett Cove),

Alternative 4 — Effects on the Surface Soundscape.

Surface Sounds

Overall effects on the surface soundscape would be reduced under alternative 4, as reduced vessel numbers would, in turn, reduce the overall noise generated. Cruise-ship-related noise under alternative 4 would be at the lowest level compared to the other alternatives. In addition, the soundscape of Dundas Bay would be considerably improved with charter vessels limited to three per day. Tour vessels would be prohibited from entering Dundas Bay and the West Arm. This would improve soundscape in wilderness waters, areas where soundscape is particularly important to maintain.

Underwater Sounds

Alternative 4 has the lowest number of seasonal-use days for cruise ships between June and August. This would greatly reduce the incidence of underwater noise. In addition, vessels greater than 262 feet (80 meters) would be required to maintain a speed of 13 knots in Glacier Bay year-round. This would reduce magnitude of underwater noise.

The slower speed limit would increase the time that cruise ship noise is present in Glacier Bay. However, the duration of underwater noise from cruise ships at any one point would be less. This is because a cruise ship traveling at 13 knots is expected to generate sound over a much smaller area than a cruise ship traveling at over 20 knots. The much smaller sound “footprint” of a cruise ship traveling at 13 knots would take much less time to pass over any one point than the large sound footprint of a cruise ship at top speeds.

Cumulative effects on the surface soundscape — alternative 4 — The effects of alternative 4, considered collectively with other effects on soundscape, are expected to remain in the moderate level.

Administrative traffic would add to the noises of cruise ships and tour, charter, and private vessels. The development at Point Sophia could increase flight traffic over Glacier Bay. Petroleum powered generators at Bartlett Cove generate noise that intrudes well beyond NPS facilities, including into non-motorized areas of the Beardslee Islands. These actions, considered in the absence of noise generated by cruise ships and tour, charter, and private vessels would be considered moderate because they regularly occur over broad areas.

Vessel traffic under alternative 4, although reduced over current levels, would remain the greatest single source of human-made sound both on the surface and underwater in both Glacier and Dundas Bays. Effects would be considered moderate because of frequent intrusion of noise onto the natural soundscape over broad areas. The total cumulative effect on soundscape of other actions and alternative 4 is expected to remain within the moderate range.

Impairment analysis for the surface soundscape — alternative 4 — Effects on soundscape under alternative 4 would be moderate and therefore not considered an impairment of the natural soundscape of the park.

Conclusion, surface soundscape — alternative 4 — Overall effects on soundscape would be similar to those of alternative 1, except that natural soundscapes at the popular inlets of the West Arm would be improved by reduced cruise ship traffic. Natural soundscapes of the East Arm also would improve because of the absence of tour vessels. Soundscape conditions in Dundas Bay would improve because of the restriction in charter vessel use and the closing of the Bay to tour vessels. Effects on soundscape would be moderate due to the regular intrusion of human-caused sounds on both the surface and underwater. Based on the assessment presented here and elsewhere in this final environmental impact statement, the noise would not have major effects on park resources and values (see Biological Environment and Visitor Experience).

Alternative 5 — Effects on Soundscape.

Surface Sounds

Overall effects on the natural soundscape under alternative 5 would be similar to those defined under alternative 1, with essentially the same level of vessel noise generated under the same vessel quotas, with the exception of cruise ships, which would generate much lower underwater sound levels due to the 13-knot speed limit.

Tour vessels would be prohibited from entering the wilderness waters of Dundas Bay, contributing to an improvement in the Bay's natural soundscape. In addition, charter vessels would be limited to an average of three entries per day in Dundas Bay, although on peak-use days, the natural soundscape could be disrupted by human-made sound in several locations because only an average limit would be set. This would be considered a minor effect, because charter vessel operators tend to avoid concentration areas and would soon avoid situations found to detract from their guests' experience.

Underwater Sounds

Changing vessel speed to "over-the-ground" versus "through-the-water" would change noise generation in whale waters because vessels could travel faster when moving against currents and slower when moving with the current.

Cumulative effects on the surface soundscape — alternative 5 — The cumulative effects of alternative 5 would be the same as those effects described for alternative 1. Other than water vessels, aircraft represent the most notable additional sound source within Glacier Bay and, to a lesser degree, Dundas Bay. Aircraft sound, combined with sounds of administrative vessels, fishing vessels, cruise ships, tour vessels, charter vessels, and private vessels would have a moderate effect on the natural soundscape at specific locations and times, but would occur for a relatively short time period (i.e., less than an hour).

Impairment analysis for the surface soundscape — alternative 5 — Effects on soundscape would be moderate and therefore would not be considered an impairment of the natural soundscape of the park.

Conclusion, surface soundscape — alternative 5 — Overall effects on soundscape would be similar to the existing condition, with the exception of the reduction in cruise ship speed, which would greatly reduce underwater noise. Effects would remain consistent with park values and resources, and would be moderate due to the regular intrusion of human-caused sounds on both the surface and underwater. Human-caused noise would not have major effects on park resources and values (see Biological Environment and Visitor Experience).

Alternative 6 — Effects on Soundscape.

Surface Sounds

Overall effects on the natural soundscape under alternative 6 would be similar to those defined under alternative 1, with essentially the same level of vessel noise generated under the same vessel quotas, with the exception of cruise ships, which would generate much lower underwater sound levels due to the 13-knot speed limit and which would increase in numbers to up to 184 from June through August.

Tour vessels would be prohibited from entering the wilderness waters of Dundas Bay, contributing to an improvement in the Bay's natural soundscape. In addition, charter vessels would be limited to an average of three entries per day in Dundas Bay, although on peak-use days, the natural soundscape could be disrupted by human-made sound in several locations because only an average limit would be set. This would be considered a minor effect, because charter vessel operators tend to avoid concentration areas and would soon avoid situations found to detract from their guests' experience.

Under this alternative, incidence of cruise-ship-related sounds could increase to up to two times per day every day. Public address systems would more frequently intrude into the surface soundscape. The incidence of private vessel sounds would increase. Sound from tour and charter vessel classes would not change from that which would occur under the existing situation.

Underwater Sounds

Cruise ships would increase, but would be required to maintain a speed no greater than 13 knots in Glacier Bay year-round. This would increase the frequency but reduce the magnitude of underwater noise. Vessel sounds would regularly carry over the waters of Glacier and Dundas Bays, to the adjacent shorelines, and well inland. Some non-motorized waters and adjacent shorelines are sufficiently distant from motorized waters and would not be subjected to motorized vessel noise. Popular stops along the route to the upper Bay would be the locations where intrusions of human-made sounds on shorelines would be most frequent and of greatest magnitude and duration.

Cumulative effects on the surface soundscape — alternative 6 — The cumulative effects would be similar to those under alternative 1, with moderate effects. Administrative traffic and floatplane traffic and landings would contribute to noise that intrudes on the natural soundscape. The development at Point Sophia could increase flight traffic over Glacier Bay. Petroleum powered generators at Bartlett Cove generate noise that intrudes well beyond NPS facilities, including into non-motorized areas of the Beardslee Islands.

Potential future flight seeing and current use of the generators of Bartlett Cove would result in regular intrusions of human-caused noise. Vessel traffic under alternative 6 would be the greatest single source of human-made sound both on the surface and underwater and would create moderate effects due to the regular intrusion of noise onto the natural soundscape and would contribute a major portion of all human-caused sounds in Glacier and Dundas Bays. The total cumulative effect on soundscape of other actions and alternative 6 is expected to remain within the moderate range.

Impairment analysis for the surface soundscape — alternative 6 — Effects on soundscape would be moderate and therefore not considered an impairment of the park's natural soundscape.

Conclusion, surface soundscape — alternative 6 — Overall effects on soundscapes would be essentially similar to those described for alternative 1, with more frequent private vessel noise and a potential increase in the incidence of cruise-ship-related sounds. Reducing cruise ship speeds would greatly reduce overall effects on soundscape. Effects would be moderate due to the regular intrusion of human-caused sounds on both the surface and underwater. Based on the assessment presented here and elsewhere in this final environmental impact statement, the noise would not have major effects on park resources and values (see Biological Environment and Visitor Experience).

Summary, Soundscape. The "natural soundscape" is what the Park Service calls natural sounds in the absence of human-caused sound. The Park Service considers the natural soundscape as a resource similar to air or water. Director's Order 47, Sound Preservation and Noise Management (NPS 2001c), directs all NPS units to protect, maintain, or restore the natural soundscape resource.

Under any of the alternatives, noise from cruise ships and tour, charter, and private vessels would continue to be common both on the surface and underwater and would frequently intrude over broad areas, such as inlets and bays. More data is needed to determine the actual extent of vessel noise. Vessel noise under all alternatives is considered moderate because noise would regularly intrude upon the natural soundscape over broad areas.

Under Alternative 1, human made sound would be present in the surface soundscape in most areas of the Glacier Bay and Dundas Bay. Human made sound would be dominant near the Bartlett Cove Dock and campground at all times and would be expected to be dominant during certain times of the day in other areas at popular stops along the route to upper Glacier Bay and the tidewater glaciers. These areas include:

- Sitakaday Narrows
- Gloomy Knob
- South Marble Island
- North Sandy Cove
- McBride Inlet
- Tarr, Johns Hopkins, and Reid Inlets

Because sound can travel long distances over water, human made sounds could also be heard within the non-motorized waters of Glacier Bay from vessels transiting outside of these areas. Under all alternatives, surface noise from cruise ships, including public address systems, would regularly intrude across broad areas.

However, because human made sounds would be present periodically throughout the day, natural sounds would still dominate in most areas of Glacier Bay and Dundas Bay.

On-going underwater sound monitoring conducted off shore near Bartlett Cove (NSWC 2002) shows that vessel noise is pervasive underwater in Glacier Bay. Underwater noise from motor vessels is expected to be present throughout all waters open to motorized vessels and also within most non-motorized waters, since sound travels well underwater. The extent of this noise proliferation is expected to be within the moderate range; however, the localized effect in some areas of Glacier Bay could be near the major level.

While no studies have been conducted in Dundas Bay, vessel noise is expected to be a regular element of the underwater soundscape there as well. Current human-caused surface sounds in Dundas Bay include tour, charter, and private vessels within the wilderness waters of the upper Bay.

Cruise ship related noise could increase in May and September when there is no seasonal-use day quota and 2 cruise ships per day, every day may enter Glacier Bay.

Alternative 2 would have the second lowest vessel noise among the alternatives. This is because reduced cruise ship and charter and private vessel numbers would reduce the overall generation of vessel noise from June through August. This alternative includes the lowest seasonal-use day quota for private vessels. This, in turn could mean a reduction in the amount of human made sound near the shoreline where many private vessels tend to travel.

Alternative 3 would generate the most sound among the alternatives. It would have similar effects to alternative 1, but with the potential to increase cruise ships; this could result in daily exposure of noise from two cruise ships per day.

Alternative 4 would result in the lowest level of vessel-related noise among the alternatives, due to reduced quotas for all vessel classes, speed restrictions on cruise ships, which could greatly reduce the magnitude of underwater sound, and the elimination of cruise ships and tour vessels form a portion of the East Arm, Beardslee Entrance, and Fingers and Berg Bays. Under alternative 4, the soundscape in Dundas Bay would improve because of the daily limit and seasonal quota on charter vessel use and the closing of the Dundas Bay to cruise ships and tour vessels.

Alternative 5 and 6 would be roughly in the middle range of noise generation among the alternatives. Alternative 5 and 6 would reduce current effects on soundscape by reducing cruise ship speeds, extending the seasonal-use day quota for cruise ships to include May and September, and prohibiting tour vessels in the wilderness waters of Dundas Bay, the entrance to Adams Inlet, and the Beardslee Entrance.

4.2.2 Air Quality

4.2.2 Air Quality

Vessel operations result in emissions of criteria air pollutants (as defined by U.S. Environmental Protection Agency regulations), including particulate matter, carbon monoxide, sulfur dioxide, nitrogen dioxide, and hydrocarbons from combustion of fuel in vessel engines. Carbon dioxide is not considered a criteria pollutant, but is a global-warming gas emitted from vessel engines. Lead and other toxic constituents found in vessel fuels are emitted in trace amounts.

Vessel emissions may cause visibility reductions immediately after the exhaust exits the vessel, which is often seen as a plume of exhaust. The intensity of this plume is measured by its opacity (i.e., the amount of light that could pass through it). As the emissions move away from the vessel, they disperse and mix with ambient air. Under certain weather conditions, the plume may not dissipate or haze may form resulting in a visibility reduction.

This subsection evaluates the potential effects on air quality within the park that would be caused by the implementation of the proposed alternatives.

Issues of Concern Raised during Scoping. The issues concerning air quality that were identified during the scoping process are as follows:

- Increases in vessel quotas could increase the particulate and pollutant load entering the air column and have a detrimental effect on air quality by increasing, thus changing, air quality, visibility, and the presence of haze.
- Increases in vessel quotas could increase the stack emissions and could result in detrimental effects to human health and the environment.

Regulatory Framework. The regulations that address air quality, emissions, and visibility fall under the federal Clean Air Act (CAA). Additional requirements are provided by NPS management policies and guidance.

Air quality — The Clean Air Act of 1970, 42 U.S. Code (USC) 7401 et seq., amended in 1977 and 1990, is the main federal statute governing air pollution. The Clean Air Act designates six pollutants as criteria pollutants based upon the effect of these pollutants on human health and the environment:

- respirable particulate matter smaller than 10 micrometers in diameter.
- carbon monoxide.
- sulfur dioxide.
- nitrogen dioxide.
- lead.
- ozone.

The National Ambient Air Quality Standards are regulatory levels that were established for these pollutants to protect public health and welfare. State and local air quality control agencies must have a state implementation plan that prescribes measures to maintain attainment or eliminate or reduce the severity and number of violations of National Ambient Air Quality Standards, and to achieve expeditious attainment of these standards. The Alaska Department of Environmental Conservation has been delegated with this responsibility.

Areas where ambient air concentrations of a pollutant are below the ambient air quality standard limits are classified as being “in attainment” for the pollutant. The park is considered to be in attainment for all criteria pollutants; however, no ambient air quality monitoring for the National Ambient Air Quality Standards criteria air pollutants has been conducted in the park.

The Clean Air Act establishes areas that are subject to Prevention of Significant Deterioration (PSD) regulations. PSD regulations limit emissions in areas where air quality is in attainment with the National Ambient Air Quality Standards. In 1977, Congress designated all international parks, national wilderness areas, and national memorial parks in excess of 5,000 acres, and all national parks in excess of 6,000 acres, as Class I areas under this legislation; Class I affords the greatest degree of protection. Areas not covered by a Class I protection level were designated as Class II. Class II areas are still protected from significant deterioration in existing air quality, but the emissions thresholds determining requirements for detailed analysis of effects are higher for Class II areas, such as Glacier Bay National Park and Preserve, than for Class I areas. In Class I areas where good visibility and scenic vistas are a goal, visibility is monitored and tracked to document baseline conditions and to assess potential effects. This is not required by the Clean Air Act in Class II areas, and has not been done in Glacier Bay.

Currently, the park remains a Class II area. In 1980, it was re-designated from a national monument to a national park and preserve; the 1977 congressional designation of Class I areas did not apply to national monuments. On June 25, 1980, (45 *Federal Register* 43002) the federal land manager recommended that the park be re-designated as a Class I area, establishing Air Quality Related Values (AQRVs) for the park. In his presentation to Congress, Secretary of the Interior Cecil D. Andrus reported:

> "*The following air quality related values are important attributes of the area of Glacier Bay National Park and Preserve:*
>
> - *Glacial Activity: Particulate air pollutants landing on glacial ice would affect the rate of glacial melt, which, in turn, would alter the sequence of natural events in Glacier Bay National Monument.*
>
> - *Visibility: The area is a unique scenic area with long viewing distances; reduction of visual range would alter scenic qualities.*
>
> - *Flora: Lichens, important early colonizers of areas bared by glaciers, are demonstrably sensitive to air pollutants. Other flora of the area may not grow where they are subjected to appreciable air pollutants; these have not yet been identified. Alteration of species composition of communities would alter the natural succession patterns; the opportunity for scientific study would then be lost.*
>
> - *Fauna: Changes in glacial behavior and in the lichen populations would result in changes in terrestrial faunal community. Changes in water quality would effect the aquatic faunal community*."

Under the NPS management policies, the Park Service will "seek to perpetuate the best possible air quality in parks to (1) preserve natural resources and systems; (2) preserve cultural resources; and (3) sustain visitor enjoyment, human health, and scenic vistas" (subsection 4.7.1). The NPS management policies state that the Park Service will assume an aggressive role in promoting and pursuing measures to protect Air Quality Related Values from the adverse effects of air pollution. The management policies apply equally to all NPS-managed areas, regardless of CAA designation. Therefore, the Park Service will protect resources at Class I and Class II units. NPS management policies provide additional protection from that afforded by the Clean Air Act's National Ambient Air Quality Standards alone, because specific park Air Quality Related Values can be adversely affected at levels below the National Ambient Air Quality Standards. Another piece of legislation that is important to the mitigation of air quality concerns in the park is the Omnibus Parks and Public Lands Management Act of 1996. In this law Congress prohibits the Park Service from imposing air, water, and oil pollution measures more stringent than those established by the authorized agencies, but allows flexibility for voluntary mitigation (Public Law 104-333, Omnibus Parks and Public Lands Management Act of 1996, section 703: Glacier Bay NP [cruise-ship-related provisions]).

Visibility — Visibility was identified as an Air Quality Related Value for the park, although no visibility standards specific to the park have been established. The only element of visibility currently measured and regulated in the park is opacity. Nitrogen oxides, sulfur oxides, hydrocarbons, and particulate matter emitted from the vessels can result in visible emissions. Opacity is a quantification of the visibility reduction resulting from these emissions (a visible white water vapor plume is not considered an opacity increase). Typically, a trained observer measures opacity at the emission point. Opacity also is measured by equipment mounted in the vessel exhaust stack. Alaska has opacity standards for marine vessels (18 Alaska Administrative Code [AAC] 50.70). The Alaska Department of Environmental Conservation's visible emissions monitoring and compliance program is responsible for enforcement of federal and state opacity standards. The NPS vessel management plan established additional federal opacity standards specific to the park (36 CFR 13.65[b][4]). These standards are as follows:

> *Visible emissions from a marine vessel, excluding condensed water vapor, may not result in a reduction of visibility through the exhaust effluent of greater than 20% for a period or periods aggregating more than:*
>
> 1) *three minutes in any one hour while underway, at berth, or at anchor; or*
>
> 2) *six minutes in any one hour during initial start up of diesel driven vessels; or*
>
> 3) *12 minutes in one hour while anchoring, berthing, getting underway or maneuvering in Bartlett Cove.*

Marine vessel emissions monitoring has occurred in the park since 1990 (Young 2003). This program is used to observe, report, and enforce the opacity requirements of the NPS vessel management plan as described in 36 CFR 13.65(b)(4). The Omnibus Act of 1996 prevents the park from enforcing 2) and 3) above, but because the limit of 20% opacity for three minutes is a state regulation listed in 18 AAC 50.70, 1) it is enforced within the park. Park rangers are certified as visible emissions (opacity) evaluators using the EPA Method 9 opacity procedure to monitor stack emissions. The Park Service attempts to read opacity of smoke plumes from each cruise ship entering the park a minimum of two times during each operating season. When the opacity regulations are exceeded, the reader documents the observation and notifies the vessel operator, district ranger, and concessions management specialist.

The Park Service addresses opacity compliance through administrative or criminal procedures. Should a violation of record be determined, written notification is given to the vessel operator. One violation of record results in the recommendation to the superintendent that the operator's annual evaluation be rated as "marginal." A second violation of record by the same ship within three years of the first results in the recommendation to the superintendent that the ship involved is not allowed to reenter the park. Each violation is subject to review by the park superintendent, and may result in immediate revocation of the concessions permit, thereby prohibiting the offending ship from operating in the park. Third-party complaints are investigated by emission readers and followed up with notification to the district ranger, the concessions management specialist, and possibly the Alaska Department of Environmental Conservation. All air quality complaints are documented, in writing if possible, on a standard visitor comment form and/or a NPS case incident form. The vessel operator is informed of the complaint and the Park Service attempts to observe the ship on its next scheduled entry into Glacier Bay. In compliance with concession permit conditions, all cruise ships that enter the park are equipped with opacity monitors. Opacity measurement records are submitted as a condition of the vessel's concessions permit, and while these data are not used specifically for violation enforcement, they are considered when the park evaluates new and renewed applications for entry permits.

Methodology and Assumptions. To evaluate air quality within the park — total emissions and visibility reduction — were analyzed. Total emissions from vessels were estimated to evaluate the amount of pollutants that would enter the air above Glacier Bay and to determine whether this amount would affect human health or the park's plant and animal life. The visual effect caused by these emissions was also evaluated to assess the potential for visible plumes and uniform haze.

In the process of developing methodology for the effects evaluation and threshold criteria, the air quality standards shown in table 4-3 were reviewed and evaluated.

TABLE 4-3: EMISSIONS AND AIR QUALITY CRITERIA REVIEWED FOR POTENTIAL APPLICABILITY

Criteria Description	Applicability
NPS and State of Alaska Marine Vessel Visible Emission Standards	Can be used.
Prevention of Significant Deterioration Stationary Source Permit Thresholds	Can be used, but limited. Estimates of potential change in annual emissions due to each alternative can be compared to stationary source permit thresholds to evaluate potential air quality degradation, although these are not applicable to mobile sources.
NPS draft *Guidance on Assessing Impacts and Impairment to Natural Resources* (NRPC 2002)	Can be used. NPS guidance is based upon CAA thresholds and NAAQS standards, as well as the Organic Act and NPS management policies related to the protection of NPS lands. Total emission thresholds are similar to PSD thresholds established by the Clean Air Act.
National and Alaska Ambient Air Quality Standards	Cannot be used. Ambient air quality standards are applicable, but data are non-existent for Glacier Bay – The closest data are from Juneau, Alaska. There are insufficient meteorological data and no applicable dispersion model to accurately conduct modeling in the park and preserve to determine the ambient effect for comparison to standards.
National Emission Standards for Hazardous Air Pollutants (NESHAPS)	Cannot be used. NESHAPS standards have not been promulgated for commercial marine engines.
EPA Vessel Emission Standards	Cannot be used. New vessel emission standards recently published should result in improvements in ship emissions. However, these standards are established only for new equipment, and quantification of any emission reductions would be speculative.
Visibility Standards	Can be used. Visibility monitoring is not performed at Glacier Bay; therefore, a background value cannot be established.
Air Quality Related Values (AQRV)	During the review to Congress in 1980 regarding the park, the federal land manager established Glacial Activity, Visibility, Flora, and Fauna as Air Quality Related Values for the park.

Most of the air quality standards in table 4-3 were considered inappropriate for this analysis. The NPS draft *Guidance on Assessing Impacts and Impairment to Natural Resources* (NRPC 2002) provides direction to evaluate total emissions and Air Quality Related Values in accordance with the Clean Air Act and NPS management policies. The human health criteria, based upon CAA definitions, PSD standards, and NAAQS, provide an appropriate measure for total emissions effect evaluation. In the evaluation of Air Quality Related Values, the guidance provides specific threshold criteria related to ambient ozone levels, deposition levels, and estimated visibility and nitrogen oxide (NO_X) and SO_2 ambient air levels. These thresholds cannot be used in this evaluation because of the lack of data. The guidance does provide additional threshold descriptions to evaluate visibility effects based upon observed conditions, and these thresholds are applicable and can be used to assess effects in this evaluation.

To quantitatively assess projected total annual emissions due to implementation of each alternative, the available data, consisting of vessel classifications, operations, and use-day quotas, were analyzed using *EPA420-R-00-002, Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data* (EPA 2000). In addition to evaluating total emissions, the change in emissions was quantitatively determined by comparing projected air quality and emissions data for each alternative to the no-action alternative. Dundas Bay is not included in the quantitative assessment because operational data for vessel use of this area do not provide specific information necessary to develop emission estimates, although it is assumed that the effect of vessel emissions to Dundas Bay would be less than the effect to Glacier Bay because cruise ships do not use Dundas Bay. Given the topography and size of Dundas Bay, the inversion conditions that are observed in Glacier Bay would not be replicated in Dundas Bay. Dundas Bay is smaller and receives less vessel traffic than Glacier Bay, so it is assumed that there would be fewer emissions in Dundas Bay.

Projections of future air pollutant emission levels were derived based on proposed changes in vessel activity for each alternative. The method of calculating emissions and the assumptions used are described in appendix D. Daily and annual use-day quotas were used to determine the number of in-season use days for all vessels and off-season use days for cruise ships and tour vessels. Baseline numbers from 2001 were used to estimate off-season use days for private and charter vessels. NPS staff and vessel operator observations were used to determine average time at each speed classification (time-in-mode). Speed restrictions of 13 knots under alternatives 4, 5, and 6 would require that cruise ships and tour vessels spend additional time in the Bay, so total time spent by cruise ships entering and leaving the Bay at a slow cruise was doubled based on the assumption that these vessels usually travel between 24 and 26 knots. Daily emissions were calculated assuming that vessel use of Glacier Bay is at the maximum daily quota. The total provides a maximum-case evaluation of daily emissions in the park on a given day and under these conditions. Annual emissions include all emissions emitted during the calendar year.

The threshold criteria (see table 4-4) developed for the air quality analysis are based on NPS guidance (NRPC 2002) for human health thresholds and qualitative visibility Air Quality Related Values. Projections of expected visibility conditions were based upon existing opacity data.

TABLE 4-4: THRESHOLD CRITERIA FOR EFFECTS ANALYSIS ON AIR QUALITY

	Human Health and Environment Threshold Criteria				Visibility AQRV Criteria
Effect	**For Proposed Action, Total Emissions**		**Current Air Quality**		
Negligible	<50 TPY (each pollutant)	**AND**	<60% of the National Ambient Air Quality Standards	**OR**	No perceptible visibility effects likely (no visible smoke or plume); no smell of exhaust.
Minor	>50 and <100 TPY (any pollutant)	**AND**	<80% of the National Ambient Air Quality Standards	**OR**	Perceptible visibility effects occur, but are of very short duration (less than one day) and not visible to most people.
Moderate	>100 TPY (any pollutant)	**OR**	>80% of the National Ambient Air Quality Standards	**OR**	Perceptible visibility effects occur but will be limited in duration, extent, and magnitude.
Major	>250 TPY (any pollutant)	**AND**	>80% of the National Ambient Air Quality Standards	**OR**	Visibility effects from project-specific or cumulative emissions are of long duration, can be frequently observed, or are visible over a broad area.

Source: (NRPC 2002). TPY = Tons per year.

Alternative 1 (No Action) — Effects on Air Quality. The analysis of the no-action alternative's effects on air quality is presented as effects to total emissions, ambient air quality, and visibility reductions.

Direct and indirect effects on air quality — alternative 1 —

Air Emissions Totals. To address air emissions, emissions were calculated based on maximum allowable use-day quotas. Table 4-5 presents the estimated daily and annual emissions in Glacier Bay for alternative 1, and also the change in the total emissions from existing conditions. This table shows that estimated annual emissions for alternative 1 would be higher than those for the existing conditions (see table 3-1). The estimated emissions for existing conditions were calculated using actual daily entry and seasonal-use day data from 2001. The total seasonal-use days used in 2001 were lower than the existing quotas, so it is likely that the emissions are conservative for private vessels, and only represent a worst-case daily emission total. While there are no regulatory limits for daily emission totals, these numbers provide information related to the potential for visibility problems on busy seasonal days.

TABLE 4-5: ALTERNATIVE 1 (NO ACTION) DAILY AND ANNUAL VESSEL EMISSIONS (MAXIMUM ALLOWABLE ENTRIES)

Daily Emissions (pounds per day)						
	Daily Vessel Quota	**PM**	**NO_X**	**SO_2**	**CO**	**HC**
Cruise Ships	2	136.01	4,393.30	4,614.38	511.46	57.50
Tour Vessels	3	17.25	694.38	110.02	73.74	7.04
Charter Vessels	6	7.42	297.51	46.93	35.42	3.70
Private Vessels	25	70.53	2,836.98	449.15	307.51	29.93
Total		231.21	8,222.17	5,220.49	928.13	98.17
Annual Emissions (tons per calendar year)						
	Annual Use Days	**PM**	**NO_X**	**SO_2**	**CO**	**HC**
Cruise Ships	261	8.87	286.66	301.09	33.37	3.75
Tour Vessels	520	1.50	60.18	9.54	6.39	0.61
Charter Vessels	607	0.38	15.05	2.37	1.79	0.19
Private Vessels	2,464	3.48	139.79	22.13	15.15	1.47
Total		14.23	501.68	335.13	56.70	6.02
Net Change from Existing Conditions		2.77	99.93	56.97	11.23	1.18
% Change from Existing Conditions		16%	17%	15%	17%	16%

Note:

Annual-use days include proposed seasonal-use day quotas for all vessels and May and September use day quotas for cruise ships and tour vessels. Ferry service is included in tour vessel totals. Projected off-season use days for charter and private vessels are based upon existing numbers (see chapter 3).

PM = particulate matter.
CO = carbon monoxide.
SO_2 =sulfur dioxide.
NO_x = nitrogen oxides.
HC = hydrocarbons.

Because climate and seasonal quotas prevent the maximum number of vessel entries from occurring every day of the year, a separate estimate of entries was evaluated to determine annual emissions. The annual emission totals provide information to evaluate the potential long-term effect of the pollutants in the park. While these are evaluated as annual emissions, practically all operations occur from May to September. Estimated total emissions of nitrogen oxides and sulfur dioxide from all vessels in Glacier Bay under this alternative would exceed 250 tons per year, but the estimated emissions of all other criteria pollutants would be below the 100-tons-per-year threshold criteria. While all classes of vessels contribute emissions to the total, cruise ships contribute more than half of the annual pollutant emissions under this alternative.

While a quantitative estimate of emissions is not possible for Dundas Bay, it is assumed that the effect of vessel emissions to Dundas Bay would be less than the effect to Glacier Bay. Although there would be no cruise ships and reduced times for other vessels, it is likely that emissions of nitrogen oxides in Dundas Bay would still be more than 100 tons per year.

Cruise ships do have incinerators to burn garbage, but as a condition of their permit they do not operate incinerators while traveling in the park. Other than vessel emissions, only small local emission sources, such as park vehicles, building heating systems, electrical generators, and campfires, exist in the park. The effects of these sources are discussed in the cumulative effects subsection.

<u>Ambient Air Quality.</u> Because of the lack of available ambient air quality data to determine whether emissions in the park would result in air quality that exceeds state or federal air quality standards, a comparison was made with air quality in Juneau, Alaska, an urbanized area that receives more cruise ships than the park. The Alaska Department of Environmental Conservation conducted air quality monitoring in Juneau in May and July 2001 and August to September 2001. Maximum readings of ambient air concentrations of nitrogen dioxide, sulfur dioxide, and particulate matter less than 10 microns are between 10% and 40% of the National Ambient Air Quality Standards (ADEC 2001a). Although Juneau has different topography and meteorological conditions than the park, it is unlikely that the park, with its fewer sources of emissions, would have ambient air quality that is less than 60% of the National Ambient Air Quality Standards (monitoring in the park would provide confirmation of this hypothesis). Therefore, using threshold criteria (see Table 4-4), total emissions would result in a negligible effect to the park under alternative 1.

<u>Visibility Reductions.</u> Daily emission totals, visible opacity, and weather conditions are factors that contribute to a reduction in visibility. Under periods of temperature inversions or days with low winds, visible emissions do not dissipate quickly, resulting in long visible plumes from ship stacks that obscure views. The visible emissions from one or several vessels could cause haze to develop throughout Glacier Bay. Visible emissions in Dundas Bay could occur but would not alter visibility because of the reduced traffic, lack of cruise ships, and less potential for temperature inversions that would trap the emissions.

As voluntary conditions of concession permits, many cruise ships have agreed to the use of opacity monitors and the submission of opacity data. Figure 4-1 provides an example of a portion of an opacity-monitoring chart that was provided to the Park Service for review. The spikes in opacity are a result of engine startup, and this is a typical and usually unavoidable cause of a visible plume. Not all visible emissions from vessel stacks violate opacity standards, but all visible emissions have the potential to affect visibility in the park. The opacity levels recorded in Figure 4-1 do not constitute a violation of opacity, but it is likely that these emissions were visible to most people. The duration, extent, and magnitude of these visible emissions would depend on the weather conditions when the plume was generated.

Visible plumes that violate opacity limits are likely to diminish visibility somewhat in certain areas in the park, and strict enforcement of the existing opacity limits would reduce this potential effect. Emissions from vessels other than cruise ships are not typically monitored for opacity violations. The occasional plumes from these vessels usually do not contain as high a concentration of pollutants as those from the cruise ships and are dispersed more quickly at a lower altitude. However, the plumes from smaller vessels may contribute to haze. Given the large potential for daily NO_x emissions that would be a result of the daily vessel quotas, there is the potential for haze to develop during temperature inversions. While there is potential for haze to occur, the duration and frequency of these conditions has not been documented.

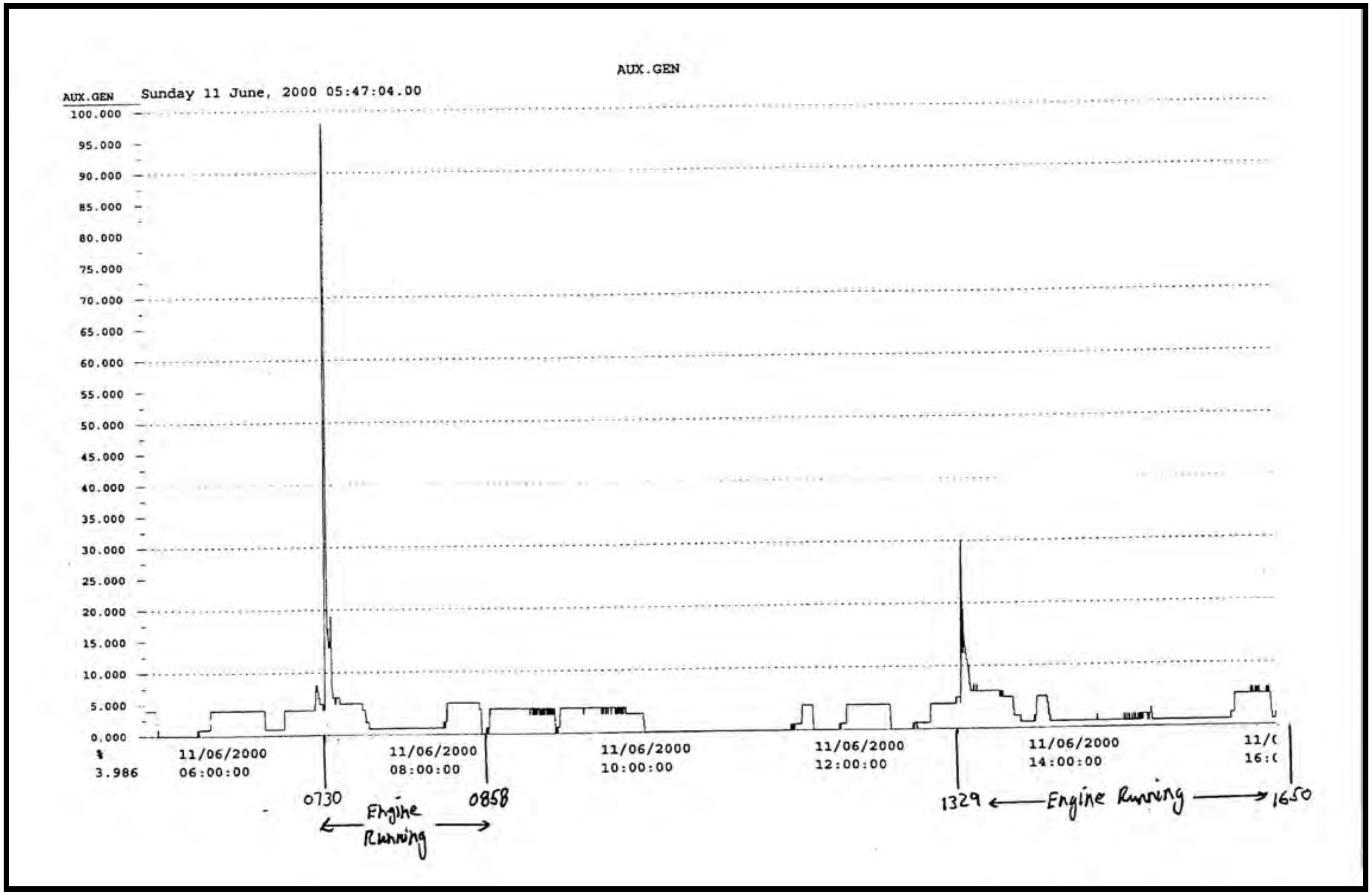


Figure 4-1 Cruise Ship Auxiliary Generator Opacity Monitor Readings in Glacier Bay, June 11, 2000
This figure shows an example of the monitoring readings taken when engines are started up and then running within the Bay. The visibility reduction associated with the start-up plumes would be dependant upon the weather conditions at the time of the emission, but most likely were visible to most people.

Source: NPS 2001 Cruise Ship Report of February 12, 2001. Gustavus, AK: National Park Service, Glacier Bay National Park and Preserve, Concession Office.

Park rangers certified to evaluate emissions enforce the state opacity limits. As of February 19, 2003, 86 certified opacity observations have been conducted since 1997, resulting in five observed violations (Young 2002). Twenty-eight opacity measurements were conducted in 1999, resulting in five observed violations and two violations of record (Young 2002). Three exceedances were caused by an unavoidable need to maneuver the ship for safety reasons; therefore, the ship was not cited. Limited resources resulted in only three readings in 2000, no readings in 2001, and 13 readings in 2002. There were no opacity violations recorded in 2002. However, of the 13 observations conducted, 11 did result in observable emissions that were recorded to be between 5% and 30% during the observation period of 20 minutes, which would be visible to most people (see table 4-6).

Under the threshold criteria established to protect the Air Quality Related Values of visibility, the emissions would, at a minimum, result in a moderate effect on the park. Further documentation of visibility conditions within the park would provide data necessary to determine the duration, extent, and magnitude of the visibility reduction and uniform haze.

TABLE 4-6
GLACIER BAY NATIONAL PARK AND PRESERVE AIR QUALITY PROGRAM 2002
VISIBLE EMISSION OBSERVATION PROGRAM SUMMARY
FROM JULY 6, 2002 TO SEPTEMBER 11, 2002

Vessel	Date	Opacity (%-20 minutes)
1. *Dawn Princess*	07/06/02	0-15%
	07/20/02	0-20%
2. *Ocean Princess*	09/02/02	5-15%
3. *Star Princess*	07/15/02	10-20%
4. *Sun Princess*	07/27/02	0-10%
	09/07/02	5-15%
5. *Ryndam*	07/29/02	10-15%
6. *Statendam*	09/10/02	0-5%
7. *Veendam*	09/03/02	5-30%
8. *Volendam*	07/19/02	5-20%
9. *Zaandam*	09/11/02	5-15%
10. *Crystal Harmony*	08/04/02	10-25%
11. *Universe Explorer*	07/14/02	0%

Source: NPS 2003b.

Currently, the park superintendent is limited in the regulatory restrictions that can be required of cruise ships by the Omnibus Parks and Public Lands Management Act of 1996. The act prohibits the Park Service from imposing air, water, or oil pollution prevention measures that are more stringent than State and Federal Regulations. However, the act states that "when competitively awarding permits to enter Glacier Bay, the Secretary may take into account the relative impact particular permittees will have on park values and resources" (Public Law 104-333). Concession conditions can be used to reduce visible and total emissions in the park. Cruise ship operators who currently hold concession permits to operate in the park have committed to voluntary conditions to reduce emissions and opacity, including the installation of opacity monitors and alarms to inform ship operators of potential opacity violations, reduced engine use in the Bay, not using incinerators in the Bay, and improved operating parameters. Competition for the few available concession permits would continue to provide opportunities for improvement, because permit applications would require renewal in 2004. Potential mitigation could include the use of cleaner fuels, onboard emission control systems, and early compliance with new EPA vessel emission standards. Because such mitigation would be voluntary, the overall effectiveness of mitigation beyond regulatory requirements would depend on the initiatives and policies of the cruise lines.

Visibility condition observations will be conducted in the summer of 2004 to assess the effect of vessels, particularly cruise ships, on visibility under different meteorological conditions. These observations also should provide information about the presence of haze. Visibility data will be collected using a camera at a strategic location. Meteorological data collected at the same time in the park should provide information to determine the effect of emissions under conditions such as inversions. This information will enable a quantitative evaluation of visibility in the park.

To enforce opacity requirements, park rangers who are certified as visible emissions (opacity) evaluators using the EPA Method 9 opacity procedure must continue to monitor stack emissions. Continued enforcement of existing opacity limits is important to reducing visibility problems in the park. The Park Service's marine vessel emissions program (Young 1999) provides adequate structure and direction to enforce opacity violations, provided it is followed as written and that appropriate funding is available to do so.

Cumulative effects on air quality — alternative 1 —The air shed of Glacier and Dundas Bays were considered in the evaluation of cumulative effects. There is no evidence that current ambient air quality has been degraded from past actions; however, ambient air quality has never been measured within the park. Visibility impacts to air quality have occurred in the form of visible plumes from cruise ships and smaller vessels, as evidenced from historical photographs in park archives and from opacity measurements by NPS personnel (Young 2003). These effects have been short-lived and would be negligible in an additive sense to the effects of alternative 1. Present actions that could diminish air quality and visibility when combined with the effects to air quality of alternative 1 include other vessel emissions that are not addressed by the Vessel Management Plan (such as the Bartlett Cove Ferry, commercial fishing vessels and administrative and park vessels) and other small, local emissions (such as park vehicles, building heating systems, electrical generators, and campfires in the park). The emissions of the Bartlett Cove Ferry and diesel generators, which are the largest of these sources, emit approximately 33 tons of NO_X and 3 tons of SO_2 (see appendix D). These emissions are negligible and will not be changed by this action. In addition, medium- and long-range emissions that are transported from outside the park boundaries can affect air quality and visibility in the park; however, the contribution of these emissions sources also would not change as a result of this action, and are likely to be negligible. . No known reasonably foreseeable future actions would alter air quality or visibility in the air shed. The additive effects of other emission sources in the Glacier and Dundas Bay air shed and from remote sources would be negligible. The cumulative effects to air quality in the park from this alternative and these other sources would be moderate.

Impairment analysis for air quality — alternative 1 — NPS draft guidance (NRPC 2002) provides the following determinants for assessing impairment of air resources:

- Where air quality concentrations are projected to adversely affect visitor or employee health, they are more likely to be considered impairment.
- Where human-made emissions in a park are likely to affect visibility conditions such that they affect visitor enjoyment or detract from the view of scenic vistas (in parks where good visibility is a goal), they are more likely to be considered impairment.
- Where human-made emissions in a park are likely to create significant effects to resources and values that are specifically mentioned in enabling legislation, key to natural or cultural integrity or opportunities for enjoyment of the park, or identified in the park general management plan or other planning document, they are more likely to be considered impairment.
- Where projected resource effects are above air quality "concern thresholds" for visibility, or nitrate or sulfate deposition, they are more likely to be considered impairment.

- Where human-made emissions are likely to create unnatural and visible smoke, haze, or plume (in parks where good visibility is a goal), they are more likely to be considered impairment.
- Where existing air quality adversely affects visibility, flora, fauna, soil, or water, small increases in park emissions that would exacerbate these stresses on resources would be more likely to be considered impairment.
- Where very clean air quality conditions exist for the "best visibility days" in a park, a small addition in emissions (in parks where good visibility is a goal) may be more likely to result in visibility impairment.

Under existing conditions, it is unlikely that air emissions would adversely affect visitor or employee health or create a physical effect to park resources. Visible emissions from vessels are present and create an unnatural and visible smoke or plume. These emissions within the park detract from the scenic quality of the park for visitors, although the visibility reductions are not permanent and could disperse with changes in weather conditions or changes to vessel operations. The duration of the visible plumes would also vary, depending upon the weather conditions. In 2002, while 11 of the 13 emission observations noted the presence of visible emissions, two observations noted no visible emissions, and there were no opacity violations, so the magnitude of the visible plume emissions in 2002 complied with acceptable standards. Through concession permitting conditions, violators would not be allowed to continue to operate in the park, providing an important incentive for the cruise ships to control opacity episodes. Given the available data, it is unlikely that impairment is currently occurring, and strict reinforcement of concession permit conditions would help to ensure that impairment would not occur. Further study of ambient air quality and visibility should be conducted to verify this conclusion.

Conclusion, air quality — alternative 1 — The implementation of alternative 1 would result in total annual emissions of nitrogen oxides and sulfur dioxide of 501.68 tons per year and 335.13 tons per year, respectively. This represents a 25% increase in NO_X and a 20% increase in SO_2 from existing conditions. These figures are higher than existing emission totals based upon 2001 operational data. However, it is unlikely that the concentrations of criteria pollutants in ambient air in the park would exceed 60% of the National Ambient Air Quality Standards. Based on daily estimated emissions data and data regarding visible plume observations, implementation of alternative 1 would reduce visibility. However, the magnitude, duration, and extent of this visibility reduction would depend upon weather conditions. Therefore, using the effects criteria in table 4-4, the effects of implementing alternative 1 on emissions, ambient air quality, and visibility would result in a moderate effect on park air resources. The magnitude and duration of visible plumes would not likely to result in impairment under this alternative. Further study would need to be conducted to evaluate actual ambient air quality if this alternative is chosen.

Alternative 2 — Effects on Air Quality

Direct and indirect effects on air quality — alternative 2 — Under alternative 2, seasonal entries and daily vessel quotas would return to 1985 levels. This section describes in sequential order the elements of the threshold criteria (table 4-4) – emissions, air quality, and visibility.

Table 4-7 presents the estimated worst-case daily and annual emissions in Glacier Bay under alternative 2, and also the change in the total emissions from existing conditions.

TABLE 4-7: ALTERNATIVE 2 DAILY AND ANNUAL VESSEL EMISSIONS

Daily Emissions (pounds per day)						
	Daily Vessel Quota	**PM**	**NO_X**	**SO_2**	**CO**	**HC**
Cruise Ships	2	136.01	4,393.30	4,614.38	511.46	57.50
Tour Vessels	3	17.25	694.38	110.02	73.74	7.04
Charter Vessels	6	7.42	297.51	46.93	35.42	3.70
Private Vessels	25	70.53	2,836.98	449.15	307.51	29.93
Total		231.21	8,222.17	5,220.48	928.13	98.17
Annual Emissions (tons per calendar year)						
	Annual Use Days	**PM**	**NO_X**	**SO_2**	**CO**	**HC**
Cruise Ships	229	7.79	251.52	264.17	29.28	3.29
Tour Vessels	520	1.50	60.18	9.54	6.39	0.61
Charter Vessels	566	0.35	14.03	2.21	1.67	0.17
Private Vessels	2,143	3.02	121.56	19.25	13.18	1.28
Total		12.66	447.29	295.17	50.52	5.35
Net Change from the Existing Conditions		1.20	45.54	17.01	5.05	0.51
% Change from Existing Conditions		10%	11%	6%	11%	11%

Note:

Annual-use days include proposed seasonal-use day quotas for all vessels and May and September use day quotas for cruise ships and tour vessels. Projected off-season use days for charter and private vessels are based upon existing numbers (see chapter 3).

PM = particulate matter.
CO = carbon monoxide.
SO_2 = sulfur dioxide.
NO_x = nitrogen oxides.
HC = hydrocarbons.

Total annual emissions of nitrogen oxides and sulfur dioxide in Glacier Bay are projected to be 447.29 tons per year and 295.17 tons per year, respectively. This represents an 11% increase in NO_X and a 6% increase in SO_2 from existing conditions. While all classes of vessels contribute emissions to the total, cruise ships contribute more than half of the annual pollutant emissions under this alternative. Despite the reduction in vessel numbers, implementation of alternative 2 would result in an increase in annual emissions compared to existing conditions because current vessel quotas are not fully utilized. However, because of the seasonal quotas, there would be some days in which only one or no cruise ships would be in the Bay, resulting in fewer daily emissions than the maximum projected daily emissions. Emissions in Dundas Bay are assumed to be less than those in Glacier Bay, but more than 100 tons per year. Annual emissions of NO_x and SO_x for Glacier Bay alone exceed the emissions threshold criteria (see table 4-4) for moderate effects of emissions of any one pollutant greater than 100 tons per year; therefore, the emissions generated under this alternative would produce moderate effects.

With respect to ambient air quality, the concentrations of criteria pollutants in ambient air in the park would likely to be less than 60% of the National Ambient Air Quality Standards. This conclusion is based on the analysis of ambient air quality data collected in Juneau discussed in alternative 1. Therefore, implementation of alternative 2 would likely to have a negligible effect on ambient air quality.

Under current conditions, plumes, or visible emissions, frequently can be observed from cruise ship stacks. However, opacity violations occur infrequently. During weather inversions, these plumes may not dissipate quickly and could result in reduced visibility quality for longer periods of time. Due to the increase in vessel traffic in alternative 2 and the resulting emissions compared to existing conditions, visible plumes from cruise ship stacks and opacity violations could occur more frequently. The extent of visible plumes would likely be limited to the area trailing the vessel and the plumes and would dissipate quickly unless a weather inversion was present. Given the likely limited duration, magnitude, and extent of the visible plumes, the effect on visibility, according to the threshold criteria, would be moderate.

The volume of emissions and the potential for visible plumes generated through the implementation of this alternative would result in overall moderate effects to the air resources of the park.

Cumulative effect on air quality — alternative 2 — The only significant change to emissions within the park is attributed to the vessels assessed in this evaluation. Past, present, and reasonably foreseeable future actions are described in alternative 1; the additive effects of other emission sources in the Glacier and Dundas Bay air shed and from remote sources would be negligible. The cumulative effects to air quality in the park from this alternative and these other sources would be moderate.

Impairment analysis for air quality — alternative 2 — Based on daily estimated emissions data and data regarding visible plume observations, existing daily vessel quotas would continue to reduce visibility at a magnitude that is below opacity standards and for a duration and extent that depend upon weather conditions. This effect would be more than existing conditions. The duration and magnitude of visible plumes would not likely to result in impairment. Strict enforcement of concession permit conditions would help to ensure that impairment would not occur.

Conclusion, air quality — alternative 2 — The direct and indirect effects of implementation of alternative 2 on air resources would be increases in emissions and an increased potential for visible plumes; therefore, the overall effect would be moderate. The frequency, magnitude, and duration of visible plumes would not likely result in impairment under this alternative. Further study should be conducted if this alternative is chosen to evaluate actual ambient air quality.

Alternative 3 — Effects on Air Quality.

Direct and indirect effects on air quality — alternative 3 — Under alternative 3, cruise ship daily vessel quotas would be increased to the maximum number allowed under the vessel management plan. This section describes the changes in emissions, air quality, and visibility as a result of the implementation of alternative 3.

Table 4-8 presents the estimated daily and annual emissions in Glacier Bay under alternative 3, and also the change in the total emissions from existing conditions compared to existing conditions.

TABLE 4-8: ALTERNATIVE 3 DAILY AND ANNUAL VESSEL EMISSIONS

Daily Emissions (pounds per day)	Daily Use Quota	PM	NO_X	SO_2	CO	HC
Cruise Ships	2	136.01	4,393.30	4,614.38	511.46	57.50
Tour Vessels	3	17.25	694.38	110.02	73.74	7.04
Charter Vessels	6	7.42	297.51	46.93	35.42	3.70
Private Vessels	25	70.53	2,836.98	449.15	307.51	29.93
Total		231.21	8,222.17	5,220.48	928.13	98.17

Annual Emissions (tons per calendar year)	Annual Use Days	PM	NO_X	SO_2	CO	HC
Cruise Ships	306	10.41	336.09	353.00	39.13	4.40
Tour Vessels	551	1.58	63.77	10.10	6.77	0.65
Charter Vessels	607	0.38	15.05	2.37	1.79	0.19
Private Vessels	2,464	3.48	139.79	22.13	15.15	1.47
Total		15.85	554.70	387.60	62.84	6.71
Net Change from Existing Conditions		4.39	152.94	109.45	17.37	1.86
% Change from Existing Conditions		38%	38%	39%	38%	38%

Note:

Annual-use days include proposed seasonal-use day quotas for all vessels and May and September use day quotas for cruise ships and tour vessels. Projected off-season use days for charter and private vessels are based upon existing numbers (see chapter 3).

PM = particulate matter.

CO = carbon monoxide.

SO_2 = sulfur dioxide.

NO_x = nitrogen oxides.

HC = hydrocarbons.

Total annual emissions of nitrogen oxides and sulfur dioxide are projected to be 554.70 tons per year and 387.61 tons per year, respectively. This represents a 38% increase in NO_X and a 39% increase in SO_2 from existing conditions. These emissions are higher than existing emission totals that are based upon 2001 operational data (see table 4-8). While all classes of vessels contribute emissions to the total, cruise ships contribute more than two-thirds of the annual pollutant emissions under this alternative. With 184 allowable seasonal-use days for cruise ships during the summer season, this would result in two entries per day every day of the summer season, representing the worst-case daily emission potential. Emissions in Dundas Bay are assumed to be less than those in Glacier Bay, but more than 100 tons per year as in alternative 1. Annual emissions of NO_x and SO_x for Glacier Bay alone exceed the emissions threshold criteria for moderate effects of emissions of any one pollutant greater than 100 tons per year; therefore, the emissions generated under this alternative would produce moderate effects.

With respect to ambient air quality, the concentrations of criteria pollutants in ambient air in the park are likely to be less than 60% of the National Ambient Air Quality Standards. This conclusion is based on the analysis of ambient air quality data collected in Juneau discussed in alternative 1. Therefore, implementation of alternative 3 is likely to have a negligible effect on ambient air quality.

The increased vessel traffic in this alternative would likely result in a reduction in visibility. Visible emissions in the form of plumes from cruise ship stacks would occur more frequently compared to existing conditions. The duration and areal extent of the visibility reduction would vary with weather conditions. Under inversion conditions, these plumes would occur for long periods and would likely result in uniform haze. The magnitude of the plumes that would be generated under this alternative would likely result in an increase in opacity violations compared to existing conditions. Since opacity violations often result from maneuvering for safety reasons, the increase in vessel traffic could result in additional opacity violations. The potential for visible plumes is increased compared to existing conditions, but the plumes would be limited in duration, extent, and magnitude. Therefore, with respect to visibility, the effect to air resources would be moderate.

Alternative 3 would likely result in an overall moderate effect on air resources in the park because of the increase in total emissions that would cause more potential for visible emissions, uniform haze, and opacity violations.

Cumulative effect on air quality — alternative 3 — The only significant change to emissions within the park is attributed to the vessels assessed in this evaluation. Past, present, and reasonably foreseeable future actions are described in alternative 1; the additive effects of other emission sources in the Glacier and Dundas Bay air shed and from remote sources would be negligible. The cumulative effects to air quality in the park from this alternative and these other sources would be moderate.

Impairment analysis for air quality — alternative 3 — The implementation of alternative 3 would result in an increase in annual emissions compared to existing conditions. Visible emissions in the form of plumes from cruise ship stacks would occur more frequently compared to existing conditions. Under inversion conditions, these plumes can occur for long periods and are more likely to result in uniform haze. The magnitude of these plumes is more likely to violate opacity thresholds. To prevent the increase in opacity violations, the park would need to strictly enforce the concession permit conditions and opacity limit. With strict permit enforcement, impairment would not occur.

Conclusion, air quality — alternative 3 — The direct and indirect effects of implementation of alternative 3 on air resources would be an increase in emissions and visible plumes, such that the effects to air resources would be moderate. Strict enforcement of opacity limits would be required to prevent an increase in the magnitude of visibility reductions. The magnitude and duration of visible plumes would not likely result in impairment under this alternative. Further study should be conducted if this alternative is chosen to evaluate actual ambient air quality.

Alternative 4 — Effects on Air Quality.

Direct and indirect effects on air quality — alternative 4 — Under alternative 4, vessel operations would be limited to the pre-1985 allowable number of entries, and additional speed limitations would be enforced on large vessels. Quotas on cruise ships, tour vessels, and charter vessels would decrease, and quotas on private vessels would increase. This section describes the changes to emissions, ambient air quality, and visibility that will result from implementation of alternative 4.

Table 4-9 presents the estimated daily and annual emissions in Glacier Bay under alternative 4, and also the change in the total emissions from existing conditions. Total annual emissions of nitrogen oxides and sulfur dioxide are projected to be 253.57 tons per year and 83.05 tons per year respectively. This represents a 37% decrease in NO_X and a 70% decrease in SO_2 from existing conditions. While the speed limits proposed under this alternative would require that the cruise ships remain in the Bay longer, the speed reductions would result in a decrease in annual emissions compared to existing conditions. Maximum daily emissions also would decrease as a result of the speed limitations. Because of the seasonal quotas, there would be some days in which only one or no cruise ships would be in the Bay, resulting in fewer daily emissions than the maximum projected daily emissions. . Under this alternative, emissions of pollutants from cruise ships will be significantly reduced, and as a result about half of the estimated emissions could come from the operations of the smaller vessels, if the annual quota for these vessels was reached.

TABLE 4-9: ALTERNATIVE 4 DAILY AND ANNUAL VESSEL EMISSIONS

Daily Emissions (pounds per day)	**Daily Vessel Quota**	**PM**	**NO_X**	**SO_2**	**CO**	**HC**
Cruise Ships	2	147.28	1,432.00	1,348.41	521.04	95.57
Tour Vessels	2	11.50	462.92	73.35	49.16	4.69
Charter Vessels	5	6.18	247.92	39.11	29.51	3.09
Private Vessels	22	62.07	2,496.55	395.25	270.60	26.34
Total		227.03	4,639.39	1,856.12	870.31	129.69
Annual Emissions (tons per calendar year)	**Annual**	**PM**	**NO_X**	**SO_2**	**CO**	**HC**
Cruise Ships	153	5.63	54.77	51.58	19.93	3.66
Tour Vessels	367	1.06	42.47	6.73	4.51	0.43
Charter Vessels	515	0.32	12.77	2.01	1.52	0.16
Private Vessels	2,530	3.57	143.55	22.73	15.56	1.51
Total		10.58	253.56	83.04	41.52	5.76
Net Change from Existing Conditions		-0.88	-148.19	-195.12	-3.95	0.91
% Change from Existing Conditions		-8%	-37%	-70%	-9%	19%

Note:

Annual-use days include proposed seasonal-use day quotas for all vessels and May and September use day quotas for cruise ships and tour vessels. Projected off-season use days for charter and private vessels are based upon existing numbers (see chapter 3).

PM = particulate matter.

CO = carbon monoxide.

SO_2 =sulfur dioxide.

NO_x = nitrogen oxides.

HC = hydrocarbons.

Emissions in Dundas Bay are assumed to be less than those in Glacier Bay, but more than 100 tons per year. Annual emissions of NO_x for Glacier Bay exceed the emissions threshold criteria for moderate effects of emissions of any one pollutant greater than 100 tons per year; therefore, the emissions generated under this alternative would produce moderate effects.

With respect to ambient air quality, the concentrations of criteria pollutants in ambient air in the park would likely to be less than 60% of the National Ambient Air Quality Standards. This conclusion is based on the analysis of ambient air quality data collected in Juneau discussed in alternative 1. Therefore, implementation of alternative 4 would likely have a negligible effect on ambient air quality.

Decreases in vessel traffic and speeds would likely result in a reduction in visible emissions because total daily emissions would decrease and the potential for opacity observations would be reduced when compared to existing conditions. However, visible emissions in the form of plumes from cruise ship stacks would still occur for periods that would vary depending on whether an inversion was present. The magnitude of these plumes would be expected to remain under opacity violation thresholds because traffic will be less and as long as opacity conditions of the concession permits would continue to be enforced. Despite the reduction of the potential for visible plumes compared to existing conditions, the effects to visibility would be moderate because there would still likely be perceptible visible effects, such as haze or plumes that would be present for a limited duration.

Cumulative effects on air quality — alternative 4 — The only significant change to emissions within the park is attributed to the vessels assessed in this evaluation. Past, present, and reasonably foreseeable future actions are described in alternative 1; the additive effects of other emission sources in the Glacier and Dundas Bay airshed and from remote sources would be negligible. The cumulative effects to air quality in the park from this alternative and these other sources would be moderate.

Impairment analysis for air quality — alternative 4 — Based on daily estimated emissions data and data regarding visible plume observations, reduced daily vessel quotas and reduced speed would result in less potential for visibility reductions compared to existing conditions. The duration and magnitude of visible plumes would not likely result in impairment, and visibility conditions would likely improve as a result of the implementation of this alternative.

Conclusion, air quality — alternative 4 — The direct and indirect effects of implementation of this alternative on air resources would be a reduction in emissions and visible plumes compared to existing conditions; however, the emissions and presence of visible plumes would be sufficient for effects to air resources to be moderate. Strict enforcement of opacity limits would limit the potential for visibility reductions. The magnitude and duration of visible plumes would not likely result in impairment under this alternative. Further study of visibility effects should be conducted if this alternative is selected.

Alternative 5 — Effects on Air Quality.

Direct and indirect effects on air quality — alternative 5 — Under alternative 5, cruise ship operations would be limited to the current number of entries allowed under the vessel management plan, and additional speed limitations would be enforced on large vessels. Compared to alternative 1, cruise ship entries would be reduced annually, tour and charter entries would remain the same, and private vessel entries would increase. Operation limitations on tour vessels, charter vessels, and private vessels would be similar.

Table 4-10 presents the estimated worst-case daily and annual emissions in Glacier Bay under alternative 5, and also the change in the total emissions from existing conditions. Total annual emissions of nitrogen oxides and sulfur dioxide are projected to be 321.05 tons per year and 115.61 tons per year, respectively. This represents a 20% decrease in NO_X and a 58% decrease in SO_2 from existing conditions. These figures are lower than existing emission totals based upon 2001 operational data. While the speed limits proposed under this alternative would require that cruise ships remain in the Bay longer, the speed reductions would result in a decrease in annual emissions compared to existing conditions. Maximum daily emissions also would decrease as a result of the speed limitations. Because of the seasonal quotas, there would be some days in which only one or no cruise ships would be in the Bay, resulting in fewer daily emissions than the projected maximum daily emissions. Under this alternative, emissions of pollutants from cruise ships will be significantly reduced, and as a result about half of the estimated emissions could come from the operations of the smaller vessels, if the annual quota for these vessels was reached. Emissions in Dundas Bay are assumed to be less than those in Glacier Bay, but more than 100 tons per year, as in alternative 1. While the total emissions of nitrogen oxides and sulfur dioxide exceed the threshold for a moderate effect, there would be a reduction of emissions under this alternative compared to existing conditions.

TABLE 4-10: ALTERNATIVE 5 DAILY AND ANNUAL VESSEL EMISSIONS

Daily Emissions (pounds per day)	**Daily Vessel Quota**	**PM**	**NO_X**	**SO_2**	**CO**	**HC**
Cruise Ships	2	147.28	1,432.00	1,348.41	521.04	95.57
Tour Vessels	3	17.25	694.38	110.02	73.74	7.04
Charter Vessels	6	7.42	297.51	46.93	35.42	3.70
Private Vessels	25	70.53	2,836.98	449.15	307.51	29.93
Total		242.48	5,260.87	1,954.51	937.71	136.24

Annual Emissions (tons per calendar year)	**Annual**	**PM**	**NO_X**	**SO_2**	**CO**	**HC**
Cruise Ships	231	8.51	82.70	77.87	30.09	5.52
Tour Vessels	520	1.50	60.18	9.54	6.39	0.61
Charter Vessels	607	0.38	15.05	2.37	1.79	0.19
Private Vessels	2,875	4.06	163.13	25.83	17.68	1.72
Total		14.45	321.06	115.61	55.95	8.04
Net Change from Existing Conditions		2.98	-80.70	-162.56	10.48	3.19
% Change from Existing Conditions		26%	-20%	-58%	23%	66%

Note:
Annual-use days include proposed seasonal-use day quotas for all vessels and May and September use day quotas for cruise ships and tour vessels. Projected off-season use days for charter and private vessels are based upon existing numbers (see chapter 3).

PM = particulate matter.
CO = carbon monoxide.
SO_2 = sulfur dioxide.
NO_x = nitrogen oxides.
HC = hydrocarbons.

With respect to ambient air quality, the concentrations of criteria pollutants in ambient air in the park would likely be less than 60% of the National Ambient Air Quality Standards. This conclusion is based on the analysis of ambient air quality data collected in Juneau discussed in alternative 1. Therefore, implementation of alternative 5 is likely to have a negligible effect on ambient air quality.

Decreased vessel speeds and traffic would likely result in a reduction in visible emissions compared to existing conditions because total daily emissions would decrease and the potential for opacity violations would be reduced. Visible emissions in the form of plumes from cruise ship stacks would still occur for periods that would vary with weather conditions. The magnitude of these plumes is expected to remain under opacity violation thresholds. The potential for visible plumes is reduced compared to existing conditions, but would represents moderate effects.

Cumulative effects on air quality — alternative 5 — The only significant change to emissions within the park is attributed to the vessels assessed in this evaluation. Past, present, and reasonably foreseeable future actions are described in alternative 1; the additive effects of other emission sources in the Glacier and Dundas Bay airshed and from remote sources would be negligible. The cumulative effects to air quality in the park from this alternative and these other sources would be moderate.

Impairment analysis for air quality — alternative 5 — Based on daily estimated emissions data and data regarding visible plume observations, speed restrictions and quotas would result in less potential for visibility reductions compared to existing conditions. The duration and magnitude of visible plumes would not result in impairment, and visibility conditions would likely improve as a result of the implementation of this alternative.

Conclusion, air quality — alternative 5 — The direct and indirect effects of implementation of this alternative on air resources would be a reduction in emissions and visible plumes compared to existing conditions; however, the emissions and presence of visible plumes would be sufficient for effects to air resources would be moderate. Strict enforcement of opacity limits would limit the potential for visibility reductions. The magnitude and duration of visible plumes would not likely result in impairment under this alternative. Further study of visibility effects should be conducted if this alternative is selected.

Alternative 6 — Effects on Air Quality.

Direct and indirect effects on air quality — alternative 6 — Under alternative 6, cruise ship operations would be limited to the maximum number of entries allowed under the vessel management plan, and additional speed limitations would be enforced on large vessels. Compared to alternative 1, cruise ship entries would be increased annually, tour and charter entries would remain the same, and private vessel entries would increase. Operation limitations on tour vessels, charter vessels, and private vessels would be similar. While the speed limits proposed under this alternative would require that cruise ships remain in the Bay longer, and despite the increase in entries and use days, the speed reductions would result in a decrease in annual emissions compared existing conditions. Maximum daily emissions also would decrease as a result of the speed limitations.

Table 4-11 presents the estimated worst-case daily and annual emissions in Glacier Bay under alternative 6, and also the change in the total emissions from existing conditions. Total annual emissions of nitrogen oxides and sulfur dioxide are projected to be 324.57 tons per year and 137.19 tons per year, respectively. This represents a 19% decrease in NO_X and a 51% decrease in SO_2 from existing conditions. Decreased speeds could result in a reduction in visible emissions because total daily emissions are lower than daily emissions under existing conditions. Under this alternative, emissions of pollutants from cruise ships will be significantly reduced, and as a result about half of the estimated emissions could come from the operations of the smaller vessels, if the annual quota for these vessels was reached. Emissions of nitrogen oxides in Dundas Bay are assumed to be less than those in Glacier Bay, but more than 100 tons per year, as in alternative 1. While total emissions of nitrogen oxides would result in continuation of a moderate effect, this effect would be reduced compared to existing conditions.

TABLE 4-11: ALTERNATIVE 6 DAILY AND ANNUAL VESSEL EMISSIONS

Daily Emissions (pounds per day)						
	Daily Use Quota	**PM**	**NO_X**	**SO_2**	**CO**	**HC**
Cruise Ships	2	147.28	1,432.00	1348.41	521.04	95.57
Tour Vessels	4	17.25	694.38	110.02	73.74	7.04
Charter Vessels	6	7.42	297.51	46.93	35.42	3.70
Private Vessels	25	70.53	2,836.98	449.15	307.51	29.93
Total		242.48	5,260.87	1,954.51	937.71	136.24
Annual Emissions (tons per calendar year)						
	Annual	**PM**	**NO_X**	**SO_2**	**CO**	**HC**
Cruise Ships	231	8.51	82.70	103.15	30.09	5.52
Tour Vessels	520	1.50	60.18	9.54	6.39	0.61
Charter Vessels	607	0.38	15.05	2.37	1.79	0.19
Private Vessels	2,464	3.48	139.79	22.13	15.15	1.47
Total		16.61	324.57	137.19	63.19	9.58
Net Change from Existing Conditions		5.16	-77.19	-140.97	17.72	4.74
% Change from Existing Conditions		45%	-19%	-51%	39%	98%

Note:

Annual use days include proposed seasonal-use day quotas for all vessels and May and September use day quotas for cruise ships and tour vessels. Projected off-season use days for charter and private vessels are based upon existing numbers (see chapter 3)

PM = particulate matter
CO = carbon monoxide
SO_2 = sulfur dioxide
NO_x = nitrogen oxides
HC = hydrocarbons

With respect to ambient air quality, the concentrations of criteria pollutants in ambient air in the park would likely be less than 60% of the National Ambient Air Quality Standards. This conclusion is based on the analysis of ambient air quality data collected in Juneau discussed in alternative 1. Therefore, implementation of alternative 6 is likely to have a negligible effect on ambient air quality.

Decreased speeds would likely result in a reduction in visible emissions and plumes compared to existing conditions because total daily emissions would decrease. The potential for opacity violations would increase with an increase in vessel traffic, but this potential could be mitigated by the strict enforcement of the concession permit opacity limitations. Visible emissions in the form of plumes from cruise ship stacks would still occur for periods that would vary with weather conditions. The potential for visible plumes would be reduced compared to existing conditions, but represents moderate effects.

Cumulative effects on air quality — alternative 6 — The only significant change to emissions within the park is attributed to the vessels assessed in this evaluation. Past, present, and reasonably foreseeable future actions are described in alternative 1; the additive effects of other emission sources in the Glacier and Dundas Bay airshed and from remote sources would be negligible. The cumulative effects to air quality in the park from this alternative and these other sources would be moderate.

Impairment analysis for air quality — alternative 6 — Based on daily estimated emissions data and data regarding visible plume observations, speed restrictions could result in less potential for visibility reductions compared to existing conditions. The duration and magnitude of visible plumes would not result in impairment, and visibility conditions could improve as a result of the implementation of this alternative.

Conclusion, air quality — alternative 6 — The direct and indirect effects of implementation of this alternative on air resources would be moderate and less than those of existing conditions. Strict enforcement of opacity limits would limit the potential for visibility reductions. The magnitude and duration of visible plumes would not likely result in impairment under this alternative. Further study of visibility impacts should be conducted if this alternative is selected.

Summary, Air Quality. The two primary concerns related to air quality are the amount of pollutants emitted into the air and the potential from emissions for vessels to leave a visible plumes and/or create haze.

Emissions under all alternatives would be within the moderate range. All alternatives would emit nitrogen oxides in Glacier Bay above the 250-tons-per-year threshold and, except for alternative 4, emissions of sulfur dioxide above the 100 ton per year threshold. However, based on the large amount of the area over which emission would occur, the limited number of other significant emission sources, and using Juneau's air quality for comparison, it is unlikely that these emissions would result in ambient air concentrations that are greater than 80% of the National Ambient Air Quality Standards.

Visible haze from stack emissions are known to occur under current conditions, although the frequency, magnitude, and duration of such events is unknown. Reduced vessels under alternative 2 would reduce the magnitude and, because alternative 2 would allow the fewest number of private vessels, nearshore – short-term reductions of air quality would be the lowest. Alternative 3 would increase the frequency of visible haze, should cruise ships be increased. The frequency cannot be predicted, although the NPS is undertaking an air quality monitoring program that would help predict the frequency, magnitude, and duration.

Alternative 4 would produce the lowest amount of emissions into the air due to the lowest numbers of vessels and speed restrictions for cruise ships. Eliminating tour vessels and limiting charter vessels in Dundas Bay would improve air quality there, although there is no evidence that air quality is currently a problem. Alternative 5 would also reduce emissions by limiting cruise ship speeds, by applying seasonal restrictions for cruise ships in May and September, and by eliminating tour vessels from the wilderness waters of Glacier Bay. These same measures would reduce emissions under alternative 6. Alternative 6 would result in increased emissions and visible haze due to the increase in cruise ships. Alternative 6 would allow for the highest level of short-term emissions near shorelines due to the increase in private vessels.

4.2.3 Water Quality

4.2.3 Water Quality

This subsection evaluates the sources and history of water pollution in Glacier Bay and Dundas Bay; regulatory framework; and the probable effects on water quality from implementing the alternatives. The regulatory framework is described first, followed by the direct, indirect, and cumulative effects on water quality from implementing each alternative. The potential for the alternatives to impair water resources also is discussed, as well as mitigation measures, if required. Conclusions are summarized at the end of the analysis for each alternative.

Issues of Concern Raised During Scoping. The issues concerning water quality that were raised during public scoping are as follows:

- Increases in vessel quotas increase the potential for unauthorized releases of marine debris, petroleum, graywater, blackwater, oil, ballast, photographic chemicals, dry cleaning solutions, and cleaning solvents. The unauthorized release of marine debris and other contaminants may degrade water quality, affect the ecosystem, and imperil park visitors.
- Increasing the vessel quota increases the potential of small and catastrophic oil spills. Current technology is inadequate to clean up oil spills in ice-filled waters.
- Vessels other than large cruise ships may not have the capacity to hold and treat waste. Possible increases in these types of vessels could result in increased discharges of waste, resulting in degradation of the marine environment.
- The park’s zero discharge policy for cruise ships means that they are dumping their sanitary waste outside the park.

Regulatory Framework. The relevant federal, state, local, and international laws and regulations pertaining to water quality in Glacier Bay and Dundas Bay are identified below. Specific regulatory requirements and thresholds are summarized in table 4-12; this is not an exhaustive list.

Federal laws and regulations —

- Clean Water Act, section 32 and regulations, and section 311 and regulations; 33 CFR 159; 40 CFR 140; 33 CFR 151.
- Oil Pollution Act (OPA) of 1990 — 33 USC 2701 et seq.
- Resource Conservation and Recovery Act (RCRA).
- Act to Prevent Pollution from Ships (see International Convention for the Prevention of Pollution from Ships [MARPOL], under international laws).

State laws and regulations —

- State of Alaska’s Water Quality Standards (18 AAC 70).
- State of Alaska’s Commercial Passenger Vessel Environmental Compliance Program (CPVEC; Alaska Statute 46.03; 18 AAC 69).

All of the regulations are pertinent to the analysis of the alternatives, but the State of Alaska’s Commercial Passenger Vessel Environmental Compliance Program needs additional explanation to understand how it is applied. The Alaska Department of Environmental Conservation’s CPVEC law regulates the discharges of the contaminants associated with graywater and blackwater, but has different provisions for vessels according to their size. The department regulates only those vessels that can accommodate 50 or more passengers in lower berths (overnight accommodations). It further distinguishes between small commercial passenger vessels (50 to 249 passengers) and large vessels (250 or more passengers). All small and large commercial passenger vessels must comply with the standards (see table 4-12), but not all of them are able to comply immediately. Those that cannot comply are operating under interim protective measures. All large commercial passenger vessels that discharge graywater or blackwater must be in compliance with the standards by 2003. Small commercial passenger vessels must come into compliance by 2004 (ADEC 2002b); therefore, large and small commercial passenger vessels may be discharging certain contaminants above standards.

Local policies and regulations — No local governmental water quality laws apply to the park; however, the Park Service prohibits discharge of blackwater at Bartlett Cove (see appendix B). Additionally, as part of the permitting process for obtaining entry to the park, cruise ship operators must submit a pollution minimization plan that documents how each operator implements the industry’s best management practices (BMPs) to minimize pollution emissions to air and water and to prevent fuel spills. The park’s goal of minimizing pollution, coupled with the competitive environment for winning entry permits, typically results in cruise ship operators submitting a pollution minimization plan that incorporates a zero discharge policy, specifically recognizing the effects to water quality from discharge of graywater, sanitation devices, incinerator ash, and oil/water separator effluent. Currently, all cruise ships with entry permits for the peak season, June 1 to August 31, have incorporated such a policy in their pollution minimization plans. In addition, three operators currently have entry permits during the off-peak season, each of whom also have committed to a zero discharge policy in their pollution minimization plans. All of the operators define zero discharge as no discharge of graywater or blackwater (NPS, Nemeth, electronic mail, October 21, 2002).

International laws and regulations — Cruise ships that are flagged under countries that are members of the International Convention for the Prevention of Pollution from Ships must comply with MARPOL requirements. MARPOL 73/78 is the international treaty regulating the disposal of wastes generated by normal operation of vessels. MARPOL 73/78 is implemented in the U.S. by the Act to Prevent Pollution from Ships, under the lead of the U.S. Particularly relevant to this analysis are MARPOL annexes I, IV, and V, which are described in more detail in table 4-12.

TABLE 4-12: MAJOR REGULATORY REQUIREMENTS AND THRESHOLDS FOR GLACIER BAY WATERS AND MARINE VESSEL WASTES

Waste	Law or Reg.	Requirements and Thresholds	Responsible Agency
Blackwater (Sewage)	U.S. Clean Water Act	Discharges of untreated sewage or sewage with a fecal coliform bacterial count greater than 200 colonies per 100 milliliters, or total suspended solids exceeding 150 milligrams per 100 milliliters are not allowed within 3 nautical miles of the shoreline. Requires a certified operable Marine Sanitation Device (MSD) on every vessel (U.S. and foreign) with an installed toilet.	U.S. Environmental Protection Agency; U.S. Coast Guard
	36 CFR 2.14	Polluting or contaminating park area waters or water courses with sanitation and refuse is prohibited.	Park Service
	Alaska Statute 46.03.460–46.03.490	Discharge limit set for blackwater (treated sewage) of 200 fecal coliform colonies per 100 milliliters and 150 milligrams per liter of suspended solids. Discharge limited to at least 1 mile from shore and 6 knots vessel speed, unless more stringent effluent levels are demonstrated.	Alaska Department of Environmental Conservation
	NPS 2002 Compendium	No discharge of blackwater in Bartlett Cove waters.	Park Service
	NPS Entry Permit	Zero discharge agreement established with cruise ship operators through competitive bid process for entry permits. Not NPS policy.	Self-regulated
	International Convention for the Prevention of Pollution from Ships Annex IV	The discharge of sewage into the sea is prohibited, except when: the ship is discharging ground-up and disinfected sewage using a system approved by the administration at a distance of more than 4 nautical miles from the nearest land, or sewage that is not comminuted or disinfected at a distance of more than 12 nautical miles from the nearest land; or the ship has in operation an approved sewage treatment plant which has been certified by the administration. The effluent shall not produce visible floating solids in, nor cause the discoloration of, the surrounding water.	U.S. Coast Guard
Graywater	U.S. Clean Water Act	No restrictions on discharging graywater.	U.S. Coast Guard, U.S. Environmental Protection Agency
	36 CFR 2.14	Polluting or contaminating park area waters or water courses is prohibited.	Park Service
	Alaska Statute 46.03.460–46.03.490	Discharge limit set for graywater of 200 fecal coliform colonies per 100 milliliters and 150 milligrams per liter of suspended solids. Discharge limited to at least 1 mile from shore and 6 knots vessel speed.	Alaska Department of Conservation
	NPS Entry Permit	Zero discharge agreement established with cruise ship operators through competitive bid process for entry permits. Not NPS policy.	Self-regulated
Solid Wastes, Marine Debris	36 CFR 2.14	Polluting or contaminating park area waters or water courses is prohibited.	Park Service
	International Convention for the Prevention of Pollution from Ships 73/78, Annex V	Dumping floatable dunnage, lining, and packing material is prohibited within 25 miles of shore. Dumping other un-ground garbage is prohibited within 12 miles. Incinerator ash is typically considered non-hazardous, and may be disposed of at sea in accordance with International Convention for the Prevention of Pollution from Ships annex V. Ash identified as being hazardous must be disposed of ashore in accordance with Resource Conservation and Recovery Act.	U.S. Coast Guard

TABLE 4-12: MAJOR REGULATORY REQUIREMENTS AND THRESHOLDS FOR GLACIER BAY WATERS AND MARINE VESSEL WASTES

Waste	Law or Reg.	Requirements and Thresholds	Responsible Agency
Toxic Wastes	Resource Conservation and Recovery Act (RCRA)	Dry cleaning solvent (perchlorethylene [PERC]); batteries including lead acid, lithium, and nickel cadmium; some print shop waste; and photo processing waste containing silver in excess of 5 parts per million are classified as hazardous waste under the Resource Conservation and Recovery Act and must be handled accordingly.	U.S. Environmental Protection Agency
	18 AAC 70.20	Antidegradation policy: Existing water uses and the level of water quality necessary to protect existing uses must be maintained and protected.	Alaska Department of Environmental Conservation
	NPS Entry Permit	Zero discharge agreement established with cruise ship operators through competitive bid process for entry permits. Not NPS policy.	Self-regulated
Oil	U.S. Oil Pollution Act of 1990	No visible sheen or oil content greater than 15 parts per million within 12 miles. Oily waste must be retained onboard and discharged at an appropriate reception facility.	U.S. Coast Guard
	18 AAC 70.020	There may be no concentration of petroleum hydrocarbons, animal fats, or vegetable oils in shoreline or bottom sediments that cause deleterious effects to aquatic life. Surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration.	Alaska Department of Environmental Conservation
	International Convention for the Prevention of Pollution from Ships 73/78, Annex I	All vessels of any type more than 400 gross tons traveling over international waters are required to have an approved Shipboard Oil Pollution Emergency Plan (SOPEP). Vessel must be equipped as far as practicable and reasonable with installations to ensure the storage of oil residues onboard and their discharge to reception facilities, or into the sea providing the ship is more than 12 nautical miles from the nearest land, the oil content of the effluent is less than 100 parts per million, and the ship has in operation an oil discharge monitoring and control system, oil-water separating equipment, and oil filtering system or other installation.	U.S. Coast Guard

Methodology and Assumptions. To evaluate the water quality effects of implementing the alternatives, the Park Service reviewed existing literature to define a baseline for Glacier Bay and Dundas Bay. Records of fuel spills and vessel discharges in the park were reviewed to establish a history of incidents resulting in discharges. The potential effects were determined by comparing them with the regulatory standards summarized in table 4-12.

To establish a qualitative understanding of petroleum discharges in Glacier Bay and Dundas Bay, reports and studies developed for the Park Service were reviewed. Specifically, the *Spill Prevention, Countermeasures and Control (SPCC) Plan* (Baker 2000a); the *Needs Assessment for a Major Fuel Oil Spill* (Eley 2000); and related NPS documents provide the basis for establishing the historical trends of petroleum discharges to the Bay and the safety measures in place to respond to a petroleum spill. This evaluation assumes that these data are representative of current conditions, and these data were extrapolated to determine the potential effects of each alternative.

To provide a qualitative understanding of vessel wastewater discharges, data compiled by the Alaska Department of Environmental Conservation under the Commercial Passenger Vessel Environmental Compliance Program were reviewed. The Park Service used these data to estimate discharges that could occur as a result of the implementation of each alternative because no blackwater discharge data are available for the park. It is reasonable to assume that these data would be representative of all passenger vessels that operate within the park. Assumptions were made about the potential effects of increased vessel traffic using the existing data for historical vessel traffic, fuel spill history from vessels at the Bartlett Cove Fuel Transfer and Storage Facility, and documented vessel discharges in the Bay. It was assumed that discharges, including spills in the future, would be similar to the historical patterns and levels if the number of vessels entering Glacier Bay remained the same. It also was assumed that any increase in the number or frequency of vessels entering the Bay would incrementally increase the potential for accidental petroleum spills, as well as the quantities of petroleum storage and transfers required at the Bartlett Cove facility. Increased vessel traffic also would increase the potential for vessel discharges into the Glacier Bay ecosystem.

Effects to water quality were evaluated by extrapolating ADEC data and historical trends for fuel spills and discharges and comparing the projections to federal and state regulations (see table 4-12). The alternatives' effects on water quality are evaluated within the context of the marine waters of Glacier Bay. The duration of effects was judged based on the regulatory timeframe for each parameter. The threshold criteria presented in table 4-13 are used to describe the intensity of effects on water quality and are based on the state and federal regulations summarized in table 4-12.

TABLE 4-13: THRESHOLD CRITERIA FOR EFFECTS ANALYSIS ON WATER QUALITY

Negligible	No detectable or measurable changes to water quality or exceedances of water quality standards would occur.
Minor	Any degradation of water quality would be temporary (less than 48 hours) and limited to the immediate area of the discharge or, in the case of marine debris, to low volumes.
Moderate	Any degradation of water quality would be short term (less than one month) and localized.
Major	Water quality would be degraded by an ongoing exceedance of water quality standards or a spill or upset that degrades water quality in the long term.

The potential water quality effects are further categorized as either routine (from normal or daily operations and activities) or upset (from distinctive, unlikely, severe incidents). To eliminate repetition, much of the discussion is found only under alternative 1 (no action). The discussions of water quality effects for alternatives 2, 3, 4, 5, and 6 were developed using alternative 1 as a baseline.

Alternative 1 (No Action) — Effects on Water Quality. Under alternative 1, entry quotas and operating requirements would not change. For this analysis, it has been assumed that current effects to water quality would continue; therefore, this section describes the sources of pollutants and other parameters that currently affect, or in the recent past have affected, water quality in the park.

Direct and indirect effects on water quality — alternative 1 — Four parameters related to vessel traffic that currently affect water quality in the park are — petroleum from a fuel or oil release, wastewater and other contaminants, marine debris, and resuspension of sediments.

<u>Petroleum from a fuel or oil release.</u> The effects of a fuel or oil release can be highly variable, depending on the type, quantity, and location of the spill. In general, exposure to the most toxic substances decreases with time and is usually limited to the initial spill area. “In some areas, habitats and populations can recover quickly. Unfortunately, in other environments, recovery from persistent or stranded oil may take years. Some organisms may be seriously injured or killed very soon after contact with the oil in a spill, however, non-lethal toxic effects are more subtle and often longer lasting” (EPA 2002c). Appendix F, table 1, describes the properties and effects of gasoline and diesel, including environmental toxicity, as well as effectiveness of mechanical recovery and shoreline countermeasures. Additional information regarding spill prevention scenarios and response countermeasures can be found in the park’s spill prevention control and countermeasure plan (Baker 2000a; Ely 2000).

The existing level of motorized vessel use in the park has resulted in discharges of petroleum products. Petroleum can enter marine waters by the following mechanisms:

- leaks, spills, or deliberate discharge of bilge or ballast water containing petroleum products.
- leaks from the use of two-stroke engines.
- leaks or spills at the Bartlett Cove vessel fueling facility.
- spills involving the Park Service fueling barge in Blue Mouse Cove.
- accidental releases of petroleum as a result of a vessel grounding or collision.

The following subsection describes the potential sources of petroleum products that could be released into the marine waters of the park.

BILGE AND BALLAST WATER: Residual oil, lubricants, and possibly fuel may accumulate in the bilge (i.e., lowest part within the interior hull) of vessels. Cruise ships can generate 1,300 to 37,000 gallons (4,921 to 140,060 liters) of oily bilge water per day (Herz and Davis 2002). On most cruise ships, oily bilge water is pumped through an oil/water separator. Separated water is either discharged into marine waters or offloaded to a treatment facility while the ship is in port. Smaller vessels typically hold their bilge water until it can be pumped out at port.

Although law prohibits the release of oily bilge water, an accidental release may occur. Between 1994 and 2001, three discharges of bilge water resulting in a visible sheen were documented in Glacier Bay by a charter vessel in 1995, and tour vessels in 1999 and 2001 (see appendix E). Additional undocumented events resulting in release of fuel also may have occurred.

A bilge water release from a small vessel would be limited to the immediate area of discharge. Because discharge volumes from a single smaller vessel would contain relatively small amounts of petroleum, this would have little or no long-term effect on ambient water quality. In an accidental or inadvertent release of bilge water from a cruise ship, the total amount of oily waste entering the park would be larger, but the discharge also would be dispersed over a larger area while the vessel travels; therefore, the potential effects to water quality likely would be minimized. The potential effects would be greater if there were an inadvertent release by a cruise ship while stopped in ice-filled water. The risk is addressed in the subsection regarding collisions and grounding.

Some vessels accommodate changes in weight and trim by taking on or discharging ballast water held in ballast tank. In general, cruise ships discharge ballast water only when they are taking on fuel (in Seattle or Vancouver for the Alaska season). The Park Service informally learned from Holland America Line that intake of ballast “would rarely be necessary in Glacier Bay” (NPS, Nemeth, electronic mail, September 16–18, 2002). The fuel barges do not take on or discharge ballast water (Petro Marine, Robertson, pers. com., January 6, 2003); therefore, any release of ballast water would be unintentional.

TWO-STROKE ENGINES: Another mechanism for oil to reach the Bay is through the release of fuel or oil from two-stroke engines. According to the Park Service, most outboard engines used in the Bay, both by the public and by the Park Service, are two-cycle engines. These are typically found on smaller vessels. The park is actively changing engines on government vessels to four-stroke as the older engines are retired. While a formal survey has not been conducted, the Park Service estimates that roughly two-thirds to three-fourths of outboards on private vessels are two-cycle (Young 2002).

Two-stroke engines release up to 20% to 30% of the gas/oil mixture unburned directly into the water (EPA 2002d). The American Watercraft Association believes that this is neither significant nor dangerous since the raw fuel eventually evaporates into the atmosphere. Other studies indicate that two-stroke engine emissions cause the most damage to the aquatic environment within the first 24 hours of discharge and that without dilution the contaminated water could remain toxic for weeks (Bluewater Network 2001).

With advancing technology, newer two-cycle engines will pollute less and will meet the upcoming EPA regulations scheduled for implementation in 2006. They will use direct and high-pressure fuel injection technologies to overcome the waste oil problems inherent in older two-cycle engines (Young 2002). Research found, however, that while these new direct-injected two-stroke engines are cleaner than older models, on average they polluted more than four-stroke engines (Bluewater Network 2001).

The boats using two-stroke engines can travel to remote areas in the park, thereby introducing pollutants in areas not visited by larger vessels. Furthermore, the tidal flushing in some remote areas may be restricted and the flushing cycles longer than in the main channel. It could take several tide cycles to exchange the water in a smaller restricted fjord than it does in mid-channel. The pollutants left by a small vessel in these areas could affect more water simply because they are present longer (NPS, Banks, pers. com., 2002).

Direct adverse effects, if any, would be limited to the area of use. Small vessels do not concentrate in any one area, and because of the strong currents in Glacier Bay, their sheens would dissipate and disperse rapidly (Young 2002), excluding some remote areas outside the main channel. Because single-discharge volumes would contain relatively small amounts of petroleum, little or no long-term degradation of ambient water quality would be expected.

BARTLETT COVE PETROLEUM TRANSFER AND STORAGE FACILITY: The marine transfer facility at Bartlett Cove is operational year-round, but is not available to the public from October to April. Primary demand for fuel is during the visitor-use season period (May through September). The Bartlett Cove facility provides fuel for vessels up to 150 feet (46 meters) long which include the Bartlett Cove Ferry. Cruise ships cannot fuel at the facility because of their size.

The Bartlett Cove facility stores and dispenses gasoline and diesel fuel. The capacity of the storage facility is approximately 15,000 gallons (56,701 liters) of gasoline and 100,000 gallons (378,541 liters) of diesel (five 20,000-gallon [75,708 liters] tanks). The double-walled tanks are filled only to 90% of their capacity; therefore, the total wet capacity of gasoline is 13,500 gallons (51,103 liters) and the total wet capacity of diesel is 90,000 gallons (340,678 liters), for a total wet capacity of 103,500 gallons (391,790 liters; Baker 2000b). Two 3,000-gallon (11,356 liters) overflow tanks (one for each fuel) are in place to prevent the fuel from escaping in an accidental overflow. The third overfill protection system for the bulk fuel storage tanks is two 3,000-gallon (11,356-liter) overflow tanks located within the tank farm, one diesel and one gasoline. Should any bulk fuel storage tank be overfilled during the filling process, the fuel will flow into the vent/overflow piping and into the overflow tank. At normal filling rates, this allows approximately 5 minutes for the operating personnel to shut valves and stop the filling process.

Commercially operated barges transfer fuel to the facility approximately every three weeks in the summer and every other month in the winter. The capacity of each of the two petroleum barges is up to 1,500,000 gallons (5,678,118 liters) of fuel (Eley 2000). The barges typically deliver 50,000 to 100,000 gallons (189,271 to 378,541 liters) of gasoline or diesel to Bartlett Cove per month during the May-to-September tourism season (Eley 2000).

All fuel transfer operations (loading and unloading) at the Bartlett Cove Petroleum Transfer and Storage Facility meet the requirements of the U.S. Coast Guard according to the facility’s spill prevention control and countermeasures plan. Because most spills are caused by human error, preventive measures, including strict control of access to the dispensing pumps, are adhered to (Baker 2000a).

Potential fueling-facility-associated petroleum spills could occur from three separate areas of operation:

- leaks from the underground storage tanks (USTs) or pipelines at the tank farm.
- spills from product transfers from the marine barge to the Bartlett Cove tank farm.
- spills during dispensing of fuel on dock or onshore.

Previous investigations of soils and hydrogeology at the Bartlett Cove tank farm suggest that fuel leaks from underground tanks and piping do not reach Bartlett Cove because of the flat hydraulic gradient and the ability of soils to absorb petroleum compounds; however, spill incidents during fuel dispensing can lead to direct discharges of fuel into marine waters.

Appendix F, table 2, identifies the response equipment that is currently available should a spill occur at Bartlett Cove and Blue Mouse Cove. Appendix F, table 3, outlines the probable spill scenarios for the Bartlett Cove facility. The most likely discharge occurs during dispensing of fuel to the vessels. The most probable spill is 1 pint (0.5 liter) of gasoline or diesel fuel waterborne in any single incident; however, if over-pumping occurs, a spill of approximately 150 gallons (568 liters) may occur (Baker 2000a).

Spills of petroleum products into Bartlett Cove have been documented since 1978 (Baker 2000a); these spills have ranged in quantity from several ounces up to 20 gallons. The largest recorded spill volume at the Bartlett Cove facility was a 100-gallon (379-liter) spill caused by the failure of an injector system on one of the facility generators; however, this spill occurred in an upland area. Most of the spills that have occurred at the Bartlett Cove facility have been related to the refueling of vessels. Based on the recorded spill history of this facility, an average of four to five spill incidents involving small quantities (less than 5 gallons [19 liters]) of fuel occur per year (Baker 2000a).

According to the Bartlett Cove Fuel Transfer and Storage Facility oil SPCC plan for the park and preserve (Baker 2000a), the largest potential spill at the facility is 3,000 gallons (11,356 liters) of diesel. The estimated worst-case scenario spill identified in the Bartlett Cove SPCC plan would have the potential for severe and immediate adverse effects to resources requiring a high level of water quality. Under alternative 1, however, the probability of effects to water quality as a result of this type of spill would remain roughly the same as present conditions, which is negligible. In the unlikely event of this spill scenario, effects likely would be localized and short term, and change in water quality could be minimized by an effective spill response.

BLUE MOUSE COVE FUEL BARGE: The fuel barge *Petrel* serves as a fueling station for NPS vessels, including the up-Bay patrol and research vessels (Young 2002). In addition to being a fuel supply for daily park operations, the barge also serves as an emergency fuel supply in the upper reaches of the Bay in the event of a large incident such as a vessel grounding or fuel spill, which involves intensive emergency vessel traffic. The barge has steel double-walled construction and measures 38 by 14 feet (11.6 by 4.3 meters), with a steel watertight storage structure mounted on top, storing fuel spill and other supplies. The Park Service tows the barge up to Blue Mouse Cove, where it is anchored from May through September. Then it is returned to Bartlett Cove for the winter. The barge has two tanks; the large tank has a capacity of 5,000 gallons (18,927 liters) and typically stores gasoline, and the smaller tank is 500 gallons (1,893 liters) and stores diesel (NPS 1995c). The barge carries spill prevention and response equipment. The worst-case scenario spill of 5,500 gallons (20,820 liters) of fuel, therefore, would have the potential for severe and immediate adverse effects to resources requiring a high level of water quality, but the probability of such a spill is small.

A large spill, although unlikely, could occur when the barge is en route to Blue Mouse Cove or upon return to Bartlett Cove. Historically spills at the Blue Mouse Cove fuel barge facility have been small and infrequent. Only one recorded incident occurred at the Blue Mouse Cove fuel barge; in 2000, 1 to 2 gallons (3.8 to 7.6 liters) of diesel overflowed and spilled into the water. The effects of these small spills would be limited to the immediate area of discharge and short term. Additionally, while it could not be fully avoided, changes to water quality would be minimized by implementing pollution prevention measures such as rapid deployment of spill containment equipment.

ACCIDENTAL RELEASE DUE TO GROUNDING OR COLLISION: Historical data indicate that the likelihood of a spill due to collision or grounding is low; and, in the event that a spill occurs, the response capability is high (Eley 2000). A needs assessment (Eley 2000) used for planning for a major fuel spill in Glacier Bay concluded that:

- powered groundings, the most likely accident, are most likely to occur when vessels intentionally deviate from established tracklines; if the ship remains relatively stable after a powered grounding, extensive bottom damage will not usually result in a serious fuel spill, even if fuel tanks are involved.
- loss of propulsion could cause drift grounding if anchoring or restoration of power does not occur.
- an accident involving an excursion vessel or small passenger vessel could occur anywhere in the park.
- the probability of a fuel spill as a result of a collision with ice is low.
- the average most probable fuel spills are from fishing vessels.

The largest spills would result from a collision or grounding of the tank barges; the two barges carry up to 1,500,000 gallons (5,678,117 liters) of fuel each. Cruise ship tanks may carry more than 400,000 gallons (1,514,164 liters), and tour vessels may have up to approximately 12,000 gallons (45,425 liters).

The park has a pre-approved agreement with the regional fuel spill response organization, Southeast Alaska Petroleum Resource Organization (SEAPRO). Southeast Alaska Petroleum Resource Organization is Southeast Alaska’s response action contractor and oil spill removal organization. Southeast Alaska Petroleum Resource Organization has two fuel spill response barges at Bartlett Cove and additional response equipment at Gustavus that are available to members to respond to spills in Glacier Bay, although they are not solely dedicated to the park. The SEAPRO barges also would respond to fuel spill incidents even if the vessel was not a contracted member. The fuel tank barge operators in Southeast Alaska are members of Southeast Alaska Petroleum Resource Organization. The fuel tank barges carry spill response equipment that can be deployed immediately.

Cruise ship companies maintain and implement a Shipboard Oil Pollution Emergency Plan in accordance with the International Convention for the Prevention of Pollution from Ships (applicable to vessels of 400 gross tons or more). The Shipboard Oil Pollution Emergency Plan is unique to each ship and must be approved by the ship's flag state. It includes procedures for reporting fuel spill incidents and taking immediate action to mitigate the spill and coordinate cleanup actions (Holland America Line [HAL] 1997). According to a representative pollution minimization plan of Holland America Line, spill cleanup equipment maintained onboard their ships consists of enough sorbent boom to cover one side of the ship, and sorbent pads. With this equipment, it is possible to contain a small spill or discharge (HAL 1997).

Despite the provisions to cleanup spills, the park has conditions that could severely hinder spill response capabilities. These include adverse weather conditions, extreme tidal ranges, and ice-filled waters. Many vessels visit the ice-filled waters near the glaciers at Johns Hopkins Inlet, Tarr Inlet, and Reid Inlet. Waters in many of the upper inlets, including Rendu, Skidmore/Charpentier, Wachusett, Adams, and Geikie, can be choked with pan ice during winter (November to May; NPS, Soiseth, pers. com., 2002). A fuel spill in ice-filled waters presents challenges different from a spill in other areas in the park. If a spill enters ice-filled waters, SEAPRO barges cannot respond. They are suitable only for incidental contact with ice (SEAPRO, Pritchard, pers. com., October 9, 2002). In general, no spill response technology currently is available to adequately clean fuel spills in slush or ice. In addition, spill response equipment, other than onboard equipment, is located at Bartlett Cove and could require several hours to mobilize to headwater areas of the Bay. Circumstances including distance to the spill, weather, and conditions of the icy water may result in delayed response to a spill in ice-filled waters. According to NPS personnel, no spills are known to have occurred in ice-filled waters (NPS, Nemeth, pers. com., unknown date). Furthermore, the probability of a fuel spill as a result of a collision with ice is low (Eley 2000); however, a tour vessel struck an iceberg and suffered hull damage in 1996 (see appendix E).

<u>Summary of effects of petroleum releases</u>. Effects of petroleum releases are highly dependent on the type, size, and location of the spill, as well as on the effectiveness of spill response activities.

Under alternative 1, changes to water quality and the occurrences of discharges of bilge or ballast water, petroleum releases from two-stroke engines, a petroleum spill at the fuel dispensing facilities, or from a collision would remain approximately the same as present conditions.

Changes to water quality due to discharges of bilge water, releases from two-stroke engines, and small petroleum spills due to normal operations would be highly localized or limited to the immediate area of discharge, and would be temporary, because much of the spilled fuel would dissipate or evaporate quickly; therefore, the effects to water quality from these types of releases under alternative 1 would be considered minor.

For a larger release (e.g., a worst-case discharge at either the Bartlett Cove or Blue Mouse Cove fueling station), direct adverse effects would be more extensive than with small spills. Likewise, under circumstances where petroleum was discharged while a vessel was stationary, not allowing for quick dissipation, effects of the petroleum could be more significant than if the discharge occurred while the vessel was under way. While resulting petroleum spills cannot be fully avoided, their effects to water quality in Glacier Bay and Dundas Bay may be minimized with spill response technology. The fueling facility takes numerous precautions to avoid this scenario, and in the event of an actual spill, spill response capability is high. Because these types of spills may be short term and could result in a threat to health of wildlife and/or their habitat, the effects to water quality from these occurrences under alternative 1 would be considered moderate.

In the unlikely event of a catastrophic spill, especially under circumstances in which an effective response is not possible, such as in ice-filled waters, direct adverse effects to resources requiring a high level of water quality may be severe and long term, and may include direct mortality or threat to health of wildlife and/or their habitat. According to the U.S. Coast Guard, a major marine fuel spill is any spill more than 100,000 gallons (378,541 liters) (EPA, Carr, electronic mail, February 24, 2003). Activities such as pre-planning, strategic staging of spill response barges, and spill response training may lessen the effects; however, these events may occur for a variety of reasons, foreseeable or not, and as such, no proper mitigation exists. The effects from catastrophic spills and from petroleum discharge in ice-filled waters where spill response is hindered would constitute a major effect on water quality. A more in-depth discussion of spill potential is addressed in subsection 4.4.3, “Vessel Use and Safety.”

Overall, the implementation of alternative 1 would likely result in minor effects to water quality as a result of petroleum releases because under normal operating circumstances, the current effects are minor and the risk of an upset would remain the same (see subsection 4.4.3, “Vessel Use and Safety”).

Wastewater and other vessel discharges. Ships generate several types of waste produced by passengers and ship operations. These wastes include graywater, blackwater, hazardous waste, and solid waste.

GRAYWATER AND BLACKWATER: Graywater contains non-sewage waste from showers, baths, sinks, and laundries. Treatment of graywater is not required before discharge from a vessel. It can contain such components as food waste; oil and grease; detergents; and, on some vessels, medical or dental wastes. Blackwater is water contaminated with human waste collected from shipboard toilets (sewage). The Alaska Department of Environmental Conservation estimates that a large cruise ship generates 5 gallons (18.9 liters) of treated blackwater per person per day and 50 gallons (189.3 liters) of graywater per person per day (ADEC 2002b).

Discharge of blackwater, or sewage, can result in eutrophication, which can lead to the growth of some algae and other microscopic organisms that capture oxygen. Disease and toxins can adversely affect exposed plants, animals, and humans. While some substances will evaporate or dissolve quickly, others may persist for many years. Although some organisms may be seriously injured or killed immediately after exposure, others may suffer from non-lethal effects. In some areas, habitats and populations can recover quickly, while others require years to recover. Graywater normally does not contain sewage, but may contain harmful wastes.

The Alaska Science Advisory Panel evaluated contaminants in cruise ship discharges, focusing on metals and total suspended solids effluent data. Their study concluded that effects of contaminants in sediments that could be associated directly with cruise ships were unlikely (ADEC 2002b).

Cruise ships hold their wastewater for a limited period of time, such as during their tour of Glacier Bay, while smaller vessels, including most tour vessels and charter and private vessels, generally cannot, and must discharge their treated waste continuously. Given the large number of passengers aboard, an accidental discharge of untreated wastewater from a large cruise ship would constitute the worst-case discharge scenario; however, all cruise ships must legally treat their blackwater before it is released. There has been only one documented release of wastewater in the park; in 1999, a cruise ship discharged graywater outside Bartlett Cove.

As part of the permitting process for obtaining entry to the park, cruise ship operators submit a pollution minimization plan that documents how each operator implements the industry’s best management practices to minimize pollution emissions to air and water and to prevent fuel spills. The plan is submitted with their application for an entry permit. The park’s goal of minimizing pollution, coupled with the competitive environment for winning entry permits, typically results in cruise ship operators submitting a pollution minimization plan that incorporates a zero discharge policy. Currently, all cruise ships with entry permits for the peak season, June 1 to August 31, have incorporated such a policy in their pollution minimization plans. In addition, three operators have entry permits during the off-peak season, all of whom have also committed to a zero discharge policy in their pollution minimization plans. In each pollution minimization plan, each operator defines zero discharge as no discharge of graywater or blackwater (NPS, Nemeth, electronic mail, October 21, 2002). Cruise ships operators also may include in their pollution minimization plan a provision to turn off incinerators while the ship is in park. According to the Park Service, if operator's discharge fuel or wastewater, the park can penalize them either criminally or through the concession program, depending on the severity of the spill or discharge, the appropriateness of the operator's response, and/or cooperation with the park and other agencies (NPS, Seraphin, electronic mail, January 6, 2003).

With advances in technology, vessels will either install advanced wastewater treatment systems whose discharges comply with CPVEC requirements or they will not be allowed to operate in the park. In addition, those vessels that are continuously discharging generate smaller volumes of waste and the waste is dispersed over large areas; therefore, the potential effects to water quality are likely to be minimized.

For large cruise ships, which can easily hold their wastewater while traveling in Glacier Bay, the likelihood of a release of wastewater to the Bay is low. In the case of smaller cruise ships and tour vessels that cannot hold their waste, wastewater is treated and discharged continuously. While the effects of a discharge of graywater or blackwater can vary, a 2002 report by the ADEC Science Advisory Panel estimates that wastewater effluent in open waters is diluted by a factor of 1:50,000 (one part effluent to 50,000 parts sea water, for a large cruise ship traveling at 6 knots and discharging wastewater at 200 cubic meters per hour) within less than 15 minutes. At these dilution levels, the only contaminant likely to be measured above ambient levels in the sea water would be fecal coliforms (ADEC 2002b). Some smaller ratio of dilution is anticipated for smaller vessels, such as tour vessels and small cruise ships, or vessels moving at slower speeds, because this dilution factor is determined by the size and speed of the vessel, and the rate of discharge. The Advisory Panel suggest that, while the loading of contaminants from smaller vessels is relatively small, stationary discharge of wastewater and discharge in areas of low net marine water outflow should be avoided because of slowed mixing and dispersion (ADEC 2002b). Private vessels may not be able to treat their wastewater before it is diluted. Because of the small volumes involved and the dilution factor, the effects would not be significant.

Changes in water quality due to wastewater discharge would be limited to the immediate area of the discharge, and effects would be short term because the effluent would be diluted and dispersed rapidly; therefore, under alternative 1, a discharge of wastewater would be considered a minor effect.

HAZARDOUS WASTE: Hazardous wastes may be generated while a ship is within park waters from processes such as photo development, dry cleaning, printing, and reverse osmosis or distillation for drinking water. Additionally, common items regularly onboard many vessels may qualify as hazardous waste, including pharmaceuticals, cleaning solutions, fluorescent lights, and batteries. A typical cruise ship with 3,000 passengers and crew will generate approximately 15 gallons (56.7 liters) of photographic processing chemicals, 1.5 gallons (5.7 liters) of dry cleaning and other chemicals, and 1.5 gallons (5.7 liters) of paint waste per day (Herz and Davis 2002).

Hazardous wastes, if not handled properly, can enter the wastewater stream on vessels by flushing them down drains, or tossing cans or other items into normal trash areas. Then, a discharge of wastewater or solid waste would allow the hazardous materials to enter marine waters. The potential for a discharge of hazardous waste, therefore, can be equated to the potential for a release of wastewater or solid waste, although each discharge of such waste would not necessarily contain hazardous materials.

The changes to water quality from these types of discharge are limited to the immediate area of the discharge, and depending on the type or quantity of the hazardous material, the extent of degradation can be highly variable. While some substances will evaporate or dissolve quickly, others may persist for many years. Although some organisms may be seriously injured or killed immediately after exposure, others may suffer from non-lethal effects. In some areas, habitats and populations can recover quickly, while others require years to recover (EPA 2002c).

The likelihood of a discharge of significant amounts of hazardous wastes is low, and the hazardous material would be diluted upon entrance to the marine waters; therefore, under alternative 1, a discharge of hazardous wastes is considered a minor effect.

SOLID WASTE: Solid waste generated onboard vessels includes food waste, bottles, plastic containers, cardboard, and paper. Each day, an average cruise passenger will generate 2 pounds (907 grams) or (0.9 kilogram) of dry trash and dispose of two bottles and two cans (International Council of Cruise Lines [ICCL] 2002). On large vessels, up to 85% of a ship's solid waste is incinerated; the remainder is retained onboard and disposed of at port. Incinerator ash is typically considered non-hazardous, and may be disposed of at sea in accordance with International Convention for the Prevention of Pollution from Ships annex V. Ash identified as being hazardous must be disposed of ashore in accordance with the Resource Conservation and Recovery Act. Because of the smaller number of passengers onboard tour, charter, and private vessels, these passengers generate less trash than cruise ships passengers. Cruise ships and tour vessels operating under concession permits are required to haul their solid wastes and trash out of the park. Solid waste from private vessels and the Park Service is transferred to the park landfill near Bartlett Cove (NPS 1995a). As part of their concession permit, cruise ships take their incinerators off line while in park waters. It is unlikely that solid waste would be discharged to the marine environment under alternative 1. The changes to water quality would be negligible.

MARINE DEBRIS*:* Marine debris (also known as flotsam) occasionally is seen in park waters and accumulates on park shorelines. The main source of the debris is from vessels outside the park and not regulated by the Park Service. Marine debris includes commercial fishing gear, building materials, and other industrial items. Sacks of trash, coffee cups, balloons, and other items from cruise ships and other vessels are occasionally found in park waters and on shorelines, though the volume of debris from cruise ships is less than the volume from other sources from outside the park (NPS 1995a). The park's sea otter dive team found bottles and cans near the southern entrance of North Sandy Cove. They noted an increase in the amount of trash in this area in the past year (Barber, pers. Comm., 2003).

Studies of marine debris volumes in the park are limited (Polasky 1992, in NPS 1995b). Marine debris has been found on the protected waters and shores of Glacier Bay and the park's exposed outer coast. Within Glacier Bay, most debris is concentrated on beaches of the lower Bay, south of Willoughby Island. Marine debris accumulates to a much greater degree on windward beaches of the exposed outer coast between Cape Spencer and Dry Bay. Within the semi-protected area of Icy Strait/Cross Sound, marine debris accumulates on beaches at levels intermediate to those of Glacier Bay and the outer coast.

Cruise ships and tour vessels operating under concession permits are required to haul their solid wastes and trash out of the park. Solid waste from Glacier Bay Lodge, private vessels, and the Park Service is transferred to a local landfill.

While at sea, marine mammals, fish, and seabirds can become entangled with or ingest marine debris. On shore, debris degrades the natural beauty of beaches and poses a threat to wildlife and health hazards to humans. Bears regularly eat debris. Marine debris such as plastic can persist in the marine environment and along the shoreline for many years. Currents also can carry it far from the point of discharge.

Because most of the marine debris in the park is discharged from vessels not covered in this document (including vessels traveling outside the Bay and fishing vessels), and the volumes discharged by vessels covered in this EIS would be low under alternative 1, the effect of the volume of marine debris in the Bay on water quality would be minor. Although vessels covered in this EIS may discharge some debris in violation of the Act to Prevent Pollution from Ships, the Park Service currently implements efforts to minimize these discharges. For example, each concession agrees to operate in accordance with the guidelines in a pollution minimization plan that is contained in each concession permit

<u>Resuspension of sediments</u>. Sediments can be resuspended by natural processes such as heavy rain or spring melt as well as from vessel movement. Resuspension of sediments can increase turbidity and degrade water quality by reducing light penetration, discoloring the ocean surface or interfering with filter-feeding benthic organisms sensitive to increased turbidity. The effects of sediment resuspension depend on vessel velocity, current velocity, sediment size, and the vertical stability of water columns.

Satellite images of the mid-water channel waters of Glacier Bay in the wake of a tour vessel show resuspended sediments. Sediment resuspension by cruise ships has been observed in the upper Bay, where cruise ships have resuspended glacial sediments from denser stratified waters below the surface to near surface in periglacial areas.

The deepest vessel listed in the NPS Vessel Database for the park and preserve (Nemeth 2002) has a draft (depth) of 33 feet (10 meters). Vessels in Glacier Bay can create internal waves of less than 40 feet (12 meters). A vessel affects only the volume of water it displaces when moving through the water. Hooge and Hooge (2002) state that stratification occurs in the summer. They found that the first layer of stratification occurs at approximately 33 feet (10 meters), but other research has shown that stratification can occur in the first 3.3 to 6.6 feet (1 to 2 meters). Most vessels in Glacier Bay have only drafts deep enough to affect the shallowest stratified layers. A vessel may cause localized mixing of the upper stratified layers along its trackline, but the effects are localized, short term, and approximately the same width as the beam of the vessel and trail behind the track. The water tends toward recovering to the original stratified state. Waters near the glaciers are likely to be stratified, with an upper layer containing glacial silt within a freshwater lens. When a vessel travels through this lens, the upper lens mixes with the lower, more saline layer; however, the mixing is limited to the volume of water displaced by the vessel and the disturbance of the stratification is temporary.

Internal waves generated by vessels traveling through waters less than 40 feet deep (approximately 12 to 13 meters) cause the resuspension of sediments. In general, areas with depths less than 40 feet are near the shore; therefore, sediments are resuspended as vessels travel close to shore. The resuspension, however, is not likely to be greater than the resuspension that occurs because of natural wave action. As with vessels traveling near the glaciers, the volume of water displaced by the vessel defines the area affected and the effect is likely to be temporary in calm waters. In already turbid waters, such as beaches with wave action and near the glaciers in the upper arms, the resuspension of sediments due to the approach of vessels may have no noticeable change in turbidity.

The effects to water quality in Glacier Bay or Dundas Bay would be limited to the immediate area and temporary. Water quality would return to normal parameters, and therefore would be considered a minor effect under alternative 1.

<u>Summary of direct and indirect effects on water quality — alternative 1</u>. The potential changes to water quality from small discharges of fuel oil from bilge water, two-stroke engines, fuel transfer operations, or a discharge of other contaminants, would result in temporary, changes to water quality and only in the immediate area of discharge. Additionally, the resuspension of sediments and marine debris would be temporary and only effect the immediate area. These changes, resulting from routine operations, would degrade water quality for less than 48 hours. Larger spills at the Bartlett Cove or Blue Mouse Cove fueling facilities also would be expected to alter water quality to levels above allowable state and federal water quality standards, but may be for less than one month, and would have a moderate effect. Other than an unlikely catastrophic event, such as a total loss of all fuel aboard a large cruise ship or fuel barge, the implementation of this alternative would have an overall minor effect on water quality from normal operations, except in the unlikely event of a catastrophic spill.

Cumulative effect on water quality — alternative 1 — Cumulative effects were considered with respect to the marine water resources in Glacier and Dundas Bays. Past actions that may have altered water quality include fuel and other spills described in appendix F. These spills changed water quality in the immediate area of the spill for a temporary period of time. However, there are no known notices of water quality violations. These past actions are not currently or in the foreseeable future likely to alter water quality in the park. Current or reasonably foreseeable actions or activities that could contribute to the changes to water quality in Glacier Bay and Dundas Bay include other vessels used in the park that are not managed under this plan, vessels operated outside Glacier Bay and Dundas Bay, and increases in population and tourism in Southeast Alaska. Research vessels (NPS and non-NPS), commercial fishing vessels, other administrative use (NPS traffic), and float planes potentially contribute pollution through discharges of fuel, wastewater, and other contaminants. The potential changes in water quality from commercial fishing vessels within Glacier Bay would decrease over time as commercial fishing ceases in the park.

The effects from these actions, combined with those resulting from implementation of alternative 1, would be minor. Increases in tourism and the human population of Southeast Alaska could result in increased vessel and other recreational activities. Because alternative 1 would regulate vessels within the park, the effects would be the same, but commercial and private vessels operating outside Glacier Bay and Dundas Bay could accidentally discharge petroleum, blackwater, graywater, or ballast water, and marine debris could migrate into Dundas Bay and Glacier Bay. The effects of small or “normal” spills would be minor, given the volumes of water in the surrounding area; however, if a catastrophic spill occurs immediately adjacent to the entrance of either Bay, then the effects due to contaminant migration could be major.

Impairment analysis for water quality — alternative 1 — Of all of the vessel discharges that would occur under alternative 1, only a catastrophic fuel spill as a result of a grounding or collision, or a spill in ice-filled water, would result in a major water quality effect. Based on historical data, the likelihood of catastrophic spills is low (Eley 2000) and effects can be minimized in open water with an effective spill response. The park maintains a supply of spill response equipment at Bartlett Cove and Blue Mouse Cove. Table 2 of appendix F identifies the location, quantity, and deployment time for this equipment. In addition, the Alaska Department of Environmental Conservation has adopted a USCG proposal that provides fuel spill response expectations for the tank vessel and cruise ship industry. The expectations include response guidelines for the two, six, 12, and 24-hour timeframes. Appendix B of the *Needs Assessment for a Major Fuel Oil Spill* (Eley 2000) details the proposal. In the case of a spill that enters ice-filled waters, however, no technology exists to contain or remediate the spill. Because there is a very low probability of a spill in ice-filled waters, the risk of such a spill causing an impairment of park water resources is low. In conclusion, with the exception of a large-scale catastrophic spill or spill in ice-filled waters, the level of impacts anticipated from alternative 1 would not impair water quality.

Potential mitigation measures for water quality — alternative 1 — Mitigation measures that could be used to protect water quality include:

- educating ship captains about the causes of collisions and groundings that could result in spills, including knowledge of local conditions and hazards such as strong currents, submerged rocks, floating ice, and vessel traffic patterns.
- upgrading spill response equipment and training for NPS, USCG, and vessel operations.

Conclusion, water quality — alternative 1 — The overall direct and indirect effects to water quality would be minor because changes in water quality would be limited to the immediate area of discharge of fuel oil or other contaminants or would be temporary for resuspension of sediments. The cumulative effect would be minor. Moreover, implementation of alternative 1 would not likely result in impairment of water quality resources in the park, with the exception of a large-scale catastrophic oil spill; therefore, the overall effect of this alternative on water quality would be minor.

Alternative 2 – Effects on Water Quality.

Direct and indirect effects on water quality — alternative 2 —

Petroleum from a fuel or oil release. As discussed in the evaluation of alternative 1, petroleum products can be released by vessels into the Bay through discharge of oily bilge water, use of two-stroke engines, at the fuel transfer facilities, or by collision or grounding. Also as discussed in alternative 1, contamination from a bilge water release would be limited to the immediate area of discharge and any accidental discharge would be dispersed over a larger area; therefore, the potential effects to water quality likely would be minimized. Under alternative 2, the occurrences and effects on water quality of discharges of bilge water may be incrementally lower because of the reduction of seasonal-use days and entries for all vessels in Glacier Bay; however, the potential alterations to water quality would remain the same, and are considered minor under alternative 2.

The operation of two-stroke engines in Glacier Bay or Dundas Bay can result in a small sheen of oil forming on the water where the engine is being run. Alternative 2 would reduce the seasonal entries and use days for private vessels; therefore, fewer smaller vessels that typically use the two-stroke engines would be in the Bay. The effects of their use under this alternative would be considered minor because the potential for discharge would still exist.

Potential water quality changes as a result of fueling at the Bartlett Cove and Blue Mouse Cove facilities would be less than those of alternative 1 because of the decrease in the number of seasonal entries and seasonal-use days for charter and private vessels. The potential for a spill also would be reduced for the same reason. A small spill at these facilities would be minor, but a spill under upset conditions could be more widespread, may be more difficult to fully contain, and would result in a larger area having degraded water quality for a longer period of time. Such a spill would be considered a moderate effect.

The risk of a vessel grounding or a collision under this alternative and a resulting fuel spill would be incrementally lower than under existing conditions. Although there is not a direct correlation between the number of vessels and the likelihood of a grounding or collision, it is expected that the overall reduction in cruise ships and charter and private vessel seasonal entries and seasonal-use days under this alternative would reduce the probability of groundings and collisions. The effects of large catastrophic petroleum spills, however, would remain the same, and constitute a major effect on water quality.

Overall, under normal operations, the anticipated effects from petroleum releases through the implementation of alternative 2 would be minor given that the risk of a major upset would be low.

Wastewater and other contaminants. The likelihood of a release of wastewater from a large cruise ship is low and water quality changes due to discharge of graywater or blackwater would be limited to the immediate discharge area. Implementation of alternative 2 would allow fewer seasonal-use days and entries for all vessel categories, except tour vessels, which could incrementally reduce the potential for a discharge of wastewater. In the case of smaller vessels that discharge continuously, wastewater would be diluted and dispersed; therefore, the discharge of wastewater is considered a minor effect under alternative 2.

The potential for discharge of solid waste and ballast water may be incrementally lessened by the reduction in cruise ships entering the Bay in alternative 2; however, the effects would be similar to those of alternative 1 and would constitute a minor effect on water quality.

Marine debris. Marine debris already is present in Glacier Bay and would be expected to be present with implementation of alternative 2. Most of the marine debris in the park is discharged from vessels not covered in this EIS, and the volumes discharged by vessels covered in this document would be low under alternative 2; therefore, the changes to water quality from the volume of marine debris in Glacier Bay under alternative 2 would be minor.

Resuspension of sediments. Similar to alternative 1, vessels potentially would resuspend sediments in the near-shore area during minus tides and near glaciers where there are freshwater lens. This would be considered a minor effect because it would be temporary and limited to the immediate area.

Summary of direct and indirect effects on water quality — alternative 2. Implementation of alternative 2 compared to the implementation of alternative 1 could result in incrementally fewer changes to water quality because of the reduction of seasonal entries and seasonal-use days for all vessel categories except tour vessels entering Glacier Bay; however, the overall consequences would be similar. Alternative 2 would result in minor effects as a result of small discharges of fuel oil from bilge water, two-stroke engines, fuel transfer operations, or a discharge of other contaminants that would be limited to the immediate area and only temporarily change water quality. Additionally, the resuspension of sediments and marine debris also would result in temporary changes to water quality. These tend to result from routine operations and activities, and the effects would be limited to the immediate area. Upsets at the Bartlett Cove or Blue Mouse Cove fueling stations or a release from a stationary vessel could result in moderate effects to water quality (i.e., a short-term change in water quality), because of the potential volumes of fuels that could be discharged. A large-scale catastrophic spill would result in major effects to water quality (i.e, a long-term reduction in water quality). Either scenario could be minimized with spill response technology.

The overall effect of implementation of alternative 2 would have minor effects on water quality from normal operations. These effects would be fewer than those from the implementation of current vessel quotas and operating requirements because of the decrease in seasonal-use days and because entries for most vessel classes would reduce the risk of upsets. The occasional release of petroleum through normal operations, however, would not cease, so small discharges that would result in temporary changes to water quality would still be anticipated.

Cumulative effects on water quality — alternative 2 — The effects of past, current, and foreseeable external actions on water resources in the park (e.g., past spills, other vessels used in the park that are not managed under this plan, vessels operated outside Glacier Bay and Dundas Bay, and increases in population and tourism in Southeast Alaska, would be negligible. The decline in commercial fishing vessel traffic in Glacier Bay over time will also reduce the potential for adverse water quality changes. The effects of the external actions would be expected to change the water quality of the park significantly; therefore, the cumulative effects of external action in conjunction with this alternative would be minor.

Impairment analysis for water quality — alternative 2 — A catastrophic fuel spill resulting as a result of a collision or grounding, or a spill in ice-filled water would result in a long-term major water quality effect. The possibility of a catastrophic spill occurring would be low because of the reduction in daily vessel quotas. The effects, in open water, could be minimized. The risk of a spill would be less than that under current conditions because fewer vessels would be entering Glacier Bay; therefore, the potential for an effect to result in impairment of park water resources is low.

Conclusion, water quality — alternative 2 — The direct and indirect effects of alternative 2 from normal operations would be minor because they would be temporary and limited to the immediate area of discharge of fuel and contaminants or where sediments have been resuspended, with the exception of a large-scale catastrophic fuel spill, which would have major effects. The cumulative effect of this alternative would be minor. Moreover, implementation of this alternative would not result in impairment of water quality resources in the park; therefore, the overall effect of the implementation of this alternative would be minor.

Alternative 3 — Effects on Water Quality.

Direct and indirect effects on water quality — alternative 3 —

Petroleum from a fuel or oil release. Discharges from the use of two-stroke engines, small bilge releases, and spills at the fueling facilities would remain identical as those under alternative 1, because there would be no change in the number of smaller vessels under this alternative. These effects are considered minor, because they would be temporary and limited to the immediate area of the discharge.

For a worst-case discharge at either the Bartlett Cove or Blue Mouse Cove fueling station, or a release from a stationary vessel, direct adverse effects would be more extensive than those of small spills. If petroleum were discharged while a vessel is stationary, effects of the petroleum may be more significant. The fueling facility takes precautions to avoid spills, and when a spill occurs, the spill response capability is high. These types of spills are anticipated to be short term and could result in a threat to the health of wildlife and/or their habitat. The effects would be much the same as those under alternative 1, but there would be a slightly higher probability that a spill may occur under this alternative if seasonal-use days and entries were increased to 184.

Although a direct correlation would be difficult to make, the increases in the total number of cruise ships with seasonal entry permits under this alternative could incrementally increase the likelihood for a major spill over the long term. While the total number of cruise ships allowed in the park in a year would be greater under this alternative than in current conditions, the number of cruise ships in the Bay at any one time would be the same as the current conditions; therefore, the potential for a collision, a grounding, or other en-route accidents resulting in a large spill would be low (see subsection 4.4.3, “Vessel Use and Safety”). Any large catastrophic spill resulting from an accident would be considered a major effect.

Overall, the implementation of alternative 3 would result in minor effects to water quality as a result of petroleum releases under normal operating circumstances. The risk of an upset would remain low, but slightly higher than under current conditions (see subsection 4.4.3, “Vessel Use and Safety”).

Wastewater and other contaminants. It is assumed that under this alternative, there would be a proportional increase in potential discharges due to the increased number of vessel entries over current conditions. Because graywater or blackwater discharges are diluted within less than 15 minutes and would be limited to the area immediately surrounding the discharge, and the potential for a large cruise ship discharging wastewater is low, the changes to water quality due to the discharge of wastewater would be the same as those under alternative 1 and would be considered minor. In addition, under the pollution minimization plan included in the concession permit, cruise ships should take reasonable measures to address discharges in park waters.

The potential for discharge of solid waste and ballast water may be incrementally greater because of the increase in the number of cruise ships entering the Bay over the summer season; however, the changes to water quality would constitute a minor effect on water quality under alternative 3.

Marine debris. Marine debris already is present in Glacier Bay and would be expected to be present with implementation of alternative 3. Most of the marine debris in the park is discharged from vessels not covered in this EIS, and the volume discharged from vessels covered in this document is low. The increased number of vessels under alternative 3 would likely result in an increase in marine debris incrementally greater than that under alternatives 1 and 2. However, the volume would remain low; therefore, the effect of the volume of marine debris on the Bay’s water quality in alternative 3 would be minor.

Resuspension of sediments. Under alternative 3, vessels would resuspend sediments in the nearshore area during minus tides and near glaciers where there are freshwater lenses. This is considered to be a minor change to water quality because the daily vessel limit would remain the same and the effects would be temporary and limited to the immediate area.

<u>Summary of direct and indirect effects on water quality — alternative 3.</u> Alternative 3 would result in minor changes to water quality as a result of small discharges of fuel oil from bilge water, two-stroke engines, fuel transfer operations or a discharge of other contaminants, resuspension of sediments, and marine debris. Moderate effects may occur as a result of larger spills at the Bartlett Cove and Blue Mouse Cove fueling facilities, or a release from a stationary vessel, and water quality could be altered to levels that violate Alaska and federal water quality standards. Major effects are unlikely, but could occur as a result of a worst-case scenario spill due to collision or grounding, or a severe spill in ice. In the unlikely event of a catastrophic spill, such as a total loss of all fuel aboard a large cruise ship or fuel barge, there would be a major effect on water quality; however, under normal operations, the implementation of this alternative would have minor direct and indirect effects on water quality, as they would be temporary and limited to the immediate area.

Cumulative effects on water quality — alternative 3 — The cumulative effects of alternative 3 and other past, present, and foreseeable external actions (e.g., past spills, other vessels used in the park not managed under this plan, vessels operated outside Glacier Bay and Dundas Bay, and increases in population and tourism in Southeast Alaska, would be minor. Over time, with the cessation of commercial fishing in Glacier Bay, there would be a decrease in potential effects on water quality from releases from the vessels. The cumulative effects could be slightly greater than those under current conditions because of the proposed increase in vessel entries; however, the effects of the current and foreseeable external actions, with the exception of a large-scale catastrophic spill, would not significantly change the water quality of the park, and the cumulative effect on water quality under this alternative would be minor.

Impairment analysis for water quality — alternative 3 — A catastrophic fuel spill resulting from a collision or grounding on open waters or a spill in ice-filled water would result in a long-term major water quality effect. The possibility of a catastrophic spill is low, and the effects in open water under good conditions can be minimized. Although additional cruise ships would be allowed in the park under alternative 3, the risk of a major spill is similar to, but incrementally greater than, that of alternative 1 because a larger number of vessels would be in Glacier Bay seasonally; therefore, the potential for an effect to result in impairment of park water resources is low.

Conclusion, water quality — alternative 3 — Implementation of alternative 3 may result in incrementally greater effects on water quality compared to alternative 1 because of the increased number of cruise ships entering Glacier Bay. The overall direct and indirect effects of the implementation of this alternative would be minor because changes to water quality as a result of normal operations would be temporary and limited to the immediate area for discharges of fuel oil and other contaminants or where sediments have been resuspended; however, a catastrophic large-scale fuel spill could result in major effects. The contribution of cumulative effects from other activities would be negligible. Moreover, implementation of this alternative would not result in impairment of water quality resources in the park. The overall effect of the implementation of this alternative would be minor.

Alternative 4 — Effects on Water Quality.

Direct and indirect effects on water quality — alternative 4 —

<u>Petroleum from a fuel or oil release</u>. The reduced number of cruise ship seasonal-use days under alternative 4 could result in a lower level of risk for the inadvertent discharge of bilge water. Additionally, restricting tour vessels from entering Dundas Bay would avoid the risk of a discharge of oily waste in Dundas Bay. Because cruise ships do not use the Bartlett Cove marine transfer facility or the Blue Mouse Cove fuel barge, the existing level of use of these facilities would not change; the potential for small petroleum releases during normal operations would decrease slightly from existing

conditions because of the reductions in daily vessel quotas for tour, charter, and private vessels. The slight increase in private vessel seasonal-use days would not be expected to change the potential for a release. These releases could result in short-term, localized changes to water quality; however, an upset at these facilities would still result in moderate effects on water quality.

The risk of a vessel grounding or collision and a resulting fuel spill under this alternative would be incrementally lower than that under alternative 1 because of the overall reduction in vessels in the park at any given time; however, the potential effects of a large petroleum discharge would remain the same and represent a major effect on water quality. Under this alternative, the restrictions on tour vessels in Dundas Bay and tour vessels and cruise ships in the East Arm of Glacier Bay would reduce the likelihood of fuel spill effects in those areas. In addition, under this alternative, the formally defined cruise ship routes (typically in mid-channel) would better separate the various users, and provide an increased margin of safety for the avoidance of nearshore collisions. The reduced ship speed to 13 knots under this alternative may also reduce the potential for accidents in tight conditions.

Under normal operations, the effects from petroleum releases through implementation of this alternative would be minor.

<u>Wastewater and other contaminants</u>. Under this alternative, the potential for a large cruise ship to release wastewater is low and would be lower than that under alternative 1 because fewer large cruise ships would enter the park. As with the other alternatives, the changes to water quality from a release would be limited in size and duration. The changes to water quality from smaller vessels that discharge continuously would be temporary and limited to the immediate area.

The potential for discharge of solid waste and ballast water would be incrementally smaller than that in alternative 1 because of the reduction in cruise ships entering Glacier Bay; however, the changes to water quality would be similar to those in alternative 1 and would constitute a minor effect on water quality under alternative 4, because they would be temporary and limited to the immediate area.

<u>Marine debris</u>. Marine debris, most of which is discharged from vessels not covered in this document, is present in Glacier Bay and would be expected to be present with implementation of alternative 4. The volume of debris from vessels covered in this document would be low under alternative 4; therefore, the effect of marine debris in the Bay on water quality would be minor.

<u>Resuspension of sediments</u>. Under alternative 4, vessels would resuspend sediments in the nearshore area during minus tides and near glaciers when there are freshwater lenses. This would be considered a minor effect because it would be temporary and limited to the immediate area. Under alternative 4, cruise ships would be required to remain in mid-channel waters. This restriction would reduce nearshore resuspension of sediments over current conditions. Additionally, there would be a reduction of any potential resuspension of sediments in Dundas Bay, Beardslee Entrance, and parts of the East Arm because cruise ships and tour vessels would be restricted from these areas.

<u>Summary of direct and indirect effects on water quality — alternative 4</u>. Water quality could be degraded under alternative 4 because of small discharges of fuel oil from bilge water, two-stroke engines, fuel transfer operations, or a discharge of other contaminants, but changes would be temporary and limited to the immediate area. Additionally, the resuspension of sediments and the discharge of marine debris would occur. Moderate effects may occur as a result of larger spills at the Bartlett Cove and Blue Mouse Cove fueling facilities. An unlikely catastrophic event, such as a total loss of all fuel aboard a large cruise ship or fuel barge, or a severe spill in ice-filled waters, would result in major effects on the water quality. The implementation of this alternative under normal operations, overall, would have minor direct and indirect effects on water quality.

Cumulative effect on water quality — alternative 4 — The cumulative effects of past, present, and foreseeable activities (e.g., past spills, other vessels used in the park that are not managed under this plan, vessels operated outside Glacier Bay and Dundas Bay, and increases in population and tourism in Southeast Alaska in conjunction with the effects of alternative 4 could contribute to changes in water quality in the park, but the effects would be slightly less than those resulting from alternative 1 because of the proposed decrease in vessel traffic and quotas. The decrease in commercial fishing in Glacier Bay also will decrease the potential changes to water quality. Overall, the cumulative effects of this alternative in conjunction with external actions would be minor.

Impairment analysis for water quality — alternative 4 — As discussed in the analysis for the previous alternatives, because of the low overall risk of an accident that would result in a fuel spill and the spill response capacity in Glacier and Dundas Bays, alternative 4 would not result in an impairment of park water resources. Only a catastrophic fuel spill resulting from a collision or grounding on open waters or a spill in ice-filled water would result in a long-term major water quality effect. The likelihood of this type of spill occurring is low, and the effects, under good conditions, can be minimized with spill response technology.

Conclusion, water quality — alternative 4 — The potential effects of the implementation of alternative 4 could result in incrementally fewer effects to water quality than alternative 1 because of the reduction of cruise ships and other vessel classes (seasonal basis) entering Glacier Bay. Routine effects as a result of operations of smaller vessels, such as small spills or discharges, would remain, but be incrementally reduced. The overall direct and indirect effects would be minor because changes to water quality would be temporary and limited to the immediate area of a discharge of fuel or contaminants or where sediments have been resuspended, with the exception of a catastrophic spill. The cumulative effect of this alternative would be minor. Moreover, implementation of this alternative would not result in impairment of water quality resources in the park. The overall effect of this alternative on water quality would be minor.

Alternative 5 — Effects on Water Quality.

Direct and indirect effects on water quality — alternative 5 —

<u>Petroleum from an oil or fuel release</u>. All changes to water quality would be anticipated to be the same as those in alternative 1 except with respect to the increase in the number of two-stroke private vessel entries. Small discharges from oily bilge water, the use of two-stroke engines, under alternative 5 and spills at fueling facilities, would incrementally increase with the increase in private vessels but would be minor. A worst-case-scenario spill at the Bartlett Cove or Blue Mouse Cove fueling facilities would be short term and localized, and would constitute a moderate effect on water quality.

The risk of a vessel grounding or collision under this alternative would be low. Changes in water quality due to a severe petroleum discharge as a result of collisions, groundings, and other en-route accidents would remain the same as alternative 1, and therefore would constitute a major effect on water quality. Under this alternative, the restrictions on tour vessels in Dundas Bay and cruise ships in Adams Inlet would reduce the likelihood of a fuel spill in those areas. In addition, cruise ship speeds would be reduced to 13 knots, which would likely reduce the potential for catastrophic spills by providing more time for course corrections.

<u>Wastewater and other contaminants</u>. Implementation of alternative 5 would allow the same number of cruise ships into Glacier Bay as alternative 1, but an increase in the number of private vessel seasonal-use days. There would be a small change in the likelihood of discharge of wastewater, or the changes to water quality due to such discharge, as compared with alternative 1; therefore, the discharge of wastewater would be considered a minor effect under alternative 5. Under alternative 5, the potential for discharge of solid waste and ballast water would be the same as that under alternative 1, and would constitute a minor effect on water quality under alternative 5.

<u>Marine debris</u>. Most of the marine debris in the park is discharged from vessels not covered in this document. The volume of marine debris currently present in Glacier Bay would be expected to be

present with implementation of alternative 5; therefore, the effect of marine debris on water quality under alternative 5 would be minor.

Resuspension of sediments. Under alternative 5, vessels would resuspend sediments in the nearshore area and near glaciers with freshwater lenses. This would be considered a minor effect because it would be temporary and limited to the immediate area.

Summary of direct and indirect effects on water quality — alternative 5. Under alternative 5, minor changes to water quality could result from small discharges of fuel oil from bilge water, two-stroke engines, fuel transfer operations, or a discharge of other contaminants. Additionally, the resuspension of sediments and marine debris also could cause temporary changes to water quality. Worst-case-scenario spills at the Bartlett Cove and Blue Mouse Cove fueling facilities could alter water quality such that contaminant levels would exceed state and federal water quality standards. Major effects also could occur from worst-case-scenario spills as a result of grounding or collision, especially in ice-filled waters; however, the likelihood of this type of spill is low. This alternative would slightly reduce the likelihood of a spill through closure of Adams Inlet to cruise ships, closure of all wilderness waters to tour vessels, and reduction of the large vessels speed limit to 13 knots. Other than an unlikely catastrophic event, such as a total loss of all fuel aboard a large cruise ship or fuel barge, the implementation of this alternative, overall, would have a minor effect on water quality.

Cumulative effects on water quality — alternative 5 — The cumulative effects from the implementation of alternative 5 with the other past, present, or foreseeable activities affecting the park (e.g., past spills, other vessels used in the park that are not managed under this plan, vessels operated outside Glacier Bay and Dundas Bay, commercial fishing vessels operating in Glacier Bay, and increases in population and tourism in Southeast Alaska) would result in effects similar to those of alternative 1. The cumulative effects of the other actions, with the exception of a large-scale catastrophic spill, would not contribute significantly to changes in water quality in the park, and the effect would be minor.

Impairment analysis for water quality — alternative 5 — A catastrophic fuel spill resulting from a collision or grounding in open waters or a spill in ice-filled water would result in a long- term major water quality effect. The possibility of a catastrophic spill occurring is low, and the effects, in open water, can be minimized. The risk of a spill is less than that under current conditions with the addition of vessel speed limits; therefore, the potential for an effect to result in impairment of park marine water resources is low.

Conclusion, water quality — alternative 5 — The potential effects of the implementation of alternative 5 would result in similar effects as that under alternative 1, because the same number of cruise ships vessels would be allowed in Glacier Bay over the course of the season, but there would be an increase in the number of private vessel seasonal-use days. The overall direct and indirect effects of this alternative on water quality under normal operations would be minor; only temporary changes to water quality would be anticipated and only in the immediate area of a discharge of fuel contaminants where sediment resuspension has occurred, with the exception of a catastrophic fuel spill. The cumulative effects of this alternative would also be minor. Moreover, with the exception of a large-scale catastrophic spill, implementation of this alternative would not result in impairment of water quality resources in the park. Overall, the effect of implementing this alternative would be minor.

Alternative 6 — Effects on Water Quality.

Direct and indirect effects on water quality — alternative 6

Petroleum from a fuel or oil release. As with alternative 5, small discharges from the use of two-stroke engines, bilge releases, and spills at the fueling facilities would likely increase compared to alternative 1, because there would be an increase in the number of private vessels under this alternative, including those with two-stroke engines. Under alternative 6, the incremental increase in occurrences and effects to water quality from these small spills is considered minor, because they would be temporary and limited to the immediate area of the discharge.

For large petroleum spills, including a worst-case discharge at either the Bartlett Cove or Blue Mouse Cove fueling station, or a release from a stationary vessel, the effects would be similar to those under alternative 1, but there would be a slightly higher probability that a spill would occur under this alternative with the potential increase in seasonal-use days to 184. Additionally, if petroleum were discharged while a vessel was fueling, the effects of the petroleum may be more significant than if discharged en route, because the petroleum will not be diluted. Direct adverse effects from these larger spills would be more extensive than smaller spills and may include a threat to the health of wildlife and/or their habitat. The fueling facilities seek to avoid spills, and when a spill occurs, the spill response capability is high. Because of this, adverse effects are anticipated to be short term and therefore are considered moderate.

While the total number of cruise ships allowed in the park in a year under this alternative is greater than under current conditions, the number of cruise ships in the Bay at any one time would be the same as the current conditions. The reduced ship speed to 13 knots under this alternative may reduce the potential for accidents in tight conditions. Therefore, the potential for a collision, grounding, or other en-route accidents resulting in a large or catastrophic spill would be slightly lower than that of alternative 1 (see subsection 4.4.3, “Vessel Use and Safety”). Under this alternative, the restrictions on tour vessels in Dundas Bay and cruise ships in Adams Inlet would reduce the likelihood of fuel spill effects in those areas. However unlikely, any large catastrophic spill resulting from a collision, grounding, or other en-route accident would likely have long term and severe impacts to water quality and would be considered a major effect.

Overall, the implementation of alternative 6 would result in minor effects to water quality as a result of petroleum releases under normal operating circumstances. The effects would be similar to those of alternative 1; however, the risk of a major upset would remain low and slightly lower than that in alternative 1 (see subsection 4.4.3, “Vessel Use and Safety”).

Wastewater and other contaminants. Under this alternative, it has been assumed that there would be a proportional increase in potential discharges due to the increased number of vessel entries over current conditions. Given that graywater or blackwater discharges are known to be diluted within less than 15 minutes and would be limited to the area immediately surrounding the discharge, and the potential for a large cruise ship discharging wastewater is low; therefore, the potential changes to water quality due to the discharge of wastewater would be the same as those under alternative 1 and would be considered minor. Cruise ships also are committed to take reasonable measures to address discharges in park waters as outlined in their pollution minimization plans included in their concession permit.

The potential for discharge of solid waste and ballast water may be incrementally greater because of the increase in the number of cruise ships entering the Bay over the summer season; however, the changes to water quality would constitute a minor effect on water quality under alternative 6.

Marine debris. Marine debris already is present in Glacier Bay and would be expected to be present with implementation of alternative 6. Most of the marine debris in the park is discharged from vessels not covered in this EIS, and the volume discharged from vessels covered in this document is low. The increased number of vessels under alternative 6 would likely result in an increase in marine debris incrementally greater than that under alternative 1. However, the volume would remain low; therefore, the effect of the volume of marine debris on the Bay's water quality in alternative 6 would be minor.

<u>Resuspension of sediments</u>. Under alternative 6, vessels would resuspend sediments in the nearshore area during minus tides and near glaciers where there are freshwater lenses. As under alternative 1, this is considered to be a minor change to water quality because the daily vessel limit would remain the same and the effects would be temporary and limited to the immediate area.

<u>Summary of direct and indirect effects on water quality – alternative 6</u>. Alternative 6 would result in minor effects to water quality as a result of small discharges of petroleum product from bilge water, two-stroke engines, or fuel transfer operations; a discharge of other contaminants or marine debris; or from resuspension of sediments. Moderate effects may occur as a result of larger spills at the Bartlett Cove and Blue Mouse Cove fueling facilities, or a release from a stationary vessel, and water quality could be altered to levels that violate Alaska and federal water quality standards for a longer duration without adequate clean-up. Major effects are unlikely, but could occur as a result of a worst-case scenario spill due to collision or grounding, or a severe spill in ice. In the unlikely event of a catastrophic spill, such as a total loss of all fuel aboard a large cruise ship or fuel barge, there would be a major effect on water quality. Implementation of alternative 6 may result in an incremental increase over alternative 1 in occurrences of small discharges or spills due to the increase in vessel quotas. No change in resuspension of sediments is anticipated. Due to the increased traffic safety provisions, the likelihood of a catastrophic spill is anticipated to decrease. Overall, under normal operations, the implementation of this alternative would have minor direct and indirect adverse effects on water quality.

Cumulative effects on water quality — alternative 6 — The cumulative effects of alternative 6 and other past, present, and foreseeable external actions (e.g., past spills, other vessels used in the park not managed under this plan, vessels operated outside Glacier Bay and Dundas Bay, and increases in population and tourism in Southeast Alaska) would be similar, but not identical to those of alternative 1. Over time, with the cessation of commercial fishing in Glacier Bay, there would be a decrease in potential effects on water quality from releases from the vessels. The cumulative effects could be slightly greater than those of alternative 1 because of the proposed increase in vessel entries; however, the effects of the external actions, with the exception of a large-scale catastrophic spill, would not significantly change the water quality of the park, and the cumulative effect on water quality under this alternative would be minor.

Impairment analysis for water quality — alternative 6 —A catastrophic fuel spill resulting from a collision or grounding on open waters or a spill in ice-filled water would result in a long-term major water quality effect. The possibility of a catastrophic spill is low, and the effects in open water under good conditions can be minimized. Although additional cruise ships would be allowed in the park under alternative 6, the risk of a major spill is similar to, but incrementally less than that of alternative 1 because of tighter restrictions. Therefore, the potential for an effect to result in impairment of park water resources is low.

Conclusion, water quality — alternative 6 — Implementation of alternative 6 may result in incrementally greater effects on water quality compared to alternative 1 because of the increased number of cruise ships entering Glacier Bay. The overall direct and indirect effects of the implementation of this alternative would be minor because changes to water quality as a result of normal operations would be temporary and limited to the immediate area of discharge of fuel oil or contaminants or where sediments are resuspended; however, a catastrophic large-scale fuel spill could result in major effects. The contribution of cumulative effects from other activities would be negligible. Moreover, implementation of this alternative would not result in impairment of water quality resources in the park. The overall effect of the implementation of this alternative would be minor.

Summary, Water Quality. While the emissions of small amounts of fuel, oil, and wastewater would vary with the vessel quotas under each alternative, effects on water quality under any of the alternatives are expected to be minor, with the exception of fuel spills in Bartlett Cove, which could cause moderate level effects. A catastrophic oil spill in not an expected outcome of any of the alternatives. Cruise ships carry sufficient fuel into Glacier Bay to cause a major spill, however, such a spill is unlikely because cruise ships have a good worldwide safety record, are built to very high safety standards, tend to travel mostly in open waters away from navigational hazards, have highly trained and knowledgeable operators, and while in Glacier Bay carry licensed pilots on board the vessel. Tour vessels, on the other hand, have the highest potential for impacts, since they carry relatively large amounts of fuel and tend travel closer to the shoreline and more remote areas of Glacier and Dundas Bay than cruise ships. Alternative 4, 5, and 6 would prohibit cruise ships and tour vessels in Dundas Bay wilderness waters, which could reduce the potential for groundings and possible resulting spills in this area and where groundings have already occurred.

4.3.1 THREATENED AND ENDANGERED SPECIES

4.3 BIOLOGICAL ENVIRONMENT

4.3.1 Threatened and Endangered Species

The central North Pacific stock of humpback whales *(Megaptera novaeangliae)* is listed as endangered and members of this stock are seasonal residents of Glacier Bay and Dundas Bay. Members of the threatened eastern stock of Steller sea lions use a haul-out (south Marble Island) in Glacier Bay and one rookery (Graves Rocks) along the outer coast of the park. Individuals from the endangered western stock of Steller sea lions also use south Marble Island (Raum-Suryan and Pitcher 2000; Raum-Suryan 2001), but they represent only a small fraction of the total Steller sea lion population in Glacier Bay, as well as a very small portion of the western stock.

Issues of Concern Raised during Scoping. Specific concerns expressed by the public regarding threatened and endangered species in Glacier Bay include the following:

- The sight and noise of vessel traffic alter humpback whale and Steller sea lion behavior; therefore, any increase in the number of vessels could further disrupt their behavior.
- Vessels traveling at high speeds could cause whale fatalities due to collisions.
- Increases in vessel traffic could result in increased vessel collisions, and whale or sea lion mortality or injury could result from such collisions.
- Increases in vessel traffic could increase marine debris, contamination, and the risk of a large oil spill, which could harm whales and sea lions.
- Whales at Bartlett Cove may be harmed because of the high level of vessel traffic there.

Regulatory Framework.

Endangered Species Act of 1973 — The North Pacific stock of humpback whales and the eastern and western stocks of Steller sea lions are protected under the Endangered Species Act of 1973 (ESA). The Endangered Species Act prohibits the "taking" of any listed species unless NOAA Fisheries and/or the U.S. Fish and Wildlife Service issue an incidental take statement. The definition of "taking" includes harassment and harm. The Endangered Species Act also requires federal agencies to exercise their authority, through consultation with the NOAA Fisheries, not to take any action that may jeopardize the species' continued existence.

The National Park Service has completed formal consultation with the NOAA Fisheries under Section 7 of the Endangered Species Act. This consultation resulted in a NOAA Fisheries' biological opinion, which documents NPS compliance with the Endangered Species Act for actions being considered in this environmental impact statement (appendix K).

Humpback whales and Steller sea lion are also protected under the Marine Mammal Protection Act (see subsection 4.3.2, "Marine Mammals").

State of Alaska Regulations —The National Park Service and Alaska Department of Fish and Game maintain a Master Memorandum of Understanding related to fish and wildlife management in Alaska National Parks. Currently, the state of Alaska and the U.S. are litigating the title to tidal and submerged lands within the National Park and Preserve, and the case is before the U.S. Supreme Court (*Alaska v. United States*, No. 128, Original).

Glacier Bay National Park and Preserve Regulations (36 CFR 13.65) and the Park Compendium — The NPS 1996 decision to increase vessel quotas included regulations to protect humpback whales and Steller sea lions, building upon others that had been established through the 1979, 1983, and 1993 biological opinions issued by NOAA Fisheries under Endangered Species Act consultations (see appendices A and B and the biological opinion; see chapter 1 and appendix K).

NPS regulations prohibit vessels from pursuing or approaching within 0.25 mile (0.40 kilometer) of a humpback whale in all Glacier Bay National Park and Preserve waters (36 CFR 13.65[b][3][i]). The Glacier Bay regulations are stricter than the 100-yard (90-meter) minimum approach distance dictated by NOAA Fisheries (50 CFR 224.103).

NPS regulations also prohibit vessels from approaching within 100 yards (90 meters) of the Steller sea lion haul-out at South Marble Island (36 CFR 13.65[b]). NOAA Fisheries' guidelines recommend that people "remain at least 100 yards (90 meters) from whales, dolphins, porpoises, and from seals and sea lions that are on land, rock, or ice" (NOAA Fisheries 2002). While the NOAA Fisheries guidelines are only suggestions, NOAA Fisheries considers that, in most cases, following these guidelines would avoid "taking" marine mammals, including harassment (*Federal Register,* Volume 67, Number 20, 30 January 2002).

Also common to all alternatives are vessel course and speed restrictions in "designated whale waters." The boundaries of designated whale waters, established by NPS regulations, are in the same areas year after year.

The superintendent can, and regularly does, establish "temporary whale waters" course and speed restrictions anywhere in Glacier Bay where warranted by the presence of whales. Specific criteria are applied to help determine the need for vessel restrictions. Typically, mid-channel course restrictions and a speed limit are implemented when more than one humpback whale is seen consistently in an area over three or more days, or when whales begin to concentrate in mid-channel or in areas of heavy vessel traffic (e.g., Bartlett Cove or South Marble Island). The purpose of vessel speed and course restrictions is to minimize whale disturbance and lower the risk of whale/vessel collision.

Methodology and Assumptions.
Table 4-14 defines the thresholds use to describe the overall level of effects determined through the analysis.

TABLE 4-14: THRESHOLD CRITERIA FOR THE EFFECTS ANALYSIS ON THREATENED HUMPBACK WHALES AND ENDANGERED STELLER SEA LIONS IN GLACIER BAY AND DUNDAS BAY

Negligible	The behavior, hearing, abundance, or distribution of one or more Steller sea lions or humpback whales would change for less than one day because of vessel activity. These temporary changes would have little or no effect on individual survival or reproduction.
Minor	The behavior, hearing, abundance, or distribution of one or more Steller sea lions or humpback whales would change because of vessel activity for more than one day but less than the remainder of the 92-day vessel season. The changes would not reduce individual survival or reproduction.
Moderate	The behavior, hearing, abundance, or distribution of one or more Steller sea lions or humpback whales would change because of vessel activity for a period longer than the 92-day vessel season, but less than one year. Mortality or injury to a very small number of individuals could occur as a result of vessel collisions or individuals could experience sublethal effects that lead to reductions in long-term survival or reproduction. Population-level distribution, abundance, survival, or reproduction in Glacier Bay, Dundas Bay, and Southeast Alaska would remain unchanged.
Major	The behavior, hearing, abundance, distribution, or mortality of Steller sea lions or humpback whales would permanently change because of vessel activity, resulting in reduced individual survival or reproduction sufficient to change population-level distribution and abundance in Glacier Bay, Dundas Bay, and Southeast Alaska, jeopardizing the continued existence of these species in Glacier or Dundas Bays.

The assessment of the effects of noise on humpback whales is based on scientific literature (as cited), professional judgment, and published NOAA Fisheries opinions regarding marine mammal sound exposure. Detailed background information on the status of Steller sea lions and critical habitat was reviewed from a number of documents including the *Steller Sea Lion Recovery Plan* (NMFS 1992); several biological opinions on the effects of groundfish fishing on Steller sea lions (NOAA Fisheries 2000, 2001a); and the supplemental environmental impact statement for the Steller sea lions implementing measures (NOAA Fisheries 2001b). The NEPA documents and the section 7 consultations also address the status of humpback whales, as does the *Humpback Whale Recovery Plan* (NMFS 1991) and considerable literature. Evaluations of the status of both species, as well as current and potential risks, were based on marine mammal stock assessments reports (Angliss et al. 2002). The sensitivity of baleen whales to vessel noise in general were based on Richardson et al. (1995) and others, and for Glacier Bay specifically on Malme et al. (1984, 1985), Kipple (2002), and Erbe (2003).

Using these sources, levels in excess of between 125 and 130 decibels (re 1 microPascal) were estimated to be sufficient to have the potential to change the behavior of humpback whales (e.g., cause them to avoid the area, change their dive or respiration patterns, or interfere with their feeding or communication).

Two analyses were used. One was prepared, in part, by LGL, Inc. (2003) and the other by Erbe (2003). The LGL, Inc., analysis compares alternatives by estimating the amount of Glacier Bay that could be "ensonified" to 130 decibels or more, due to the vessel entries and operating requirements for each vessel class. "Ensonification," in this document, means an area that is exposed to noise above the 130 decibels.

Source levels of underwater vessel noise were calculated using the best available noise signatures of cruise ships, tour vessels, charter vessels, and private vessels (Malme et al. 1983; Kipple 2002). The noise signatures are considered as a rough estimate, since every vessel creates a different type of noise and underwater noise is subject to a wide range of factors, many of which are not known.

Six cruise ship noise signatures were recorded at a speed of 10 knots (Kipple 2002). One sound signature of a cruise ship traveling at 19 knots was used to estimate cruise ships traveling at higher speeds. As just mentioned, this measurement is probably not representative of all cruise ships traveling at this speed, because sound production varies with factors including engine type and configuration, propeller condition, and other onboard machinery. In addition, sound travel through the water is complex, especially within the complex underwater topography of Glacier Bay. Despite its limitations, analyses based on this reading are general approximations, using the best available information. Tour, charter, and private vessel noise signatures were based on those recorded in the 1980s (Malme et al. 1983). Please note that private vessels are diverse and can range from small skiffs to 100-foot (30.5-meter) yachts; therefore, it is difficult to generalize about sound signatures for private vessels.

Erbe (2003) modeled the acoustic effects of vessels on humpback whales in Glacier Bay based on measured vessel sound signatures from the acoustic monitoring program, vocalizations, ambient noise, and oceanographic parameters from Glacier Bay and estimations of whale hearing abilities (audiograms). Administrative traffic noises were evaluated using Kipple and Gabriele (2003). The study was exploratory and produced only tentative results because whale-hearing capabilities are not well understood. Note that Erbe (2003) used a 125-decibel threshold for when behavioral changes might occur in humpback whales, while the LGL, Inc. (2003) analysis, just described, used a 130-decibel threshold.

Alternative 1 (No Action) – Effects on Threatened and Endangered Species.

Direct and indirect effects — alternative 1

<u>Estimation of ensonified area.</u> Marine mammals, especially whales, dolphins, and porpoises, are sensitive to noise disturbance. Vessel noise is prevalent under water throughout much of Glacier Bay and Dundas Bay. Based on recent results from the underwater sound study being conducted at the mouth of Bartlett Cove in Glacier Bay, peak vessel noises average 94 decibels, or about 11 decibels louder than the average wind noise level (NSWC 2002). The percentage of samples (one, 30-second sample taken every hour) in which vessel noise was detected ranged from nearly 70% in August to

7% in December. The average percentage of samples per day that contained vessel noise was 32% year-round.

When traveling at speeds greater than 10 knots, cruise ships ensonify areas much greater than any other vessel type that visits Glacier and Dundas Bays. Based on calculations using vessel signatures recorded by Kipple (2002), cruise ships traveling at 10 knots projected noise at or above 130 decibels for about 0.30 mile (500 meters) (LGL 2003). The cruise ship traveling at 19 knots projected noise at or above 130 decibels for up to 3 miles (5,000 meters). While this zone is only a rough estimation, it does show that cruise ships can be considerably louder when traveling near 20 knots, a prevalent speed at which cruise ship travel in Glacier Bay outside of whale waters (although peak speeds are in the 25-knot range). This 130-decibel ensonified area is where humpback whales and Steller sea lions could alter their behavior in response to the sound.

Because of the relatively great distance at which cruise ships generate noise above 130 decibels, and because cruise ships travel up the entire length of Glacier Bay to Tarr Inlet, it is assumed that currently much of Glacier Bay's waters are exposed temporarily to sound levels greater than 130 decibels every time a cruise ship visits the Bay. The six-mile diameter ensonification zone developed by LGL, Inc. (2003) represents about 6% of the total area of Glacier Bay for each cruise ship, at any single moment on the ships path through the Bay. The zone is based on the single sound reading of a cruise ship traveling at 19 knots. Two cruise ships in the Bay would ensonify about 12% of the Bay's total area. This hydrophone is within the lower Bay whale waters. The study found that noise levels dropped considerably when vessel speed limits in whale waters were set at 10 knots, rather than at 20.

In any area where lower speed limits are set (13 knots for 2003), cruise ship noise is lower than when speed limits are not in effect. Based on the *Glacier Bay Underwater Noise Interim Report* (NSWC 2002), a hydrophone just southwest of Bartlett Cove and approximately 1 mile (1.5 kilometers) off shore, received peak vessel noise levels that exceeded 120 decibels only about 1% of the time.

Other vessel types produce less noise and, each vessel ensonifies less than one-tenth of one-percent of the total area of Glacier Bay at any one moment. Table 4-15 shows the estimated area ensonified by a single vessel each vessel category (with two speeds presented for cruise ships).

TABLE 4-15: ESTIMATES OF ENSONIFIED AREA EMITTED BY EACH VESSEL CLASS

Vessel Class	130 decibel zone radius (ft)	130 decibel (mile^2)	Glacier Bay area
Cruise ship (10 knots)	1804 (0.34 mi)	0.36	.0719%
Cruise ship (19 knots)	16404 (3.1 mi)	30	5.9432%
Tour (10 knots)	459	0.02	0.0047%
Charter (10 knots)	459	0.02	0.0047%
Private (10 knots)	75	0.0007	0.0001%

Source: LGL 2003.

Erbe (2003) found that small craft and the cruise ship traveling 19 to 20 knots would be detectable by diving humpback whales within about 25 miles (40 kilometers) of the moving vessel. The small craft and cruise ship create the potential for behavioral response (received sound levels greater than 125 decibels re 1 micro Pascal, established in other studies as a behavioral response threshold) within about 1.2 miles (2,000 meters) and 6.2 miles (10,000 meters), respectively.

In summary, cruise ships generate the loudest underwater noise among vessels that travel within Glacier Bay. When traveling, they can cause some level of disturbance to humpback whales estimated to be in the range of 3 to 6 miles (5,000 to 10,000 meters).

In Dundas Bay, which is used by humpback whales, vessel noise could increase over time, as the area is becoming popular with charter vessels and no daily limits are in place.

<u>Potential for temporary or permanent reduced hearing sensitivity in humpback whales or Steller sea lions</u>. Based on the analysis conducted for this environmental impact statement, vessel noise is

expected to be sufficiently loud to potentially cause temporary reduced hearing sensitivity in both humpback whales and Steller sea lions in Glacier and Dundas Bays, but such noise would not cause permanent reduced hearing sensitivity.

Based on Erbe 2003 no studies of permanent reduced hearing sensitivity in marine mammals are available, so estimations of risk must be derived from studies of terrestrial mammals. Kryter (1985) estimated that for terrestrial mammals, a sound would have to be 155 dB above the hearing threshold in order to induce permanent reduced hearing sensitivity after a single exposure. Based on estimations of whale hearing ability, no vessel class is loud enough to induce permanent reduced hearing sensitivity after a single exposure. Prolonged and repeated exposures to sounds at 60 dB above threshold were judged to put whales at risk of permanent reduced hearing sensitivity after daily exposure for many decades. A recent acoustic modeling study examined killer whale exposure to noise generated by whale-watching activities in the Strait of Juan de Fuca (Erbe 2002). Erbe (2002) estimated the various zones of noise exposure and speculated that killer whales could experience permanent reductions in hearing ability as a result of prolonged noise exposure (8 hours per day, 5 days per week, for 50 years) from whale-watching vessel traffic at source levels of 145 to 169 decibels.

For a ship traveling 19 knots, the estimated maximum time a stationary object would be exposed to 130 decibels or more is approximately 17 minutes. These time periods are shorter than the 20- to 22-minute exposures that caused temporary reduced hearing sensitivity (temporary threshold shift) in a harbor seal, elephant seal, and California sea lion (Kastak et al. 1999). However, humpback whale hearing may be more sensitive than these species, and with multiple vessels in the same area, individuals could be exposed to levels in excess of 130 dB for longer time periods for sufficient time to temporarily lose some hearing ability.

<u>Changes in behavior of threatened and endangered species due to the sight and noise of motorized vessel traffic</u>. The sight and sounds of motorized vessels are known to disturb both humpback whales and Steller sea lions (Bauer 1995; Mathews 2000). Under alternative 1, both species would be regularly exposed to vessel traffic. The specific reaction of an individual on any particular encounter cannot be predicted, since the reaction depends on many factors, including the prior activity and previous experience of the individual animal, the speed and course of the vessel, the vessel type, and an unknown number of other factors.

Still, it can be assumed that the presence of vessels in Glacier and Dundas Bays startles, frightens, and/or annoys individual animals and, in some cases, causes them to increase activity, flee, change activities, dive, make sounds (or stop making sounds), or, for Steller sea lions, occasionally causes them to reenter the water from a haul-out. Such reactions have been regularly observed in Glacier Bay and elsewhere. Animals may also react in less detectable ways, such as changing breathing or heart rates or changing swimming patterns. Behavioral changes may be due to fear, annoyance, or interference in feeding or resting.

The effect of such changes in behavior is a reduced benefit from whatever activity the animal was undertaking at the time of the encounter, as well as the energy expended due to the reaction. If an animal is feeding, then the effect is a loss of energy acquired. If the animal is resting, then the effect is a loss of rest and, potentially, the need to rest later rather than feeding. The effect can include exposure to hazards such as another vessel, predators, or other animals that might be territorial or otherwise antagonistic. Long-term exposure can potentially increase stress, which, as has been shown in humans, can contribute to health problems. Long-term exposure may also cause individuals to become accustomed to the sight and sounds of vessels (habituate) and consider them as just another element of their environment. Habituation has the potential to be detrimental if it increases the animal's risk of vessel collision (Laist et al. 2001; Terhune and Verboom 1999).

The ultimate effect of repeated behavioral disturbance is reduced energy intake and increased energy expenditure, and increased risks of harm. Such loss of energy and increased risks can affect the health of the individual and, when considered with many other factors, might contribute to reduced reproduction and survival.

STELLER SEA LION. Under alternative 1, individual Steller sea lions would be regularly disturbed by vessel traffic. Sea lions using haul-outs would be disturbed by closely approaching cruise ships, tour boats, and charter/private vessels. Steller sea lion use of haul-outs in Glacier Bay is highest during the months of October through May, although numbers during the summer months are usually well over 100. Vessel use in Glacier Bay occurs primarily in June, July, and August when the number of sea lions hauled out in Glacier Bay is lower. However, under alternative 1, seasonal restrictions for charter and private vessels are not in effect during May (daily limits for cruise ships and tour vessels apply year-round). With the expected trend of increased visitation during May and September to continue, disturbance of Steller sea lions at Marble Island could increase over time.

Vessel disturbance of sea lions would result in energy expenditures. Disturbance would be expected to occur multiple times per day at the haul-out located at South Marble Island. No studies of the behavioral responses of Steller sea lions in water to motorized vessel traffic are available. In studies of Steller sea lions at South Marble Island, it was observed that the activity rate of sea lions at the haul-out increased as vessels approached within 200 yards (180 meters) (Mathews 1997 and 2000). The study also found that 21% of the vessels (both motorized and non-motorized) that visited South Marble Island did not comply with the NPS 100-yard (90-meter) distance limit. Private motorized and non-motorized vessel users were found to approach closer than allowed more than commercial vessels. Vessels that maintained a slow, steady course and kept the engines on seemed to disturb sea lions less than vessels with erratic course or speed. This supports the intuitive conclusion that private vessels, whose operators may have less local knowledge and be less aware of protection rules, may disturb Steller sea lions more than commercial vessels.

HUMPBACK WHALES. Humpback whales that use Glacier and Dundas Bays would also be regularly disturbed by vessel traffic. Several humpback whale concentration areas overlap with vessel use concentration areas, including Sitakaday Narrows and Bartlett Cove. Therefore, it is expected that many individual whales would be exposed to the sights and sounds of vessels multiple times during a day and would also be exposed to the sight and sounds of multiple vessels simultaneously.

The scientific literature related to behavioral reaction of humpback whales to noise reports a wide range of responses. Studies typically report a few case studies observed during the course of a larger study and represent extreme behavioral responses for a few individuals with a limited statistical link directly to a given factor such as noise or vessel proximity (Baker and Herman 1989; Bauer 1995). Moreover, some of the conclusions reached by different researchers are contradictory, indicating that the responses of humpback whales to vessels are variable and not completely understood (Frankel and Clark 1998).

In their feeding areas, humpback whale distribution is closely correlated with forage fish and euphausiid density and distribution (Krieger and Wing 1986; Krieger 1988). Humpback whales persistence in areas of high prey density, despite vessel traffic or industrial noise (e.g., Todd et al. 1996), illustrates that whales will tolerate disturbance if a nearby prey resource is sufficiently attractive. Building on the work of Todd et al. (1996), Borggaard et al. (1999) found that humpback whales remained in an area of high prey availability despite exposure to loud construction activity, including underwater explosions, dredging, and vessel traffic during a four-year period of offshore construction.

Factors such as habituation, sensitization, individual variability, and a whale’s initial activity likely explain some of the observed variability in response to vessel traffic. The complicated acoustic pathways associated with vessel noise may also mislead whales as to locations of ships or the rate at which they are approaching (Terhune and Verboom 1999). Whale responsiveness to vessels can play an important role in their ability to avoid vessel collisions (Laist et al. 2001; Terhune and Verboom 1999).

Given the close relationship between prey density and distribution of marine mammals, some individuals may not leave an area — ensonified or not — when prey are present. Shifts in distribution may range from hours to days, but seem unlikely to exceed a day. Annual humpback whale population counts have increased and remained high since 1996 under the level of vessel traffic proposed in alternative 1 (see figure 4-2).

However, it is important to note that the increase in populations actually increases the potential for individuals to be adversely affected, since more whales are present. Based on simple probability, more whales and more vessels together increase the likelihood of whale/vessel interactions. In addition, it is possible that the increase could have been greater in the absence of vessel traffic.

For humpback whales, feeding in Southeast Alaska is a critical component of their annual energy cycle, since individuals are believed to stop feeding entirely on the wintering and mating grounds (Hawaii and Mexico). Therefore, interference in feeding or otherwise reducing energy intake or increasing energy expenditure pose a greater biological significance for humpback whales in Southeast Alaska.

Because humpback whales are assumed to be regularly disturbed by vessel traffic and noise, the repeated nature of this disturbance makes it a long-term impact rather than a short-term impact, and likely changes behavior to some (or perhaps most) individual humpback whales over the entire 92-day peak season. In addition, individual humpback whales could experience temporary reduced hearing sensitivity when feeding in areas of high vessel traffic, such as within the mid-channel portions of Sitakaday Narrows. Therefore, this impact is expected to be at the moderate level.

<u>Effects of vessel noise on communication and hearing</u>. Under alternative 1, vessel noise is expected to interfere with humpback whale and Steller sea lion hearing and communication. Individuals of both species would be occasionally exposed to noise levels sufficient to temporarily reduce their ability to feed, breed, seek shelter, or communicate. It is expected that cruise ship sound would persist for approximately one to two hours (Malme et al. 1983), and the peak level when communication could be masked could last for a matter of minutes. The analysis behind both of these conclusions is presented in the following paragraphs.

During scoping, the issue was raised that sound might mask hearing of humpback whales or Steller sea lions. Sound is very important to marine mammals, thus, a reduction in hearing sensitivity would reduce the ability of humpback whales or Steller sea lions to communicate or hear important sounds of predators or prey.

However, based on known characteristics of marine mammal hearing, and on the expected frequency and duration of noise encounters, vessel noise is expected to interrupt humpback whale feeding at times, but not to the point where survival and/or reproduction would be reduced. As described in chapter 3 and appendix C, marine mammals have highly evolved hearing capabilities (for review, see Richardson et al. 1995); however, such highly evolved hearing also includes the ability to hear important sounds, even within a noisy environment. Marine mammals have been found to discriminate important sounds at levels equal to background noise (e.g., Malme et al. 1983). To reduce masking of sounds, marine mammals can shift the frequency band of their communications to use a less "noisy" spectrum, alter the number or rate of calls, or increase the source levels of calls.

In many cases, vessel noise is broadband in nature, and "less noisy" bands may not be available. Additionally, some communications may be frequency-dependent and shifting the dominant bands of such vocalizations may not be possible (Baker 1985). Such situations are assumed to occasionally occur in Glacier Bay and Dundas Bay and communications would be masked at times. Because the duration of noise exposure to vessels is typically short term, interruptions in communication are expected to occur during brief, isolated events.

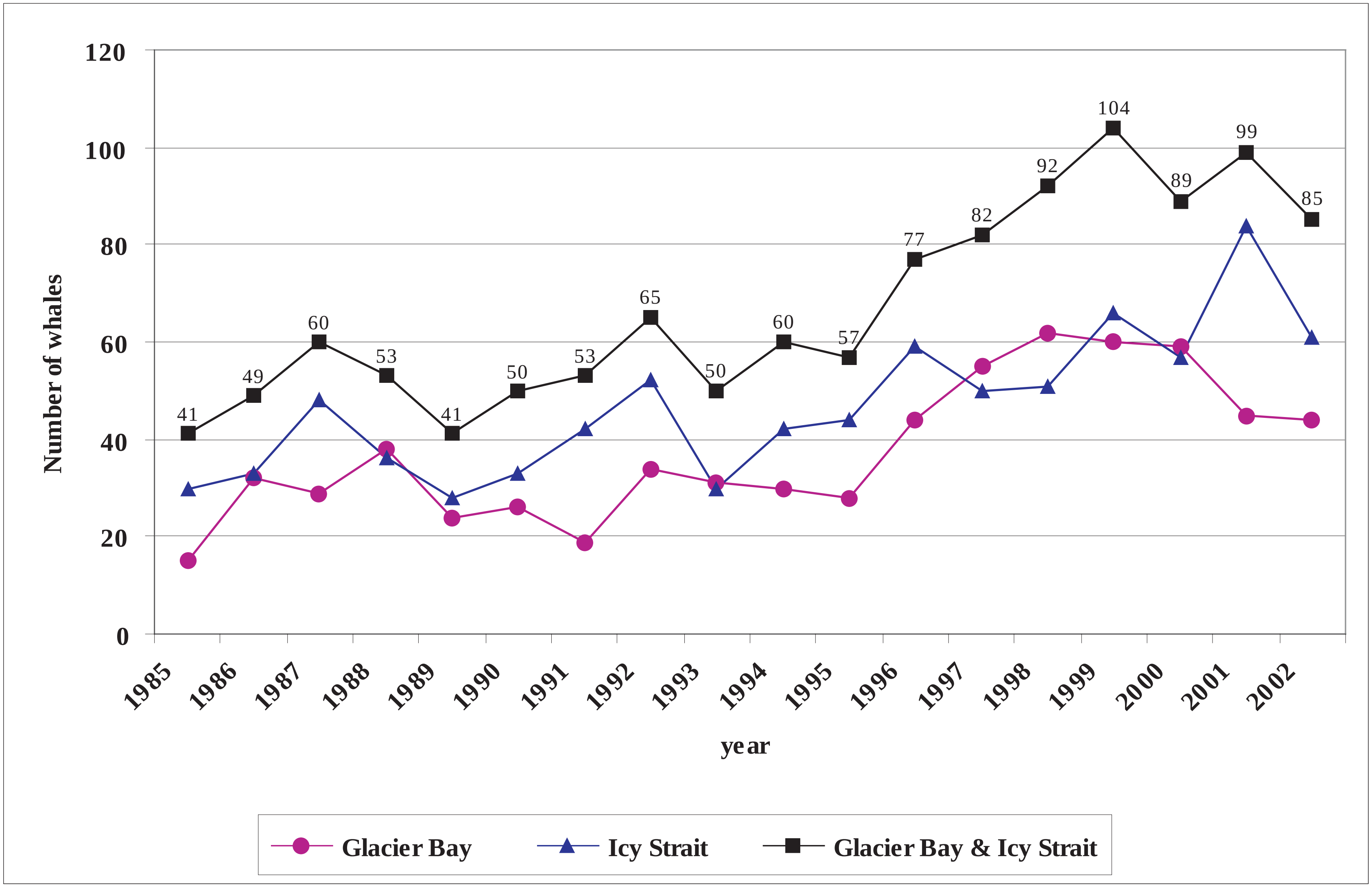


FIGURE 4-2: ANNUAL HUMPBACK WHALE POPULATION COUNTS

Effects of vessel collisions. Between 1996 and 2003, five whales (humpbacks, gray whales, and unidentified whales) have been reported killed by vessel collisions in Southeast Alaska, while more have been struck, but have not been confirmed as killed (NOAA Fisheries Stranding Network database query June 2003). In July 2001, an adult female humpback whale was found floating dead in Glacier Bay National Park and Preserve waters at the mouth of Glacier Bay. The whale was identified as whale #68, an individual first photographed in Glacier Bay in 1975. A detailed necropsy revealed that the whale had sustained “multiple compound fractures of the skull” that would have been immediately fatal to the animal (Gulland 2001). The nature of the injuries was consistent with a strike by a large ship. Although this was the first documented mortality of a ship-struck whale in Glacier Bay National Park, NPS records document two other non-fatal whale-vessel collisions since 1985.

In addition, several humpback whales in the Southeast Alaska photographic catalog have propeller scars or other injuries that clearly indicate collisions with vessels (C. Gabriele, pers. com.; J. Straley, pers. com.), although there is usually no way to determine if the collisions occurred in Glacier Bay, Icy Strait, Hawaii, or anywhere else within their range. Two male humpbacks in the Glacier Bay area sustained wounds on their dorsal fins in 2001 and 2002. These wounds are believed to originate from collisions with small vessels (see photographs in Doherty and Gabriele 2002). Two more humpback whales returned to Glacier Bay with propeller scars in 2003 (NPS, C. Gabriele, pers. comm.).

Vessel size and speed are important variables in whale/vessel collisions. Russell and Knowlton (2001) suggested that when vessel speeds exceed about 13 knots, the ability of right whales to avoid collisions is reduced. Collisions between a whale and a ship greater than 262 feet (80 meters) in length (in Glacier Bay only cruise ships would be this large) are likely to result in the death of the whale (Laist et al. 2001). Under alternative 1, cruise ships travel at speeds (based on through the water) up to 26 knots outside of whale waters. In general, cruise ships travel above 20 knots all the way up and down the Bay, except when near the tidewater glaciers. At these speeds, the risks of humpback whales being killed by a collision with a vessel are greatly increased over those that would occur should vessels be traveling below 14 knots (based on through the water).

Based on that study, a cruise ship collision with a whale is more likely to result in the death of the whale than if a whale is hit by a tour, charter, or private vessel, due to differences in vessel size. In the lower Bay whale waters, all vessels must remain at least 1 mile (1.6 kilometers) from shore, away from where whales generally occur, so the risk of collision is reduced. Even more than other vessel types, cruise ships spend the majority of their time in offshore areas, while approximately 90% of humpback whale sightings occur within 1 mile (1.6 kilometers) of shore (figure 3-4; Gabriele et al. 1999). However, humpback use is unpredictable and has been known to shift to mid-channel in some occasions. For example, during the summer of 2003, a year of exceptionally high humpback whale use in Glacier Bay, many whales were found to feed regularly in mid-channel. Therefore, the mid-channel course of cruise ships does not eliminate risks of vessel collisions with humpback whales.

Although collisions with smaller vessels are less likely to kill a whale, the effects cannot be discounted. Under the current regulations and operating requirements, smaller vessels are many times more numerous and travel closer to shore, which is where humpback whales tend to be. Also, operators of private vessels are more likely to operate their vessels in ways that pose a greater risk of collision, due to being less familiar with regulations and local conditions. While alternative 1 includes many measures to reduce the risk of collisions, such collisions cannot be completely prevented.

Many protective operating requirements are in place in the current regulations, including speed restrictions in designated whale waters, mid-channel course requirements for all vessel classes while in designated whale waters, and approach and avoidance protocols. Collisions between vessels and humpback whales are expected to be rare yet inevitable. All motorized vessels would be restricted to a 20-knot speed (measured through the water) for transits through lower Bay whale waters in Glacier Bay in June through August under alternative 1. When whales aggregate in whale waters, the vessel speed limit would decrease to 10 knots, reducing both the risk of collision and the risk of mortality if a collision occurred. Outside of the lower Bay, vessels may operate at any speed; therefore, the potential for fatal collisions between ships and whales remains. The collision risk for whales in low density areas may actually be higher than within whale waters, both because the vessels are traveling faster and pilots may not be as alert for whales. However, NPS regulations authorize the superintendent to implement whale waters vessel course and speed restrictions to protect whale aggregations anywhere in Glacier Bay, so much of the risk is for solo whales in transit between feeding areas whales, rather than those known to be using areas for several days (as determined through regular NPS monitoring).

Overall, the probability of humpback whale/vessel collision in Glacier Bay is assumed to be much less than the annual rate of ship strikes (0.8 strike per year) for the central North Pacific stock for the period 1995 to 1999 (Angliss et al. 2001). This is because the estimate above represents the entire North Pacific stock, and Glacier Bay represents only a small portion of this stock. Vessel collision is possible with any level of vessel traffic but increases with increased traffic and increased numbers of whales.

Steller sea lions are found at most water depths, but tend to be sighted farther offshore than other marine mammals (Gabriele and Lewis 2000), and therefore, are more likely to encounter larger vessels. Vessels of all sizes could seriously injure or kill a sea lion. Given their swim speeds and ability to maneuver, however, collisions between vessels and Steller sea lions are expected to be rare. The lack of published evidence or stranding records of Steller sea lions being struck by vessels suggests that vessel collision is not a large source of mortality or injury but, again, the possibility cannot be ruled out.

<u>Other effects from motorized vessel movement</u>. As described in subsection 4.4.3, “Vessel Traffic and Safety,” a major fuel spill is unlikely under any of the alternatives. Small fuel spills could cause some toxic reactions to humpback whales or Steller sea lions through contact with skin or through ingestion of contaminated water and/or prey. Overall, toxic effects are not expected due to the long-term records of relatively few spills in and near the park and preserve and the anticipated low level of spills that would occur.

Vessel wake effects on Steller sea lions and humpback whales would be negligible. Steller sea lions often use areas around rookeries and haul-outs within heavy surf action, waves, and wakes while moving to and from shore. At most rookeries and haul-outs within their range, they regularly encounter wave action in excess of that resulting from vessel wakes. Humpback whales have been observed being startled by vessel wakes striking steep-walled fjords in calm waters, but these occurrences are infrequent.

The type of marine debris found in Glacier and Dundas Bays is generally not the type in which marine mammals become entangled. Most entanglement comes from fishing gear (especially pot gear), while recreational vessel debris contains small waste items such as food wrappers, cups, containers, bottles, and cans (see biological opinion). Therefore, marine debris would not likely be generated at a level that would harm humpback whales or Steller sea lions.

Cumulative effects on threatened and endangered species — alternative 1 — The humpback whales that visit Southeast Alaska are exposed to many effects other than those being considered in this final environmental impact statement (cruise ship and tour, charter, and private vessels). For humpback whales, these effects occur over a much greater geographic area, including the waters of Hawaii and Mexico, and the migratory waters in-between these wintering areas.

Considered collectively, these multiple factors (or “actions,” under NEPA) are additive to both humpback whales and Steller sea lions, and act at the individual level and at the population level. While collectively, these actions are likely to slow the recovery of both species (reducing survival and/or reproduction), the incremental contribution that vessel management and operating requirements in Glacier and Dundas Bays make to these effects is relatively minor. This is because NPS vessel quotas and operating requirements at Glacier and Dundas Bays affect only a small portion of stocks involved and are not causing any apparent population declines in either species.

The following summarizes the other actions that were considered to evaluate potential cumulative effects on threatened and endangered species, as well as the incremental effect that alternative 1 would have on cumulative effects.

Several types of vessels travel in Glacier Bay in addition to cruise ships and tour, charter, and private vessels. Administrative vessels include vessels on official government business and do not require individual permits. However, with the exception of emergency situations, all administrative vessel use would be subject to review using the decision matrix in appendix E. Because the Park Service is based in Bartlett Cove, much of the administrative traffic passes through that area, an area of known whale concentrations.

Some administrative traffic benefits humpback whales and Steller sea lions. Law enforcement patrols, educate the public and monitor compliance with the many regulations in place to protect humpback whales and Steller sea lions. Likewise, whale research vessels, which may disturb humpback whales, also provide the critical population and life history information needed to protect whales, including identifying locations where temporary whale waters are needed.

Aircraft may cause some disturbance to whales. In 2001, NPS whale monitoring biologists witnessed two floatplanes that circled low over three humpback whales, although these incidents occurred outside of park waters and did not appear to affect the whales' behavior (Doherty and Gabriele 2002).

Humpback whales also experience vessel noise and disturbance outside of park waters, and, since regulations are less stringent and enforcement is less rigorous, the level of disturbance may be greater in the outside waters (especially Icy Strait) than within Glacier Bay National Park and Preserve. Because whales that use Glacier Bay also use Icy Strait, effects of vessel traffic there are additive to any incurred at Glacier Bay. Point Adolphus is a known whale concentration area, as well as a concentration area for whale watching. It is expected that whales at Point Adolphus are subjected to many of the same types of disturbances they are while within Glacier Bay. Restrictions, such as approach distances, are less at this area than within the waters at Glacier Bay National Park and Preserve.

Development of the cruise ship dock and facility at Point Sophia is expected to increase whale watching in Icy Strait, including Point Adolphus. Two 100-foot (30.5 meters) whale-watching vessels are planned at Point Sofia beginning in 2004. Charter fishing and other tour vessels would increase vessel traffic in the Icy Strait. This would increase the potential incidents of disturbance.

Because humpback whales are migratory, they encounter many other obstacles outside of Glacier and Dundas Bays, which are primarily summer feeding areas. Most of the whales travel to Hawaii to breed, while a few may travel to Mexico. Along the way they encounter a wide range of vessel traffic, including oil tankers, cargo ships, and large fleets of commercial fishing vessels. Once on their breeding grounds, they are again met with whale watching and other vessels (Green 1990).

Pollution, over fishing, and other factors have reduced some prey species, and persistent organic pollutants (POPs), such as the pesticide DDT, and polychlorinated biphenyls (PCBs) can contaminate prey and, in turn, accumulate in humpback whales.

Entanglement, particularly in pot gear, has become a growing problem throughout the humpback whale range, including Southeast Alaska.

Finally, scientists and environmental groups have long raised concerns about the amount of noise created by shipping, military activities (including sonar), oil and gas exploration, and other sources.

While all of these activities could directly or indirectly affect the central North Pacific stock of humpback whales, this population has been growing since commercial whaling ended. Angliss et al. (2001) reports the annual human-caused mortality rate would have to exceed 7.4 humpback whales per year for the central North Pacific stock to experience a population decline. The current, minimum estimate for human-caused mortality from direct fishery interactions, vessel collisions, and entanglement in marine debris is 4.3 whales per year.

The combination of these factors could reduce population size in the humpback whale stock that frequents Southeast Alaska, including Glacier and Dundas Bays and Icy Strait. Even with these impacts, population is increasing, but probably at a lower rate and with a lower potential peak than if these effects were not occurring.

The eastern stock of Steller sea lions has increased in recent years, and may be at the highest levels in recent history, warranting reevaluation of the species threatened status (Kruse et al. 2001); therefore, cumulative effects of human-caused activities are considered negligible.

Impairment analysis for threatened and endangered species — alternative 1 — Two purposes of implementing legislation for Glacier Bay National Park and Preserve pertain to the continued presence of marine mammals within the park and preserve:

- Maintain sound populations of, and habitat for, wildlife species of inestimable value to citizens.
- The park and preserve "in large part … [is] intended to be [a] large sanctuary where fish and wildlife may roam free, developing their social structure and evolving over long periods of time as nearly as possible without the changes that extensive human activities would cause."

Any effects on threatened or endangered marine mammals that could be interpreted as resulting in overall population declines for either local populations or regional populations would impair park and preserve resources and values, as would profound changes in their social structure that could result from chronic displacement from preferred areas due to vessel disturbance. Alternative 1 would not result in population declines or prolonged displacement for either humpback whales or Steller sea lions; therefore, neither of these park and preserve resources would be impaired.

Potential mitigation measures for threatened and endangered species — alternative 1 —

<u>Increase buffers at South Marble Island.</u> Based on studies conducted by Mathews (2000), increasing the 100-yard (90-meter) approach distance would reduce disturbance to Steller sea lions. The studies showed that the activity rate of sea lions at the haul-out increased as vessels approached within 200 yards (180 meters) (Mathews 1997 and 2000).

<u>NOAA Fisheries recommendations.</u> NOAA Fisheries made four conservation recommendations in the 2003 biological opinion:

1. NPS should continue to monitor the levels of disturbance from vessels and vessel noise in Glacier Bay National Park Waters to determine the extent of take of Steller sea lions and humpback whales that would occur under the decision. Upon determination of appropriate take levels, and issuance of regulations or authorizations under Section 101(a)(5) of the Marine Mammal Protection Act and/or its 1994 Amendments, NOAA Fisheries would amend the opinion to include an ESA incidental take statement for listed species in the action area. No increases in cruise ship entries into Glacier Bay from the 2003 levels should occur until these determinations have been made.

2. NOAA Fisheries expressed concern about the potential for collisions to occur that result in serious injury or mortality to the whale, especially because as numbers of whales and vessels increase the probability of collision would likely increase. The Park Service continues to monitor the occurrence of whales in nearshore waters to determine if maximizing private vessel use in Glacier Bay by increasing the number of seasonal-use days for private vessels

results in increased disturbances to marine mammals including sea lions on rocks, or foraging whales.

3. Given that vessel length and speed are an important factor in the severity of whale vessel collisions, and that NOAA Fisheries included waters immediately adjacent to the park entrance in Icy Strait and at Point Adolphus as part of the action area, and that the large whale concentration at Point Adolphus, a popular whale watching location for vessels entering and exiting NPS waters, is not protected by vessel speed limits NOAA Fisheries made the following recommendation. The NPS should work with NOAA Fisheries, the U.S. Coast Guard and the State of Alaska to implement vessel speed limits, or exclusion zones in nearshore waters of Icy Strait (i.e, within 1 mile [1.6 kilometers] of Point Adolphus) adjacent to park waters that contain known concentrations of whales, or establish agreements with cruise ship and tour vessel concessionaires whereby vessel speed and course restrictions are adopted beyond the NPS boundaries in these areas where whales are known to forage and occur in large numbers.

4. And finally NOAA Fisheries concluded that the proposed increases in vessel traffic are occurring in an area where disturbance and collision risk are already a concern, and in absence of a quantitative determination of ESA and MMPA take levels. It is NOAA Fisheries recommendation, therefore, that the Park Service should monitor and evaluate its vessel operating requirements to determine if they are effective at protecting whales in these nearshore waters. Two essential elements of this recommendation are measurements of compliance and effectiveness of regulations.

Conclusion, threatened and endangered species — alternative 1 — Existing levels of vessel traffic cause regular disturbance to both humpback whales and Steller sea lions due to the sight and sound of motorized vessels. Because disturbance occurs regularly, it is considered a long-term effect. Therefore, disturbance to humpback whales and Steller sea lions from alternative 1 would be at the moderate level, as defined in table 4-14. Collisions with vessels are expected to be rare due to whale and sea lion distribution, vessel traffic patterns, and effectiveness of NPS regulations, yet over the long-term collisions are assumed to be inevitable. Steller sea lions are not particularly vulnerable to collisions with vessels, but collisions can occur and cannot be ruled out. However, some disturbance is expected to occur for some individuals on a daily basis, and some individuals may be disturbed repeatedly on a single day. The actual level of disturbance may not be such that is significantly reduces the ability of individuals to feed, breed, or seek shelter, but this is not fully known.

As determined in the NOAA Fisheries' biological opinion, none of the alternatives would jeopardize the continued existence of the North Pacific stock of humpback whales or the eastern or western stocks of Steller sea lions. Populations of both species in Glacier Bay National Park have been exposed to the level of vessel traffic proposed in alternative 1 since 1996 with no evidence of population decline. The central North Pacific stock of humpback whales and the eastern stock of Steller sea lions have increased in recent years despite increasing human activities throughout the North Pacific Ocean, including within humpback whale wintering areas surrounding the Hawaiian Islands. It is possible that populations would have increased at a faster rate without the effects of vessel traffic.

Alternative 2– Effects on Threatened and Endangered Species.

Direct and indirect effects on threatened and endangered species – alternative 2 — Under alternative 2, vessel numbers would be reduced to those in place prior to the 1996 increases. The difference of alternative 2 from the existing management situation is reduced cruise ship and charter and private vessel quotas (tour vessel quotas would not change). In general, the level of effects would be reduced in proportion to the number of vessels reduced. While the effects would be less under alternative 2, the overall level of effect is still considered moderate because of continued long-term disturbance or adverse effects to of both humpback whales and Steller sea lions from the sight and sound of vessel traffic, and because of the potential for harm for both species from collisions with vessels and potentially from temporary reduced hearing sensitivity.

Estimation of ensonified area. The maximum ensonified areas of alternative 2 at any given time would be the roughly the same as outlined for alternative 1, with area of about 12% of Glacier Bay being ensonified at any one time due to cruise ships. However, under alternative 2, fewer cruise ships would enter Glacier Bay than is currently allowed. A total of 107 cruise ship visits would be allowed, creating the possibility of 214 17-minute passings (two per cruise ship visit) where sound would be greater than 130 decibels at any given point. This represents a maximum duration of approximately 2.7% of the time any one point would be disturbed by cruise ship noise from June through September.

Potential for temporary or permanent reduced hearing sensitivity in humpback whales or Steller sea lions. As explained under the analysis of alternative 1, vessel traffic may be sufficient to cause temporary reduced hearing sensitivity in humpback whales or Steller sea lions, but noise exposure would not be sufficient to cause permanent reduced hearing sensitivity. The reduction of vessels under alternative 2 reduces the likelihood of temporary reduced hearing sensitivity, with a 23 % reduction in cruise ship traffic causing a corresponding reduction in the incidence of exposures to loud noises.

Changes in behavior of threatened and endangered species due to the sight and noise of motorized vessel traffic. Cruise ship encounters with humpback whales and Steller sea lions would be reduced by roughly 23%. The overall effect of cruise ships on the behavior of both species is related to noise, and the exposure to noise is relatively short term, since cruise ships do not actively whale watch in Glacier Bay but rather focus on traveling to the tidewater glaciers. Therefore, the 23% reduction would not cause as significant change in the anticipated impacts on humpback whale and/or Steller sea lion behavior from cruise ships.

The 13% reduction in both charter and private vessels would create a more notable reduction in disturbance, since these vessel types are the most likely to engage in whale watching and in visiting the sea lion haul-out at South Marble Island.

Effects of vessel noise on communication and hearing. The reduced cruise ship numbers would reduce the frequency of whale encounters with loud noise. Potentially more notably, reduced charter and private vessels would reduce noise intrusions from whale watching activities.

Effects of vessel collisions. Reducing cruise ships and charter and private vessels would also reduce the potential for collisions. The reduction in charter and private vessels would reduce the likelihood of non-fatal injuries, such as propeller scaring. Reducing cruise ship numbers would reduce the likelihood of fatal collisions.

Other effects from motorized vessel movement. Other effects would be relatively minor, as described under alternative 1.

Cumulative effects on threatened and endangered species — alternative 2 — Alternative 2 would have slightly lower effects and, therefore, provide a lower incremental contribution to cumulative effects on humpback whales and Steller sea lion. As described under alternative 1, NPS vessel management and operating requirements in Glacier and Dundas Bays are expected to make only a minor contribution to the overall cumulative effect on humpback whales and/or Steller sea lions because of the small portion of each stock that is effected and the overall level of expected effects.

*Impairment analysis for threatened and endangered species — alternative 2 —*Alternative 2 would not reduce populations or cause displacement for either humpback whales or Steller sea lions; therefore, neither of these resources would be impaired.

Potential mitigation measures for threatened and endangered species — alternative 2 — Reasonable and prudent measures outlined in the biological opinion, and described under alternative 1, provide

NOAA Fisheries' required and recommended measures to reduce disturbance to humpback whales and/or Steller sea lions.

Conclusion, threatened and endangered species — alternative 2 — The overall effect would remain in the moderate level, but effects would be reduced in roughly the proportion of vessel reductions. Reducing cruise ships would reduce loud noise exposure events and the frequency of humpback whale mortalities due to vessel strikes. Reducing charter and private vessels would reduce disturbance to humpback whales and Steller sea lions.

Alternative 3– Effects on Threatened and Endangered Species

Direct and indirect effects on threatened and endangered species – alternative 3 — The primary difference between alternative 3 and the no-action alternative is the potential to increase cruise ship numbers to 184 from June through August. The effects of tour, charter, and private vessels would be similar to those described under alternative 1, with potential harm and regular disturbance from vessel traffic. If the Park Service were to increase cruise ships, then the effects of noise and the risk of vessel strikes would also increase. While the effects could be greater under alternative 3, the overall level of effect is still considered moderate, because of continued long-term disturbance of both humpback whales and Steller sea lions from the sight and sound of vessel traffic, and because of the potential for harm for both species from collisions with vessels.

Estimation of ensonified area. The maximum ensonified areas of alternative 3 at any given time would be the roughly the same as outlined for alternative 1, with area of about 12% of Glacier Bay being ensonified at any one time due to cruise ships. However, under alternative 3, potentially two cruise ships could enter per day, every day, throughout the summer season and potentially in May and September as well. A total of 184 cruise ship visits would be allowed in June through August under alternative 3, creating the possibility of 36 , 17-minute passings (two per cruise ship visit) where sound would be greater than 130 decibels at any given point. If two ships entered the Bay each day, any one point would be ensonified to 130 decibels or more approximately 4.7% of the time from June through August. This figure does not account for ensonification due to other vessel classes.

Potential for temporary or permanent reduced hearing sensitivity in humpback whales or Steller sea lions. As explained under the analysis of alternative 1, vessel traffic may be sufficient to temporarily reduce hearing sensitivity in humpback whales or Steller sea lions, but noise exposure would not be sufficient to cause permanent reduced hearing sensitivity. The potential increase of cruise ships under alternative 3 increases the likelihood of temporary reduced hearing sensitivity, with a 32% increase in cruise ship traffic causing a corresponding increase in the number of exposures to loud noises.

Changes in behavior of threatened and endangered species due to the sight and noise of motorized vessel traffic. Cruise ship encounters with humpback whales and Steller sea lions could increase by roughly 32% (the same percentage that cruise ship numbers could be increased).

Effects of vessel noise on communication and hearing. Increased cruise ship numbers would increase the frequency of whale encounters with loud noise, with interference in feeding or communication occurring up to 4.6% of the time.

Effects of vessel collisions. Increasing cruise ships would also increase the potential for collisions and associated mortality. Based on probability, vessel collisions with humpback whales and associated mortality would increase in proportion to the increased cruise ship visits – or a 32% increase. Potentially, the increase mortality could be greater if increased habituation and or hearing difficulties resulted from the increase in cruise ship numbers or if whale numbers increased.

Other effects from motorized vessel movement. Other effects would be minor, as described under alternative 1.

Cumulative effects on threatened and endangered species — alternative 3 — Alternative 3 could have greater effects than under current conditions, the NPS decide to increase cruise ship traffic, and, therefore, would provide the potential for a greater incremental contribution to cumulative effects on humpback whales and Steller sea lions.

Impairment analysis for threatened and endangered species — alternative 3 —Alternative 3 would not cause population-level declines or prolonged displacement for either humpback whales or Steller sea lions; therefore, neither of these resources would be impaired.

Potential mitigation measures for threatened and endangered species — alternative 3 — Reasonable and prudent measures outlined in the biological opinion, and described under alternative 1, provide NOAA Fisheries' required and recommended measures to reduce disturbance and harm to humpback whales and/or Steller sea lions.

Conclusion, threatened and endangered species — alternative 3 — The overall effect would be expected to remain in the moderate level, but effects would be increased in roughly the proportion of vessel increases. Increasing cruise ships would increase loud noise exposure events and the frequency of humpback whale mortalities due to vessel strikes.

Alternative 4 – Effects on Threatened and Endangered Species

Direct and indirect effects on threatened and endangered species — alternative 4 – Alternative 4 would reduce effects on threatened and endangered species by:

- generally reducing vessel quotas in all vessel categories in Glacier Bay, except daily quotas for cruise ships and seasonal-use day quotas for private vessels,
- expanding the season when vessels quotas are in place to include May and September,
- prohibiting tour vessels and cruise ships and establishing vessel quotas for charter vessels in Dundas Bay,
- establishing additional closed waters for cruise ships and tour vessels,
- adding to ferry vessel operating requirements the provision that they cannot deviate from a direct course between the mouth of Glacier Bay and Bartlett Cove, and
- adding several operating requirements.

Because of these factors, overall impact levels would be reduced but still considered moderate, due to repeated exposures of humpback whales and Steller sea lions to vessel-related disturbance and due to the potential of vessel/whale collisions.

Alternative 4 calls for the greatest reduction in cruise ships and tour and charter vessels. In addition, alternative 4 would expand seasonal limits to include May and September, which would result in a 50% reduction in the maximum number of cruise ships allowed during those two months and a 33% reduction in the maximum number of tour vessels, compared to the current situation. Daily limits for charter and private vessels also would be restricted in May in September to five and 22 vessels, respectively. Currently, no limits are set for charter or private vessels during May and September.

The elimination of cruise ships and tour vessels and the limits placed on charter vessels in Dundas Bay would result in significant reductions in vessels there. This would significantly reduce the exposure of humpback whales by vessels and the potential for vessel/whale collisions in this area.

<u>Estimation of ensonified area — alternative 4</u>. Because cruise ships would be limited to 13 knots throughout Glacier Bay, the amount ensonified area would be greatly reduced. Sound signatures of cruise ships traveling at 13 knots are unavailable, so the extent of ensonification cannot be estimated. However, the area is likely considerably less when considering the dramatic, exponential increase of ensonified area that occurs between 10 knots and 19 knots. Cruise ships currently travel at speeds up to 26 knots, so reducing the speed to 13 knots would reduce the potential for noise generation by at

least half, and potentially much more. Under alternative 4, the superintendent could still reduce vessel speed to 10 knots anywhere within Glacier Bay when prudent to protect whales.

In addition to reducing the area of Glacier Bay that would be ensonified at any one time, the reduction in cruise ship speed and associated noise would also reduce the duration of ensonification at any one point. Even though it would take a cruise ship longer to pass over any one point, the radius where noise would exceed 130 dB would be significantly shorter, so the time of exposure would be less.

Vessel noise would also be reduced in Dundas Bay, since tour vessels would no longer visit there and since charter vessels would be limited to no more than three per day.

<u>Potential for temporary or permanent reduced hearing sensitivity in humpback whales or Steller sea lions</u>. As explained under the analysis of alternative 1, vessel traffic may be sufficient to cause temporary reduced hearing sensitivity in humpback whales or Steller sea lions, but noise exposure would not be sufficient to cause permanent reduced hearing sensitivity. The reduction of cruise ship speed and vessel numbers across all categories under alternative 4 reduces the likelihood of temporary reduced hearing sensitivity.

<u>Changes in behavior of threatened and endangered species due to the sight and noise of motorized vessel traffic</u>. Cruise ship encounters with humpback whales and Steller sea lions would be reduced by roughly a third. The 17% reduction charter vessels and 12% reduction in private vessels would create a more notable reduction in disturbance, since these vessel types are the most likely to engage in whale watching and in visiting the sea lion haul-out at South Marble Island.

By expanding the vessel quota season to include May and September, disturbance to Steller sea lions at South Marble Island would be substantially reduced in May, since use is highest during the months of October through May.

<u>Effects of vessel noise on communication and hearing</u>. Reducing cruise ship speed and reducing the numbers within all vessel categories would likely greatly reduce the effects on noise on communication and hearing. As stated above, cruise ship noise increases exponentially at greater speeds. In addition, the reduced vessel numbers would reduce the frequency of whale encounters with loud noise. Potentially more notably, reduced charter and private vessels would reduce vessel noise that results from whale watching activities.

<u>Effects of vessel collisions</u>. The risks of fatal vessel/whale collisions would be very low under alternative 4 due to the year-round 13-knot speed limit placed on vessels greater than 262 feet (80 meters) in length. Laist et al. (2001) reported that vessel collisions and the severity of large vessel collisions with whales greatly increased when vessels speeds approached 14 knots. Steller sea lions are unlikely to be struck by vessels because they are more maneuverable than humpback whales.

Under alternative 4, designated whale waters would be eliminated in Whidbey Passage, the East Arm entrance waters, and Russell Island Passage. This, however, would not change the overall risks of collision because of the effectiveness of the temporary whale water system, which would remain a primary tool available to NPS staff to protect whales. The Park Service has found that the current boundaries are confusing to boaters and that whale use in areas other than the lower waters of Glacier Bay is so highly variable that the permanent designation of these other areas is not necessary. Each year, NPS biologists have found it necessary to modify these areas using a combination of temporary and designated whale waters, which not only added confusion to boaters, but also placed restrictions over large areas where whales were not currently present.

Restrictions within the lower Bay whale waters would be in place from May 1 to September 30, rather than May 15 to August 31, as in alternatives 1 through 3. In some years, including 2003, humpback whales have entered Glacier Bay in significant numbers before May 15. Extending the season would help protect whales during such times.

The reduction in charter and private vessels would also reduce the likelihood of non-fatal injuries, such as propeller scaring. Reducing cruise ship numbers would reduce the likelihood of fatal collisions.

<u>Other effects from motorized vessel movement</u>. Other effects would be relatively minor, as described under alternative 1.

Cumulative effects on threatened and endangered species — alternative 4 — Alternative 4 would have lower effects than alternative 1 and, therefore, provide a lower incremental contribution to cumulative effects on humpback whales and Steller sea lions. As described under alternative 1, the contribution that vessel management and operating requirements makes to other actions that affect humpback whales and/or Steller sea lion is not expected to combine to form major risks to the recovery of these species.

Impairment analysis for threatened and endangered species — alternative 4 —Alternative 4 would not result in population declines or prolonged displacement for either humpback whales or Steller sea lions; therefore, neither of these resources would be impaired.

Potential mitigation measures for threatened and endangered species — alternative 4 — Measures outlined in the biological opinion, and described under alternative 1, provide mitigation measures to reduce disturbance to humpback whales and/or Steller sea lions.

In addition, disturbance to Steller sea lions could be reduced by increasing the current 100-yard (90-meter) approach distance (Mathews 2000).

Conclusion, threatened and endangered species — alternative 4 — The overall impact on humpback whales and Steller sea lions would be reduced, but would still be considered moderate since regular disturbance due to vessel traffic would be unavoidable. Reducing cruise ship numbers and tour vessel numbers in Glacier Bay and lower speeds would reduce loud noise exposure events and the frequency of humpback whale mortalities due to vessel strikes. Reducing tour, charter, and private vessels would reduce disturbance events to humpback whales and Steller sea lions.

Alternative 5 – Effects on Threatened and Endangered Species.

Direct and indirect effects on threatened and endangered species – alternative 5 — Alternative 5 would reduce effects on threatened and endangered species by:

- expanding the seasonal-use day quotas and the season for cruise ships to include May and September,
- establishing vessel quotas for Dundas Bay, and
- adding several operating requirements.

Overall impact levels under alternative 5 would be reduced from the current situation but would still be considered moderate due to repeated exposures of humpback whale and Steller sea lions to vessel-related disturbance and due to the potential of vessel/whale collisions.

<u>Estimation of ensonified area</u>. Because cruise ships would be limited to 13 knots throughout Glacier Bay, the amount ensonified area would be reduced. Sound signatures of cruise ships traveling at 13 knots are unavailable, so the extent of ensonification cannot be estimated. However, as described under alternative 4, the area is likely considerably less when considering the dramatic, exponential increase of ensonified area that occurs between 10 knots and 19 knots. Under alternative 5, the superintendent could still reduce vessel speed to 10 knots anywhere within Glacier Bay when prudent to protect whales.

<u>Potential for temporary or permanent reduced hearing sensitivity in humpback whales or Steller sea lions</u>. As explained under the analysis of alternative 1, vessel traffic may be sufficient to cause

temporary reduced hearing sensitivity in humpback whales or Steller sea lions, but noise exposure would not be sufficient to cause permanent reduced hearing sensitivity. The reduction of cruise ship speed under alternative 5 reduces the likelihood of temporary reduced hearing sensitivity.

<u>Changes in behavior of threatened and endangered species due to the sight and noise of motorized vessel traffic</u>. Cruise ship encounters with humpback whales and Steller sea lions would remain the same as described under alternative 1, except for a potential increase in private vessels. Private vessels could conceivably increase to 25 vessels per day, every day. This may increase vessel encounters with humpback whales as well as vessel visits to South Marble Island to view Steller sea lions.

<u>Effects of vessel noise on communication and hearing</u>. Reducing cruise ship speeds would reduce the effects of noise on communication and hearing. As stated above, cruise ship noise increases exponentially at greater speeds. In addition, the reduced cruise ship numbers in May and September would reduce the frequency of whale encounters with loud noise

<u>Effects of vessel collisions</u>. The risks of fatal vessel/whale collisions would be reduced under alternative 5 due to the year-round 13-knot speed limit placed on vessels greater than 262 feet (80 meters) in length. Steller sea lions are unlikely to be struck by vessels because they are more maneuverable than humpback whales.

Under alternative 5, designated whale waters would be eliminated in Whidbey Passage, the East Arm entrance waters, and Russell Island Passage. This, however, would not change the overall risks of collision because of the effectiveness of designating temporary whale waters, as described under alternative 4.

Restrictions within the lower Bay whale waters would be in place from May 15 to September 30, rather than May 15 to August 31 as in alternatives 1 through 3. Extending the season would help protect whales during such times. This may result in disturbance and increased potential for vessel/whale collisions in years that whales have entered Glacier Bay in significant numbers before May 15.

The reduction in charter and private vessels would also reduce the likelihood of non-fatal injuries, such as propeller scaring. Reducing cruise ship numbers would reduce the likelihood of fatal collisions.

Changing the method by which vessel speed is measured could increase the risk of vessel collisions with humpback whales. The current system is based on speed through the water, which gives speed relative to the currents. Under alternative 5, speed would be measured over the ground, meaning that when vessels travel against the current, their speed relative to the water would be their ground speed plus the speed of the current. This could add up to 8 knots to the speed relative to the water, thereby increasing the risk of hitting a humpback whale.

<u>Other effects from motorized vessel movement</u>. Other effects would be minor, as described under alternative 1.

Cumulative effects on threatened and endangered species — alternative 5 — Alternative 5 would have lower effects than alternative 1 and, therefore, provide a lower incremental contribution to cumulative effects on humpback whales and Steller sea lions.

As described under alternative 1, the contribution that vessel management and operating requirements makes to other actions that affect humpback whales and/or Steller sea lion is not expected to combine to form major risks to the recovery of these species.

Impairment analysis for threatened and endangered species — alternative 5 — As with all alternatives, alternative 5 would not result in population declines or prolonged displacement for either humpback whales or Steller sea lions; therefore, neither of these resources would be impaired.

Potential mitigation measures for threatened and endangered species — alternative 5 — Reasonable and prudent measures outlined in the biological opinion, and described under alternative 1, provide NOAA Fisheries required and recommended measures to reduce disturbance to humpback whales and/or Steller sea lions.

In addition, as with all alternatives, disturbance to Steller sea lions could be reduced by increasing the current 100-yard (90-meter) approach distance and by improving compliance with regulations through increased education and enforcement (Mathews 2000).

Conclusion, threatened and endangered species — alternative 5 — The overall effect would remain in the moderate level, but effects would reduced in roughly the proportion of vessel reductions. Reducing cruise ship and tour vessel numbers and speeds would reduce loud noise exposure events and the frequency of humpback whale mortalities due to vessel strikes. Reducing charter and private vessels would reduce disturbance events to humpback whales and Steller sea lions.

Alternative 6 – Effects on Threatened and Endangered Species

Direct and indirect effects on threatened and endangered species – alternative 6 — Alternative 6 includes most of the protection measures included in alternative 5, but with the option to increase cruise ship numbers to up to 184 from June through August and up to 122 in May and September. Protection measures of alternative 6 include:

- expanding seasonal-use day quotas and the season for cruise ships to include May and September,
- establishing vessel quotas for Dundas Bay, and
- adding several operating requirements.

Estimation of ensonified area. Because cruise ships would be limited to 13 knots throughout Glacier Bay, the amount ensonified area would be reduced. Sound signatures of cruise ships traveling at 13 knots are unavailable, so the extent of ensonification cannot be estimated. However, as described under alternative 4, the area is likely considerably less when considering the dramatic, exponential increase of ensonified area that occurs between 10 knots and 19 knots. Under alternative 6, the superintendent could reduce vessel speed to 13 knots anywhere within Glacier Bay when prudent to protect whales (a change from the current 10-knot limit, based on the best available information).

Potential for Temporary or Permanent Reduced hearing sensitivity in Humpback Whales or Steller Sea Lions. As explained under the analysis of alternative 1, vessel traffic may be sufficient to cause temporary reduced hearing sensitivity in humpback whales or Steller sea lions, but noise exposure would not be sufficient to cause permanent reduced hearing sensitivity. The reduction of cruise ship speed under alternative 6 reduces the likelihood of temporary reduced hearing sensitivity.

Changes in behavior of threatened and endangered species due to the sight and noise of motorized vessel traffic. Cruise ship encounters with humpback whales and Steller sea lions would be increased by roughly 32%. The overall effect of cruise ships on the behavior of both species is related to noise, and the exposure to noise is relatively short term, since cruise ships do not actively whale watch in Glacier Bay but rather focus on traveling to the tidewater glaciers. Therefore, the 32% increase would probably not make a major change in the anticipated impacts on behavior from cruise ships.

Effects of vessel noise on communication and hearing. Reducing cruise ship speeds would reduce the effects of noise on communication and hearing. As stated above, cruise ship noise increases exponentially at greater speeds. However, as with alternative 3, cruise ship numbers would increase the frequency of whale encounters with loud noise.

Effects of vessel collisions. The risk of fatal vessel/whale collisions is expected to be similar to the existing situation due to two off-setting factors. First, risks for each cruise ship visit would be reduced under alternative 6 due to the year-round 13-knot speed limit placed on vessels greater than 262 feet (80 meters) long. On the other hand, increasing cruise ship numbers could increase the risk of vessel/whale collisions based on probability alone.

Under alternative 6, designated whale waters would be eliminated in Whidbey Passage, the East Arm entrance waters, and Russell Island Passage. This, however, would not change the overall risks of collision because of the effectiveness of designating temporary whale waters, as described under alternative 4.

As with alternative 5, restrictions within the lower Bay whale waters would be in place May 15 to September 30. This may result in disturbance and increased potential for vessel/whale collisions in years that humpback whales have entered Glacier Bay in significant numbers before May 15.

Other effects from motorized vessel movement. Other effects would be minor, as described under alternative 1.

Cumulative effects on threatened and endangered species — alternative 6 — As with all alternatives, alternative 6 is not expected to create major effects and would have lower effects than alternative 1. Alternative 6, therefore, would provide a lower incremental contribution to cumulative effects on humpback whales and Steller sea lions.

As described under alternative 1, the contribution that vessel management and operating requirements makes to other actions that affect humpback whales and/or Steller sea lions are not expected to combine to form major risks to the recovery of these species.

Impairment analysis for threatened and endangered species — alternative 6 — As with all alternatives, alternative 6 would not result in population declines or prolonged displacement for either humpback whales or Steller sea lions; therefore, neither of these resources would be impaired.

Potential mitigation measures for threatened and endangered species — alternative 6 — Measures outlined in the biological opinion, and described under alternative 1, provide NOAA Fisheries required and recommended measures to reduce disturbance to humpback whales and/or Steller sea lions.

In addition, as with all alternatives, disturbance to Steller sea lions could be reduced by increasing the current 100-yard (90-meter) approach distance and by improving compliance with regulations through increased education and enforcement (Mathews 2000).

Conclusion, threatened and endangered species — alternative 6 — The overall effect would remain in the moderate level. Reducing cruise ship speeds would reduce loud noise exposure events and the likelihood of humpback whale mortalities due to vessel strikes.

Summary, Threatened and Endangered Species. Populations of both humpback whales and Steller sea lions are recovering from historic lows. A biological opinion, issued by NOAA Fisheries, documents that alternative 6 would not jeopardize the continued existence of the North Pacific humpback whale population or Steller sea lion populations present in Southeast Alaska and would comply with the Endangered Species Act.

Under all alternatives, vessel traffic could regularly disturb humpback whales and Steller sea lions. The traffic is not expected to cause animals to leave Glacier or Dundas Bays, but it could cause some animals to leave particular areas to avoid vessel traffic, which in turn, can reduce foraging, survival and reproduction. The ultimate effect of this disturbance could be reduced energy intake (e.g., feeding) and/or increased energy expenditure (e.g. vessel avoidance behavior). Most wild animals operate under an extremely tight energy budget. Such energy budgets can become critical during high-energy demands, such as breeding, pregnancy, caring for young, or during bouts of extreme weather. Animals subject to repeated disturbances might have lower energy reserves and consequentially lower reproduction and/or survival.

The effect level is expected to be within the moderate range for all alternatives. Even though disturbance could occur regularly it is not expected due to overall abundance of either humpback whales or Steller sea lions. Animals located near highly traveled vessel areas could be disturbed several times per day during summer.

The amount of predicted disturbance varies among alternatives generally in proportion to vessel numbers and in relation to cruise ship speeds.

Humpback whales are vulnerable to being struck by vessels, although an average of only about one whale/vessel collision is reported each year for the entire North Pacific stock. Still, a humpback whale was struck and killed by a cruise ship in park waters in 1999. Smaller vessels also strike whales, but such strikes are typically not lethal. Based on the best available information, reducing speed limits for large vessels to 13 knots would reduce the risk of fatal vessel/whale collisions. This speed limit would be required throughout Glacier Bay in alternatives 4, 5, and 6.

Underwater noise from vessels is expected to interfere with humpback whale foraging and communication. Cruise ships generate more underwater noise than any other vessel type in Glacier Bay. Based on the analysis, a cruise ship traveling at near 20 knots is probably audible to humpback whales up to 25 miles (40 kilometers) away and would be sufficiently loud to provoke a response from a humpback whale over 6 miles (9 kilometers) away.

Sound levels under alternatives 1, 2, and 3 would commonly be at these levels or higher (with the exception of waters where 10-knot speed limits have been put in place to protect whales). Reduced speed limits (13 knots) for large vessels under alternatives 4, 5, and 6 would greatly reduce underwater noise and its associated effects.

Steller sea lions may be disturbed by vessel noise as well. However, the primary vessel disturbance factor in Glacier Bay is vessels approaching the sea lions hauled out at South Marble Island. Based on recent research, the 100-yard (90-meter) buffer at this area may not be sufficient and increasing the buffer to up to 200 yards (180 kilometers) might reduce disturbance to Steller sea lions.

Listed from the highest to lowest levels of disturbance are:

- Alternative 3, which has highest cruise ship numbers and does not include speed limits for cruise ships outside of designated and temporary whale waters;
- Alternative 1, the no-action alternative, which would not change vessel numbers from those presently in place and does not include speed limits for cruise ships outside of designated and temporary whale waters;
- Alternative 6, the NPS preferred, which has the potential to increase cruise ship numbers would restrict cruise ship speeds to 13-knots throughout Glacier Bay and eliminate cruise ships from Dundas Bay.
- Alternative 5, which reduces cruise ship numbers in May and September, restricts cruise ship speeds to 13 knots or less throughout Glacier Bay, and eliminates cruise ships from Dundas Bay.
- Alternative 2, which contains the lowest vessel numbers does not include speed limits for cruise ships outside of designated and temporary whale waters;.
- Alternative 4, the environmentally preferred alternative, which contains the lowest numbers of vessels, includes speed restrictions for cruise ships to 13 knots or less throughout Glacier Bay, and would eliminate cruise ships and tour vessels from Dundas Bay.

4.3.2 MARINE MAMMALS

4.3.2 Marine Mammals

This section evaluates the consequences of implementing the various vessel management alternatives on marine mammals. Species evaluated in this section are all those known to occur in Glacier or Dundas Bay. They are:

- minke whale.
- harbor porpoise.
- killer whale.
- harbor seal.
- sea otter.

Issues of Concern Raised during Scoping. Specific public concerns regarding marine mammals include the following:

- The sight and noise of vessel traffic alter marine mammal behavior; therefore, any increase in the number of vessels would further disrupt their behavior.
- Increases in vessel traffic could result in increased marine mammal/vessel collisions.
- Vessel traffic may be contributing to the harbor seal population's declines noted in Johns Hopkins Inlet and the Beardslee Islands.

Potential effects on marine mammals in Glacier Bay and Dundas Bay from motorized vessels include the following:

- behavior may change.
- distribution in the park may change.
- communication may be disrupted.
- permanent or temporary hearing impairment may occur.
- collisions with vessels may occur.
- ingestion of pollutants or debris may occur.

Regulatory Framework.

> *Marine Mammal Protection Act* – Marine mammals are protected under the Marine Mammal Protection Act (16 USC 1361). This law prohibits "taking" marine mammals without authorization. Taking is "to harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect or kill any marine mammal (16 USC 1362)." NOAA Fisheries can issue regulations to "take" marine mammals. Determinations of "take" or "harassment" are under jurisdiction of NOAA fisheries.

State of Alaska Regulations — As stated under Threatened and Endangered Species, the State of Alaska, under the management authority of the Alaska Department of Fish and Game (ADF&G), has the primary responsibility of protecting fish and wildlife species within the state. The National Park Service met with ADF&G staff during scoping and would continue such consultation and cooperation, including ADF&G management activities in adjacent areas (e.g., Icy Strait) and application of their expertise in wildlife and fish in the park and preserve and surrounding areas.

Glacier Bay National Park and Preserve Regulations (36 CFR 13.65) and the Park Compendium — Park regulations prohibit vessels from approaching to within 0.25 mile (0.40 kilometer) of harbor seals hauled out on ice in Johns Hopkins Inlet from July 1 through August 31 of any given year. This is to protect harbor seals within the largest pupping area in Glacier Bay.

Methodology and Assumptions. Effects on marine mammals were evaluated based on a review of the literature, consultations with National Park Service, ADF&G, and NOAA Fisheries biologists, and records and reports related to marine mammals in Glacier and Dundas Bays. Noise exposure from motorized vessel traffic was evaluated as described previously for threatened and endangered marine mammals (subsection 4.3.1). Table 4-16 summarizes the significance criteria used to evaluate effects of the alternatives on marine mammals. Criteria were developed based on extensive consultation with Glacier Bay National Park and Preserve biologists, professional judgment, the provisions of the Marine Mammal Protection Act, and published literature on marine mammals.

TABLE 4-16: THRESHOLD CRITERIA FOR THE EFFECTS ANALYSIS ON MARINE MAMMALS

Negligible	An individual or group of marine mammals in Glacier Bay or Dundas Bay would notice a human-caused stimulus, such as a passing vessel, but the disturbance would not change short-term behavior and would not be biologically significant. There would be no harm to an individual or group of individuals. The duration would last only as long as the stimulus was perceptible to the individual or group.
Minor	An individual or group of marine mammals in Glacier Bay or Dundas Bay would notice a human-caused stimulus and would be disturbed, resulting in a short term change in behavior. The individual/group would resume undisturbed behavior within one day of exposure to the stimulus with no biologically significant effects. No individual or group of individuals would be harmed or injured.
Moderate	An individual or group of marine mammals in Glacier Bay or Dundas Bay would notice a human-caused stimulus and would be disturbed, resulting in a long term change in behavior. Individuals may be occasionally injured or killed, but at levels that do not affect overall abundance. The individual/group would be affected for more than one day with the potential for biologically significant effects. Numbers in Glacier and Dundas Bays may be less than if the action were not taken, but not to the point that numbers become unstable or well below historic numbers.
Major	A majority of individuals of one or more species within Glacier Bay and Dundas would be exposed to human-caused stimulus or actions that result in physical injury or mortality. Effects would be so frequent as to reduce populations below levels or shift use away from important habitat areas (e.g., breeding or feeding concentration areas). The injury or mortality would have biologically significant effects on populations within Glacier and Dundas Bays (or beyond).

Alternative 1 (No Action) — Effects on Marine Mammals.

General direct and indirect effects on all marine mammals — alternative 1— As described under Threatened and Endangered Species, the sight and sounds of motorized vessels are known to frighten or otherwise disturb marine mammals. Vessel traffic would regularly disturb marine mammals throughout Glacier and Dundas Bays. Due to the repeated nature of this disturbance, the overall effect on marine mammals is considered to be moderate, based on the criteria listed in table 4-14. While each species can exhibit characteristic behavior in response to disturbance (described for each species later in this section), the specific reaction of an individual to any particular vessel encounter cannot be predicted, since the reaction depends on many factors, including the specific sensitivity of the individual animal, the speed and course of the vessel, the specific vessel type, and an unknown number of other factors. Still, it can be assumed that the presence of vessels in Glacier and Dundas Bays regularly startles, frightens, and/or annoys individual animals and, in some cases, causes them to flee, dive, make sounds (or stop making sounds), or leave an area. The ultimate effect of this disturbance is reduced energy intake and increased energy expenditure. Such loss of energy can reduce the health of the individual and, when considered with many other factors, might contribute to reduced reproduction and survival. In general, most wild animals operate under an extremely tight energy budget (Robbins 1985). Such budgets may become critical at certain times of the year when animals operate on an energy deficit (meaning they are spending more energy than they are consuming). Such critical times include during the mating season, when giving birth to and feeding young, when molting fur, during bouts of extreme weather, and/or during times of low food supplies. Most marine mammals rely on fat stored during periods of high food supplies/low energy demands to survive periods of high-energy demand/low food supplies, when energy expenditure often exceeds intake. Disturbance at any time reduces the overall energy budget of an animal and, if it occurs regularly, could push certain individuals over the brink of survival during periods of energy stress, such as during food shortages, harsh weather, or molting. Reduced energy reserves can also reduce reproductive success. Weaker individuals are particularly vulnerable to such stresses, including the very young, the old, and the injured.

Another effect of vessel traffic is the potential for vessels to strike and injure or kill marine mammals. With the possible exception of the minke whale and harbor seal, the species of marine mammals that are present in Glacier and Dundas Bays are expected to be at a low risk of collision, but the possibility cannot be ruled out. Harbor seals have been known to be struck by vessels, but such events are relatively rare. NOAA Fisheries did not even note vessel collisions as a source of mortality as part of its 2002 Alaska Marine Mammal Stock Assessment (2002).

Overall effects are expected to be within the moderate level (see table 4-16). Vessel traffic has become a common element of the near shore environment throughout Southeast Alaska and, in fact, much of the world. Some degree of habituation to disturbance has occurred in most marine wildlife species. Still, in some cases, traffic has been shown, or at least is suspected, to significantly contribute to the decline of marine mammals (e.g., the manatee in Florida and the fin whale in the Atlantic Ocean). However, based on current population numbers and trends for all species except harbor seals, it appears marine mammal populations in Glacier and Dundas Bays are stable and self-sustaining. Current vessel use has been in effect for several years, with no notable decline in marine mammal populations, with the exception of harbor seals (discussed below). While marine mammal populations in Glacier and Dundas Bays may be lower than would occur with lower motorized vessel use than currently allowed, no major population-level concerns are expected.

Under alternative 1, it is assumed that such disturbance and associated energy costs to marine mammals would gradually increase as vessel numbers reach the maximum allowed. Current use is actually less than the maximum allowed, and many days are not at full capacity.

Within Glacier Bay, increases in vessel traffic would be the greatest in May and September due to expected increases in demand and lack of seasonal restrictions under alternative 1 (cruise ships and tour vessels would be limited to two per day and three per day, respectively, year-round). Current speed restrictions in whale waters would provide some protection for most marine mammals, since designated whale waters are also regularly used by other marine mammal species.

In Dundas Bay, use could increase substantially, since no limits are in place and the Bay has become increasingly popular, particularly for charter vessels. Harbor seals, sea otters, and harbor porpoises commonly use Dundas Bay, and disturbances may reduce some use by these species. The increase in charter use would increase disturbance from wildlife watching and vessel noise in both Dundas and Glacier Bays. Species-specific effects are described below.

<u>Species-specific effects</u>

HARBOR SEALS. Between 1992 and 1998, harbor seal numbers in Glacier Bay are estimated to have declined by 25-48% (Mathews and Pendleton 1997 and 2000). The causes for this decline are unknown, but vessel traffic is known to disturb harbor seals, and Mathews and Pendleton (2000) stated that “human disturbance is a factor that is most likely to have contributed…”

Harbor seals spend much time “hauled out” on shore or ice, and concentrations are located in Johns Hopkins Inlet, where a large supply of ice rafts exist, and in the Beardslee Islands, where the islands provide suitable haul-outs (particularly the “reefs” around Spider Island). The primary concerns for effects are that vessels scare seals into leaving haul-outs and entering the water. During the pupping period (May and June), females that leave haul-outs can become separated from their pups, resulting in starvation and or exposure mortality to the pup. During the molting period, entering the water comes at a high-energy cost for seals because they lack their protective layer of fur. In August, harbor seals shed their fur in a process called molting. At such times, harbor seals are at their lowest energy reserves (due to the energy expended to wean pups). Also during molting, harbor seals loose their normal insulation from the cold waters and, therefore, tend to spend much more time out of water than during other times of the year. They also are more reluctant to enter the water when disturbed.

Lewis and Matthews (2000) determined that 93% of the groups of people monitored in McBride Glacier Fjord in May and June 1998 disturbed harbor seals. Kayakers are believed to be more likely to disturb seals than were motorized vessels, but harbor seals tend to be disturbed at a further distance from motorized vessels than from non-motorized. Lelli and Harris (2001) found that 50% of non-motorized vessels caused seals to enter the water, whereas 11% of the motorboats did. Calambokidis et al. (1983) found that 50% of the harbor seals hauled out on ice entered the water when cruise ships approached to less than 330 feet (300 meters), whereas the response occurred for kayaks, tour boats, and pleasure boats at distances less than 186 feet (170 meters). Henry and Hammill (2001) found that disturbances to harbor seals most often were caused by kayaks and canoes (33.3%) rather than motorized vessels (27.8%) or sailboats (18%).

A study of harbor seal reactions to cruise ships in Disenchantment Bay, Alaska, (Jansen et al. 2002) found that "…the likelihood of harbor seals vacating ice floes rose steeply when ships approached to less than 500 m (+/-100m)." Even more did so at closer distances, with 25 times more abandonment of haul-outs documented when ships approached to 90 feet (100 meters).

The overall level of effects on harbor seals is moderate under alternative 1. Existing regulations to protect harbor seals in Johns Hopkins Inlet would remain in effect under alternative 1. The regulations include closing much of Johns Hopkins Inlet to all vessels, including non-motorized, in May and June, the time when harbor seals are pupping. Existing regulations also prohibit cruise in Johns Hopkins Inlet during August and require all other vessels to remain at least 0.25 mile (0.40 kilometer) from harbor seals hauled out on the ice during this time to reduce disturbance during the molting period.

After the seasonal closures, some harbor seals would still likely be disturbed during feeding and while at haul-outs by tour, charter, and private vessels. The current 0.25-nautical-mile 0.4-kilometer) buffer equates to 1,519 feet (463 meters), the lower range at which Jansen et al. found the likelihood of harbor seals abandoning their ice rafts. Therefore, under current regulations, even assuming full compliance with regulations (which is unlikely) vessel traffic is expected to cause some proportion of harbor seals to temporarily vacate haul-outs.

Harbor seals are less sensitive to underwater noise than are whales (Richardson et al. 1995). Effects from wakes potentially swamping harbor seal haul-outs is expected to be minor. In areas with high concentrations of harbor seals hauled out on glacial ice, vessels would likely be moving slower due to the risks of ice striking the hull and associated vessel damage. Cruise ships and tour vessels travel slowly (less than 8 knots) in Johns Hopkins Inlet because it is a destination, rather than a travel area, so their wakes would be relatively small (see appendix F).

MINKE WHALES. Minke whales are expected to be affected in ways similar to those described for humpback whales in subsection 4.3.1, including disturbance and annoyance from the presence of vessels, reduced communication and hearing due to vessel noise, and the risk of collision. Minke whales are not abundant in Glacier or Dundas Bays, with between five and eight reported sightings per year. Minke whales are relatively fast swimmers (up to 20 miles [32 kilometers] per hour), which might make them more maneuverable and able to avoid vessels better than humpback whales.

HARBOR PORPOISES. Harbor porpoises are much less vulnerable to collisions with vessels than are humpback whales, since they are very mobile and fast swimmers. They are, however, very shy and typically leave an area once a vessel approaches. Vessel traffic has been suggested as a possible reason for declines in harbor porpoise populations in Puget Sound, Washington. Because harbor porpoises rely heavily on hearing and use echolocation, vessel noise is much more likely to hinder feeding and navigation compared with other marine mammals. Vessel traffic might have contributed to reduced numbers of harbor porpoises observed since 1996 in Glacier and Dundas Bays (Gabriele et al. 1999), however, currently there is no evidence to support this.

KILLER WHALES: Vessel traffic and operating requirements under alternative 1 would be expected to cause regular disturbance to both resident and transient killer whales. The level of vessel noise present is expected to occasionally detract from the foraging efficiency of killer whales by reduced hearing, communications, and by potentially dispersing prey. Baird (1999) summarized current knowledge of effects of vessel traffic on killer whales. Baird (1999) reported that effects were not readily apparent for isolated incidents, but the cumulative effect of continuous vessel interactions can be significant. This is not expected to occur under alternative 1, since killer whales are not extremely common in Glacier or Dundas Bays, and they do not attract a focused whale watching fleet. The effects reported by Baird (1999) included instances where an average of five vessels were following a pod of killer whales at any one time during daylight hours of summer. In one area, whale-watching vessels increased to an average of 25 vessels following a particular pod. In these conditions, killer whales continued to forage and remain in the area, although Baird believed that foraging efficiency was likely reduced. This sort of disturbance does not occur in Glacier or Dundas Bays and is not expected to under alternative 1. Killer whales in Glacier or Dundas Bays are likely less conditioned to vessels and are expected to avoid vessel traffic. Therefore, vessels might increase energy expenditures and decrease foraging success.

Baird (1999) also reported that incidents of vessels striking killer whales are rare, even in areas where concentration areas of vessel traffic and killer whales overlap. Therefore, due to the restricted vessel traffic in Glacier Bay, collisions between vessels and killer whales are unlikely.

SEA OTTERS. Sea otters are not particularly sensitive to vessel traffic, but will avoid close contact with vessels. They do not rely on sound as much as other marine mammals and, therefore, effects are expected to be minor. Sea otters are unlikely to be struck by vessels as they are generally quite maneuverable and use nearshore habitats. Sea otters are currently colonizing prime habitat and might be better able to afford reduced forage time if disturbed. The sea otter population has increased tremendously since vessel numbers were increased in 1996, so vessel traffic does not seem to have a major effect on population size or distribution.

Cumulative effects on marine mammals - alternative 1 — Marine mammals in Glacier Bay or Dundas Bay are likely to be affected by several activities external to motorized vessel traffic. These activities would include changes in the concessions contracts, administrative and commercial fishing vessel traffic, subsistence harvest, commercial fishing catch, increases in tourism, and increases in the population in Southeast Alaska. The effects of these activities are described below.

- Expected changes in concession contracts to be initiated in 2005 would eventually allow charter vessel use to near maximum levels. Currently, many charter permits go unutilized because Glacier Bay Park Concessions, Inc., is not using several permits available for charter fishing trips. With reallocation of permits, the increase in charter use could increase disturbance to marine mammals.
- Administrative vessel traffic and the remaining commercial fishing vessel traffic create noise and disturbance in addition to that caused by cruise ships, and tour, charter, and private vessels commercial fishing vessel travel will decrease over time.
- Subsistence harvests of harbor seals and sea otters outside Glacier Bay could influence the level of immigration of these species into Glacier Bay.
- Commercial fishing may affect marine mammals by altering food availability, or by entanglement in fishing gear. The intensity of commercial fishing in Park waters would decline over time, thereby reducing the effects, but would continue in Icy Strait and elsewhere.
- Increases in tourism and human populations in Southeast Alaska may increase pressure on fish resources through commercial and sport fishing, thereby altering the distribution of

available food for marine mammals in Glacier Bay. Marine mammals that move in and out of Glacier Bay may be affected by increasing human influence outside the Bay.

- Backcountry use.

The incremental effect of vessel traffic in Glacier and Dundas Bays on the potential cumulative effects described above are anticipated to have the greatest cumulative effects on harbor seals for the following reasons (from Mathews and Pendleton 2000):

a. Harbor seal populations have declined by up to 85% in central and western Alaska;
b. Glacier Bay has historically contained one of the largest breeding colonies in Alaska;
c. Once relatively stable, harbor seal populations in Glacier Bay have declined by up to 50% over the past ten years;
d. Vessel traffic is known to cause harbor seals to leave haul-outs and enter the water, which can cause significant stress during molting and can lead to abandonment of pups.
e. Harbor seal pupping and molting seasons occur during the most intense period of vessel activity.

The causes for harbor seal population declines in Glacier Bay are unknown, but probably relate to multiple of factors, including disturbance by vessel traffic. Transient killer whales regularly eat harbor seals, and some have suggested that killer whales in Southeast Alaska are shifting from Steller sea lions to harbor seals. Non-motorized vessels are known to disturb harbor seals hauled out on ice or rocks, or other marine mammals in areas larger vessels cannot reach. As stated under the assessment of harbor seals, seals can be more disturbed by kayaks than by motorized vessels. Non-motorized vessel use is relatively high in the Beardslee Island Complex, the area that contains the largest concentration of harbor seal terrestrial haul-outs.

Considered collectively, these and other factors have contributed to widespread population declines throughout Alaska. However, the contribution that current vessel quotas and operating requirements make to overall cumulative effects is considered moderate, rather than major, due to the considerable level of protection provided by the regulations for Johns Hopkins Inlet.

For other species of marine mammal, the incremental effect of vessel quotas and operating requirements is not expected to make a major contribution to cumulative effects.

Impairment analysis for marine mammals — alternative 1 — While vessel traffic would continue to regularly disturb marine mammals, alternative 1 would not impair marine mammal populations to the point that people would no longer be able to enjoy seeing them.

Conclusion, marine mammals — alternative 1 — As described under subsection 4.3.1, Threatened and Endangered Species, the sight and sounds of motorized vessels are known to frighten or otherwise disturb most marine mammals. Under all alternatives, vessel traffic would regularly disturb marine mammals throughout Glacier and Dundas Bays. Due to the repeated nature of this disturbance, and due to the unavoidable potential for vessel/animal collisions, the overall effect on marine mammals is considered to be moderate, based on the criteria listed in table 4-16.

Alternative 2 - Effects on Marine Mammals.

Direct and indirect effects on marine mammals — alternative 2 — Lower vessel numbers allowed under alternative 2 would reduce the number of interactions between vessels and marine mammals. The actual reduction cannot be quantified, but the number of incidental “takes” of marine mammals would probably be reduced in roughly the same proportion as vessel quota reductions.

Alternative 2 would allow the fewest number of private vessels among the alternatives. Since private vessels are more likely to travel close to shore, in less than straight courses, and actively seek out marine mammals viewing, and since private vessel operators may be less aware of marine mammals and how to operate near them, the reduction in private vessels would result in fewer disturbances of marine mammals.

While lowering vessel numbers in Glacier Bay would reduce overall impact there, vessel disturbance to marine mammals in Dundas Bay could increase over time, should the current trend of increased charter use continue as expected. While effects would be reduced over the existing situation, overall effects would remain within the moderate level, as defined in table 4-16. Vessel traffic would still regularly disturb marine mammals over the long term, resulting in increased energy costs which, over time, could reduce fitness and survival in some individuals.

One potential indirect effect of reducing cruise ship entries into Glacier Bay would be a shift of cruise ship use to other areas, including Disenchantment Bay and other areas used by harbor seals. This could, conceptually, reduce harbor seal availability to subsistence hunters. However, the actual extent of such increased use and associated effects cannot be determined, since too many variables are involved and the exact increase, if any, cannot be predicted.

Cumulative effects for marine mammals — alternative 2 — Reducing vessels would reduce the overall contribution of vessel management within Glacier Bay to past, present, and reasonably foreseeable impacts on the marine mammal species that use Glacier and Dundas Bays. The effects of other past, present, and reasonably foreseeable actions would be as described under alternative 1, including those for harbor seals. The incremental effect of vessel quotas and operating requirements is not expected to make a major contribution to cumulative effects.

Impairment analysis for marine mammals — alternative 2 — As described under alternative 1, marine mammal populations are expected to be regularly disturbed by vessel traffic but are not expected to experience serious population declines. Therefore, alternative 2 would not impair marine mammals.

Conclusion, marine mammals — alternative 2 — Disturbance would be reduced over current levels due to lower vessel traffic, however, the overall effect would still be considered moderate due to repeated disturbance of marine mammals.

Alternative 3 - Effects on Marine Mammals

Direct and indirect effects on marine mammals — alternative 3 — Any increase in cruise ship numbers would result in a corresponding increase in vessel interactions with marine mammals. The increase cannot be quantified. The primary concern would be disturbance of whales and harbor porpoises due to noise. Increasing cruise ships could also increase risks of vessel collisions with minke whales. Such collisions are unlikely, since these whales are not often present in Glacier and Dundas Bays.

Cumulative effects for marine mammals — alternative 3 — The effects of other past, present, and reasonably foreseeable future actions would be as defined under alternative 1, including those for harbor seals. The incremental effect of vessel quotas and operating requirements is not expected to make a major contribution to cumulative effects.

Impairment analysis for marine mammals — alternative 3 — As described under alternative 1, marine mammal populations are expected to be regularly disturbed by vessel traffic but are not expected to experience serious population declines. Therefore, alternative 2 would not impair marine mammals.

Conclusion, marine mammals — alternative 3 — Disturbance could increase with increased cruise ship traffic. Overall effects would likely remain moderate.

Alternative 4 - Effects on Marine Mammals

Direct and indirect effects on marine mammals — alternative 4 —Alternative 4 would reduce effects on marine mammals by:

- Reducing vessel quotas for cruise ships and tour and charter vessels in Glacier Bay. Reducing vessel numbers would reduce the number of disturbances caused by vessels venturing near marine mammals.
- Expanding the season when vessels quotas are in place to include May and September. This would reduce vessels and associated disturbances to marine mammals in the spring and fall.
- Prohibiting tour vessels and cruise ships and establishing vessel quotas for charter vessels in Dundas Bay. This would reduce disturbances to marine mammals using Dundas Bay.
- Establishing additional closed waters for cruise ships and tour vessels, including the East Arm and Dundas Bay. This would also reduce vessel exposure to marine mammals.
- Adding to ferry vessel operating requirements the provision that they cannot deviate from a direct course between the mouth of Glacier Bay and Bartlett Cove. This would reduce the possibility of whale watching or other excursions in the lower Bay.
- Reducing vessel speeds to 13 knots for large vessels (262 feet [80 meters] or greater) throughout Glacier Bay and to 20 knots for smaller vessels (less than 262 feet [80 meters]) in the lower Bay would reduce disturbance to marine mammals using both Glacier and Dundas Bays.

Because of these factors, overall impact levels would be reduced but still considered moderate, due to repeated exposures of marine mammals to vessel-related disturbance and due to the potential of vessel/marine mammal collisions.

Alternative 4 calls for the greatest reduction in cruise ships and tour and charter vessels. This would reduce the overall incidence of vessel-related disturbance to marine mammals.

As described under alternative 2, one potential indirect effect of reducing cruise ship entries into Glacier Bay would be a shift of cruise ship use to other areas, including Disenchantment Bay and other areas used by harbor seals. This could, conceptually, reduce harbor seal availability to subsistence hunters. However, the actual extent of such increased use and associated effects cannot be determined, since too many variables are involved and the exact increase, if any, cannot be predicted.

Reducing vessel speeds to 13 knots for large vessels (262 feet [80 meters] or greater) throughout Glacier Bay and to 20 knots for smaller vessels (less than 262 feet [80 meters]) in the lower Bay would reduce disturbance to marine mammals using Glacier Bay.

Cumulative effects for marine mammals — alternative 4 — The effects of other past, present, and reasonably foreseeable future actions would be as defined under alternative 1. The incremental effect of vessel quotas and operating requirements is not expected to make a major contribution to cumulative effects.

Impairment analysis for marine mammals — alternative 4 — As described under alternative 1, marine mammal populations are expected to be regularly disturbed by vessel traffic but are not expected to experience serious population declines. Therefore, alternative 2 would not impair marine mammals.

Conclusion, marine mammals — alternative 4 — Alternative 4 would reduce overall effects on marine mammals. Similar effects, such as disturbance, would occur as described under alternative 1, but at a lower overall intensity and frequency.

Alternative 5 - Effects on Marine Mammals

Direct and indirect effects on marine mammals — alternative 5 — Expanding the season when vessels quotas are in place to include May and September for cruise ships would reduce vessels and associated disturbances to marine mammals in the spring and fall.

Establishing vessel quotas for charter vessels in Dundas Bay would reduce disturbances to marine mammals using Dundas Bay.

Establishing additional closed waters for cruise ships and tour vessels, including the East Arm and Dundas Bay would also reduce vessel exposure to marine mammals.

Changing the method by which vessel speed is measured could increase the risk of vessel collisions with marine mammals. The current system is based on speed through the water, which gives speed relative to the currents. Under alternative 5, speed would be measured over the ground, meaning that when vessels travel against the current, their speed relative to the water would be their ground speed plus the speed of the current. This could add up to 8 knots to the speed relative to the water. This would increase underwater noise under some conditions and potentially increase the risk of vessel collisions with marine mammals.

Reducing vessel speeds to 13 knots for large vessels (262 feet [80 meters] or greater) throughout Glacier Bay and to 20 knots for smaller vessels (less than 262 feet [80 meters]) in the lower Bay would reduce disturbance to marine mammals using Glacier Bay.

Cumulative effects for marine mammals — alternative 5 — The effects of other past, present, and reasonably foreseeable future actions would be as defined under alternative 1. The incremental effect of vessel quotas and operating requirements is not expected to make a major contribution to cumulative effects.

Impairment analysis for marine mammals — alternative 5 — As described under alternative 1, marine mammal populations are expected to be regularly disturbed by vessel traffic but are not expected to experience serious population declines. Therefore, alternative 5 would not impair marine mammals.

Conclusion, marine mammals — alternative 5 — Overall effects would be very similar to those described under alternative 1, but the additional operating requirements and expansion of the quota season to include May and September would generally reduce the overall intensity and frequency of effects. Overall effects on marine mammals are still considered moderate due to the long-term and repeated disturbance caused by vessel traffic.

Alternative 6 - Effects on Marine Mammals

Direct and indirect effects on marine mammals — alternative 6 — Alternative 6 includes most of the protection measures included in alternative 5, but with the option to increase cruise ship numbers to up to 184 from June through August and up to 122 in May and September. The effects of tour and charter vessels would be similar to those described under alternative 1, with potential harm and regular disturbance from vessel traffic. If the Park Service were to increase cruise ships, then the effects of noise and the risk of vessel strikes would also increase. The overall level of effect is still considered moderate, because of continued long-term disturbance of marine mammals due to vessel traffic.

Cumulative effects for marine mammals — alternative 6 — The effects of other past, present, and reasonably foreseeable actions would be as defined under alternative 1. The incremental effect of vessel quotas and operating requirements is not expected to make a major contribution to cumulative effects.

Impairment analysis for marine mammals — alternative 6 — As described under alternative 1, marine mammal populations are expected to be regularly disturbed by vessel traffic but are not expected to experience serious population declines. Therefore, alternative 2 would not impair marine mammals.

Conclusion, marine mammals — alternative 6 — Overall effects would be similar to those described under alternative 1, but may increase in frequency should the Park Service increase the number of cruise ships allowed.

Under all alternatives, vessel traffic would regularly disturb marine mammals throughout Glacier and Dundas Bays. Due to the repeated nature of this disturbance, and due to the unavoidable potential of vessel/animal collisions, the overall effect on marine mammals is considered moderate. Numbers of some marine mammals species may be lower than if motorized vessels were not present, but not to the point that numbers are well below historical numbers.

Reducing cruise ship speeds, as would occur under alternatives 4, 5, and 6, would reduce underwater noise and the associated disturbance. Reduced speeds would also reduce the potential for vessel collisions with marine mammals.

Under alternatives 1, 2, and 3, disturbance of harbor seals would contribute to the declining numbers of harbor seals in Glacier Bay. The extension of approach distance requirements to be year-round, as would occur under alternatives 4, 5, and 6, would serve to reduce the contributions that motorized vessel disturbance is having on declining populations.

Summary, Marine Mammals. Vessel traffic under each of the alternatives would regularly disturb marine mammals in Glacier Bay and Dundas Bay. The overall effect is considered moderate because vessels would regularly disturb individual animals, however numbers are expected to remain within historic levels.

The ultimate effect of this disturbance could be reduced energy intake (e.g., feeding) and/or increased energy expenditure (e.g. vessel avoidance behavior). Most wild animals operate under an extremely tight energy budget. Such energy budgets can become critical during high-energy demands, such as breeding, pregnancy, caring for young, molting, or during bouts of extreme weather. Animals subject to repeated disturbances might have lower energy reserves and consequentially lower reproduction and/or survival. Existing regulations for Glacier Bay National Park and Preserve (36 CFR 13.65) specify buffers at haul-outs and approach distance requirements that provide protection from motor vessel activities.

The amount of predicted disturbance varies among alternatives generally in proportion to vessel numbers. Alternatives 5 and 6 allow the most private vessels among the alternatives, and private vessels are expected to cause some of the greatest disturbances because they tend to travel closer to the shoreline then the other vessel classes where marine mammals are predominant.

The greatest concern for marine mammals is potential additive effect on harbor seals from vessel traffic when combined with the other factors that may be causing harbor seals to decline in Glacier Bay and Southeast Alaska. Glacier Bay supports one of the largest concentrations of harbor seals in Alaska, yet populations have declined dramatically over the last 10 years. The reasons are not known, but declines have occurred throughout the species range and reasons are expected to include factors other than vessel traffic.

Under all alternatives, the upper portions of Johns Hopkins Inlet would be closed to all vessels from May 1 through June 30 to protect harbor seals when they are pupping. Alternatives 1, 2, and 3 would require that vessels remain at least 0.25 mile away from harbor seas hauled out on ice in July and August. This would reduce disturbance to harbor seals when they are molting and especially sensitive to disturbance.

Alternatives 4, 5, and 6 would extend the requirement that vessels remain a minimum of 0.25 mile away from harbor seals hauled out on ice to year-round. This would reduce vessel disturbance to harbor seals after August 30, when Johns Hopkins Inlet is open to all vessel types, including cruise ships.

4.3.3 Marine Birds and Raptors

4.3.3 Marine Birds and Raptors

This section addresses the effects of each alternative on marine birds and raptors, with emphasis on the potential disturbance of breeding seabirds, raptors (particularly bald eagles), shorebirds, waterfowl (principally during their molting period), and gulls. Breeding birds are of concern because of their vulnerability to disturbance during the high-energy demands of breeding. In addition to expending energy for day-to-day living, they must also expend energy defending nesting territories; building nests; generating, laying, and incubating eggs (which constantly require the input of heat from a bird); and caring for and feeding young until they are large enough to live capably on their own. Similarly, molting waterfowl are a concern because of the high-energy demands required during the molt and their inability to fly, which make them highly sensitive to disturbance. As with birds during the breeding season, birds molt their feathers and store body fat in order to prepare for migration and winter survival.

Issues of Concern Raised during Scoping. The following issues of concern related to marine birds and raptors were identified during scoping:

- The presence of vessels in the marine environment alters marine bird behavior, specifically harlequin ducks in Dundas Bay.
- Waves from vessel wakes could swamp marine bird nests that are in low-lying areas, thus reducing reproductive success and altering marine bird feeding behavior.
- Private and charter vessels that offload visitors onshore could disturb bird colonies, specifically at McBride Glacier, as well as nesting arctic terns and mew gulls in other breeding locations, thus reducing reproductive success.
- Vessel traffic may disturb the large concentrations of black oystercatchers that congregate in Glacier and Dundas Bays prior to fall migrations.

Regulatory Framework. The regulations related to birds that were considered in regard to the potential effects of the alternatives are as follows.

Bald Eagle Protection Act of 1940 (16 USC 668-668d) —

> *"No person within the United States shall possess, sell, purchase, barter, offer to sell, transport, export, or import, at any time or in any manner, any bald eagle or golden eagle, alive or dead, or any part, nest, or egg.*
>
> *"The Secretary of the Interior can permit taking, possessing, and transporting specimens for scientific or exhibition purposes or for the religious purposes of Indian tribes, if the action is determined to be compatible with the preservation of the bald or golden eagle."*

Bald eagles are common along park's shorelines and in nearshore areas.

Endangered Species Act of 1973 (PL 93-205; 16 USC 1531 et seq., as amended) — As previously discussed in section 4.3.1, the Endangered Species Act protects animal and plant species currently in danger of extinction (endangered) and those that may become endangered in the foreseeable future (threatened). No threatened or endangered bird species are present in Glacier Bay or Dundas Bay.

Migratory Bird Treaty Act of 1918 (16 USC 703-712) — The Migratory Bird Treaty Act provides the following protection to migratory birds:

> *Except as allowed by implementing regulations, this act makes it unlawful to pursue, hunt, kill, capture, possess, buy, sell, purchase, or barter any migratory bird, including the feathers or other parts, nests, eggs, or migratory bird products. Public Law 95-616 also ratified a treaty with the Soviet Union specifying that both nations will take measures to protect identified ecosystems of special importance to*

migratory birds from pollution, detrimental alterations, and other environmental degradations."

All birds discussed in this section are classified as migratory birds under this act.

Methodology and Assumptions. The methodology for evaluating the effects on marine birds and raptors consists of:

- identifying proposed activities that could affect birds.
- determining how those activities would affect the birds (e.g., behavioral changes, changes in mortality, changes in reproduction, changes in habitat use).
- determining the level of effect of those activities and whether the effects are adverse or beneficial.
- determining the significance of those effects in terms of the resource.

To determine whether the effects on marine birds and raptors were adverse or beneficial, the significance of those effects was evaluated according to the threshold criteria in table 4-17.

TABLE 4-17: THRESHOLD CRITERIA FOR EFFECTS ANALYSIS ON MARINE BIRDS AND RAPTORS

Negligible	Individuals may be disturbed, but disturbance would be infrequent (less than once per day), lasting less than a few minutes, and limited to the point of disturbance. No measurable reductions in the survival, reproduction, and/or habitat use of bird populations in the park would occur, and any change would be within those levels that would occur naturally.
Minor	Local abundance may be reduced, but at levels that are within the range of normal population flux. Reductions and/or other effects would be localized.
Moderate	Disturbance would be sufficiently high to reduce local abundance (such as the numbers present in a breeding colony) to a lower number than would occur without disturbance. Disturbance and resulting declines would occur over a relatively large area, such as an entire breeding colony or island or abandonment of a cove used for shelter by molting waterfowl.
Major	Local abundance of one or more species would decline to the point that large areas are essentially abandoned, such as a breeding colony or bay used during molting.

Alternative 1 (No Action) — Effects on Marine Birds and Raptors.

Direct and indirect effects on marine birds and raptors — alternative 1 — The potential effects on marine birds and raptors were evaluated in regard to the four issues of concern previously discussed—vessel disturbance, vessel wake, propwash, and fuel spills.

<u>Vessel disturbance</u>. Moving vessels disturb birds by startling them and causing them to take flight or otherwise expend energy to avoid the vessels. Some authors (Bell and Austin 1985; Edwards and Bell 1987, cited in Cryer et al. 1987) have indicated that anglers may cause substantial disturbance to birds. Every vessel traveling up Glacier Bay might disturb many birds. If disturbance is so severe that it affects the ability to breed, the birds probably will abandon an area and nest elsewhere.

COLONIAL NESTING SEABIRDS: Of the 66 seabird colonies identified in Glacier Bay and Dundas Bay (see figure 3-6), 23 (35%) occur within non-motorized waters and, therefore, are protected from disturbance by motorized vessels. In the areas where motorized vessels are permitted, an examination of vessel tracklines indicates that:

- cruise ships stay mid-channel and do not venture near seabird colonies except near Lone Island, which lies near the middle of the channel, and while visiting the tidewater glaciers of the West Arm (see figure 3-23).

- tour vessels typically pass by seabird colonies at South Marble Island, and on the southeastern side of Russell Island (where the attraction is bears, rather than seabirds, and the vessels are in mid-channel; see figure 3-24).
- charter vessels typically do not visit most seabird colonies, with only South Marble and Puffin Islands receiving some visitation (see figure 3-24).
- Private vessels can travel freely in Dundas and Glacier Bays and tend to have the most diverse tracklines of the four vessel categories. Burger (1998) found that vessels not following standardized vessel routes elicited a significantly higher response in birds than did vessels following marked channels.

Seabirds on South Marble Island, which is the most intensively visited colony in Glacier and Dundas Bays, are still abundant with the current level of vessel traffic. Although no long-term studies have been conducted in this area, there is no indication of a decline in abundance.

MURRELETS: Research suggests that vessel disturbance affects the ability of marbled murrelets to feed and might exclude them from important feeding areas (Piatt and Naslund 1995). Vessel disturbance may affect the ability of Kittlitz's murrelets to feed in preferred glacial-affected and glacial-stream-affected waters in Prince William Sound, while their abandonment of Blackstone Bay in Prince William Sound may be caused by the presence of excessive vessel traffic and related disturbance (Day and Nigro 1999).

Similarly, Kuletz (1996) found that, in Alaska waters, marbled murrelet abundance declined in proportion to the density of vessels. About 85% of murrelets on the water in Prince William Sound left the area when the vessel density exceeded one boat per transect (a 656-foot [200-meter] wide survey area that is, on average, approximately 2.5 miles [4 kilometers] long) and up to 94% left when traffic was three or more vessels per transect. In Kachemak Bay, there were approximately 46% fewer murrelets on the water when vessel density exceeded one boat per transect, and approximately 60% fewer when traffic was three or more vessels per transect. Sitakaday Narrows, Reid Inlet, much of the East Arm, and the eastern entrance of Dundas Bay are all areas where vessel traffic is expected to impact murrelets. The effect is expected to be a decline in population numbers from those that would occur if vessels were not present. Due to the sensitivity of these species, vessel traffic is expected to cause a moderate effect on marbled and Kittlitz's murrelets through regular disturbance.

Of the areas in Glacier Bay and Dundas Bay where murrelets concentrate on the water, several occur within non-motorized waters and, therefore, are protected from disturbance by motorized vessels during the visitor-use season. Those areas include the Beardslee Islands, Hugh Miller/Scidmore Inlet Complex, Rendu Inlet, and Wachusett Inlet (see figure 3-7). Other areas where murrelets concentrate and are vulnerable to vessel disturbance include mouth of Dundas Bay, Sitakaday Narrows, Berg Bay, Geikie Inlet, Blue Mouse Cove, Queen Inlet, Muir Inlet from Sebree Island to Leland Island, and Beartrack Cove.

RAPTORS: For raptors (hawks and eagles), individuals would be disturbed by passing vessels, but overall effects of disturbance would be negligible. Of the five species of raptors that occur in the planning area, bald eagles are of most concern due to their strong association with shorelines and open water. Sharp-shinned hawk and northern goshawk are mostly forest-associated birds and would not be affected by vessel traffic.

Research conducted on the behavioral responses of breeding bald eagles to vessel disturbance indicates that, even though eagles are likely to respond to vessels that approach within about 650 feet (200 meters), on average, the percentage of breeding eagles that may be disturbed by vessel traffic is low, particularly for adults with eggs or chicks (Anthony et al. 1991; Buehler et al. 1991; McGarigal et al. 1991; Steidl and Anthony 1991). For alternative 1, the presence of cruise ships is likely to have a negligible effect on bald eagles. Tour, charter, and private vessels would be more likely to disturb bald eagles because these vessels operate closer to shore (and closer to eagle nests) than cruise ships, and are more likely to stop or remain stationary, activities that have been found to be more disruptive. Bald eagles likely would be flushed from perches regularly, but the overall effect is not expected to cause them to leave the area or otherwise affect populations. In addition, studies indicate that animals often habituate to regular non-threatening disturbances. For example, eagles nesting in the Bay that are visited at the same time each day by a tour vessel continue to produce young and do not tend to flush from the nest or nest tree (NPS, Kralovec, pers. com., April 10, 2002). At existing levels of vessel use, potential adverse effects on breeding bald eagles likely would be no more than negligible to minor and would be in compliance with the Bald Eagle Protection Act.

Peregrine falcons breed in Glacier Bay and Dundas Bay and could be disturbed by vessels traveling near the shoreline. Tour, charter, and private vessels would be more likely than cruise ships to disturb breeding and foraging peregrine falcons because they tend to travel closer to the shore. However, at the existing level of vessel use, this disturbance is expected to be minor because peregrine falcons tend to nest on cliffs high above the water line and away from close vessel contact.

NESTING SHOREBIRDS: The effects of vessel disturbance on shorebirds are not well understood; however, in general, vessel disturbance in certain circumstances can reduce shorebird nesting success or disturb foraging. Shorebirds may respond to disturbance by: 1) flying away and not returning, 2) flying away and then returning quickly to the same or a nearby location, 3) walking away, or 4) remaining in the same location and becoming motionless or continuing to feed (Burger 1986; Fitzpatrick and Bouchez 1998; Yalden and Yalden 1990; Yalden 1992). Shorebird sensitivity to disturbance is greater during spring migration and summer months when they tend to be in smaller flocks and their young are present (Burger 1986 and 1995; Burger and Gochfeld 1991). Individual shorebirds may be disturbed and/or temporarily displaced from habitats, but long-term displacement of a significant proportion of the shorebird population from foraging habitats does not appear to be likely in Glacier Bay and Dundas Bay, and therefore impacts are expected to be minor.

GULLS: Gulls (primarily black-legged kittiwakes, mew gulls, and glaucous-winged gulls) congregate in large numbers in Glacier Bay, especially in the vicinity of Sitakaday Narrows, to feed on zooplankton and small fishes in the ephemeral tide rips and tidal fronts that form there. They also congregate on beaches near river mouths to feed on small fishes and other organisms (Wik 1967; Matkin 1989). Gulls might experience effects due to vessel disturbance, which could affect habitat use.

Black-legged kittiwakes would likely be disturbed at breeding areas, since they are known to flush when vessels approach closely. Alternative 1 includes vessel approach distances to known seabird breeding colonies in Glacier Bay. These vessel approach distances are believed to be sufficient to prevent disturbance to nesting gull colonies and, therefore, the overall effect of vessels on gulls is expected to be minor.

BREEDING SEADUCKS: The most common breeding seaduck species seen on salt water in Glacier Bay and Dundas Bay are harlequin duck (a species that nests inland along stream edges) and Barrow's goldeneye and common merganser (two species that nest in cavities in trees). Because all three species nest away from the shore, they would not be affected by vessels during incubation; therefore, any effects of vessel disturbance on this stage of nesting would be negligible.

The chick-rearing stage is when broods are most sensitive to disturbance from vessels. Harlequin ducks appear to be highly sensitive to disturbance, with females taking broods to undisturbed areas and birds abandoning chronically disturbed areas (Hunt 1998; Robertson and Goudie 1999). In Glacier Bay and Dundas Bay, the potential effects of vessel disturbance on seaducks could be substantial if vessels routinely traverse habitat used by brood-rearing seaducks; therefore, under alternative 1 any effects of vessel disturbance on the productivity of breeding seaducks would be more pronounced during the brood-rearing season (June and July) and negligible during other times. Further, the greatest effects would come from tour, charter, and private vessels because they spend so much time near the shore, where these broods occur. Overall, the effects to breeding sea ducks from the implementation of alternative 1 would be moderate because local abundance could decrease due to vessel disturbance.

MOLTING WATERFOWL AND SEADUCKS: Vessels could disturb molting waterfowl and seaduck survival and habitat use by causing them to temporarily move from or totally abandon some areas of Glacier Bay and Dundas Bay. Disturbance could affect waterfowl and seaduck survival by forcing them to expend much needed energy reserves in order to avoid vessel disturbance. This could result in these birds entering the winter with less energy reserves than they normally would have. One study estimated that a duck with the mass of a canvasback would require an extra two days to feed in high-quality habitat if the disturbed birds were displaced into flying an extra eight hours overall (Frederickson and Reid 1988, cited in Havera et al. 1992).

Some observations of disturbance to molting waterfowl have been conducted in Glacier Bay National Park and Preserve. Babcock and Sharman (1983) indicated that molting Canada geese responded to their presence by fleeing into the ocean and swimming away; Spicer and Prussin (1989) also found that their presence could disturb Canada geese. Calambokidis et al. (1983) found that molting geese responded to disturbance by running away or entering the water and swimming away; molting geese responded to vessels at a significantly greater distance (average of 3,935 feet [1,200 meters]) than did post-molting (i.e., flight-capable) geese (average of 961 feet [293 meters]). They also found that molting geese were more sensitive to aircraft than to vessels (sometimes responding to aircraft that were heard but not seen), but that they even were sensitive to kayaks. Climo and Duncan (1991) also found that non-motorized vessels such as kayaks disturbed Canada geese.

Non-motorized waters (see figure 3-9) represent approximately 50% of the area used by molting waterfowl. This area includes the Beardslee Islands, Hugh Miller/Scidmore Inlet Complex, Adams Inlet, and Wachusett Inlet. The areas where these birds concentrate in motorized waters include Berg Bay, Whidbey Passage, Tidal Inlet, the Tlingit Point area, central Muir Inlet, and the Sturgess Island–Puffin Island area.

Due to their increased sensitivity, effects on molting waterfowl under alternative 1 would be moderate. While non-motorized waters provide some protection, it is assumed that large areas of Glacier and Dundas Bays are avoided by molting waterfowl directly because of vessel traffic.

NON-BREEDING SHOREBIRDS: Phalaropes gather and feed in large numbers in Sitakaday Narrows; however, based on the literature, this species is not vulnerable to disturbance. Wik (1967) indicated that phalaropes do not flush until they nearly are under the bow of the vessel suggesting that they are not disturbed by the presence of vessels. When disturbed, these birds simply fly a short distance (a few meters or tens of meters) and land again (R.H. Day, ABR, Inc. –Environmental Research & Services, Fairbanks, AK, pers. obs.). From these descriptions, it appears that phalaropes are not disturbed by vessels; therefore, vessel disturbance on these shorebirds would be negligible under alternative 1.

<u>Vessel wakes</u>. The possibility of vessel wakes swamping colonial nesting seabirds or shorebirds must be considered for each alternative. Vessel wakes would have to be higher than seas that occur naturally during high winds and high tides, because both colonial nesting seabirds and shorebirds naturally nest high enough to avoid natural flooding under normal circumstances. Based on modeling and direct observation, cruise ships produce a wake that is less than 1 foot (0.3 meter) high (PND 2002). Vessel wakes attenuate to 1 foot high or less at a distance of 2,000 feet (610 meters) or more from the ship. Both colonial nesting seabirds and shorebirds typically nest at least 1 foot (0.3 meter) above the highest tide level; therefore, swamping of bird nests by vessel wakes is unlikely or would occur infrequently. The percentage of higher spring high tides during the summer is about 56% or one out of every 200 hours (PND 2002). Tide tables for Juneau, Alaska, indicate that the highest (spring) monthly tide for June 2002 was 18.3 feet (5.6 meters) and occurred on two days that month. The highest tides for May 2002 exceeded that height on four days, reaching heights of 19.3 feet (5.9 meters). During May and early June, seabirds are likely to nest at heights that keep their nests from being inundated or at heights 1 foot above those recorded in June, a month when vessel wakes could

be expected to add up to 1 foot additional height to a high tide. Because the largest vessel wakes expected in either Glacier Bay or Dundas Bay are less than 1 foot high, and because shore nesting birds generally nest more than 1 foot above the highest tide level, effects of vessel wakes on nesting birds would be negligible.

Propwash. Another effect to be addressed is the potential for propwash (the back trust of propellers or bow-thrusters) to churn up sediments, and thereby reduce visibility for birds that forage underwater. Propwash generally is related to vessel size, in that it would require considerably larger propellers and engine thrust to move a large ship (e.g., a cruise ship) than a small vessel (e.g., a 25-foot [7.6-meter] pleasure craft); therefore, the effects of propwash increase with increasing ship size. Wake size was evaluated based on direct observations from a tour vessel of a 778-foot-(237-meter) long cruise ship in Glacier Bay in June 2002 (appendix G; PND 2002). Because this ship was the largest size entering the park, propwash would be the greatest of all vessel types. No evidence of increased turbidity from this ship's wake was observed, suggesting that propwash did not cause a great amount of vertical water motion. Cruise ships displace a large amount of water from propellers, bow thrusters, and by just the sheer mass of the vessel moving through the water. It is expected that cruise ships may stir up some sediments, but overall, the vessels operate at such depth that this is not an issue. However, cruise ships can change the distribution of milky water, bringing up deeper, clearer water to the surface. This can temporarily reduce the foraging areas for Kittlitz's murrelets. Because the effect would be localized and temporary, vessel numbers under alternative 1 are expected to cause a minor amount of disruption to Kittlitz's murrelet foraging areas. Charter and private vessels, particularly ones small enough to enter shallow waters, stir up fine sediments when maneuvering near shore, but the extent of this would be isolated and temporary, so the overall effect would be minor.

Fuel spills. The potential for a major fuel spill under this alternative is negligible (see section 4.4.3, "Vessel Use and Safety"). Fuel spills from vessels have obvious effects on marine birds and raptors, with effects on habitat use, productivity, or survival (Wiens 1996). The literature is extensive, and only a few papers are cited here (also see Burger and Fry 1993). Studies by Day et al. (1997a, 1997b) and Bernatowicz et al. (1996) found that fuel spills may have dramatic effects to habitat use and productivity of birds, but that the effects generally are short-lived. Nesting success could be reduced by direct exposure of eggs or young to fuel, disturbance caused by cleanup activities, indirect effects on food availability or quality, or a host of other factors (Kuletz 1996). Populations could be affected if there was extensive mortality after a spill (Piatt et al. 1990a). In the event of a large spill, all of these factors may act in concert to cause shifts in the species composition of the entire bird community (Wiens et al. 1996); however, the overall probability of a major fuel spill is low, and therefore, this is unlikely to occur.

Bird/vessel collisions. Although it is not a common occurrence, vessels may hit or run over birds and kill them. Birds also could be hit by a vessel prop. No data exists as to the mortality of birds in Glacier and Dundas Bays currently; therefore, the current effect is unknown, but assumed to be negligible.

Summary, direct and indirect effects on marine birds and raptors. Based on the previous analysis of the four mechanisms of concern—vessel disturbance, vessel wake, propwash, and fuel spills—the primary effects of alternative 1 on marine birds and raptors include the following:

- In general, black oystercatchers, breeding seaducks (common mergansers, harlequin ducks, and Barrow's goldeneyes), marbled and Kittlitz's murrelets, nesting cormorants, and molting waterfowl are most sensitive to vessel disturbance and noise and, therefore, would be affected the most. Overall effects are expected to be moderate because populations of these species are likely lower than they would be without vessel traffic.
- While a major fuel spill near a bird colony would result in a major effect, the likelihood of a catastrophic spill is negligible (see section 4.4.3). In most cases, spills would be small and, depending on where a fuel spill occurred and at what time of year, effects would be expected to be a minor to moderate.

Based on the threshold criteria, overall direct and indirect effects of alternative 1 on birds in Glacier and Dundas Bays would be moderate.

Cumulative effects on marine birds and raptors — alternative 1 — Foot traffic, non-motorized vessels (especially kayaks), and vessel traffic from administrative vessels, including research vessels, are the actions most likely to add to effects evaluated for this alternative. Several authors (e.g., Burger 1981, 1986, 1995; Bell and Austin 1985; Cryer et al. 1987) have indicated that anglers—primarily either on foot or in small vessels—may cause substantial disturbance to birds. Administrative vessel traffic can disturb marine birds and raptors in similar ways to other vessels. Helicopters and aircraft also create noise and visual disturbance that are cumulative to the actions addressed in this EIS.

Non-motorized vessels (kayaks) sometimes land on seabird (mew gull and Arctic tern) colonies on glacial outwash plains and disturb molting waterfowl, especially in McBride Glacier and Adams Inlet (e.g., Babcock and Sharman 1983; Calambokidis et al. 1983; Spicer and Prussin 1989). Fixed-wing and (especially) helicopter overflights may disturb breeding seabirds (e.g., Giese and Riddle 1999; but see Dunnet 1977), raptors (e.g., Andersen et al. 1989; Watson 1993; Grubb and Bowerman 1997), and waterfowl (e.g., Conomy et al. 1998) and (especially) to molting waterfowl (e.g., Babcock and Sharman 1983; Calambokidis et al. 1983; Spicer and Prussin 1989; Ward et al. 1999).

Considered collectively with the direct and indirect effects of alternative 1, the above actions would result in a total greater sum of disturbance, but effects are still expected to be moderate, with populations of birds expected to remain healthy and no large areas (such as an inlet) being avoided or abandoned by one or more species.

Impairment analysis for marine birds and raptors — alternative 1 — Overall effects would be moderate because of some reduction of local populations, but the effects on marine birds and raptors are not expected to result in an impairment of park resources.

*Conclusion, marine birds and raptors — alternative 1 —*Alternative 1 would have moderate effects on birds in Glacier and Dundas Bays. Vessels would disturb black oystercatchers, breeding seaducks, and molting waterfowl. Propwash and wake effects are not expected to change bird behavior. Although fuel spills could result in mortality to seabirds, black oystercatchers, and seaducks, the possibility of a spill is low. Although vessel traffic resulting from alternative 1 would disturb birds in Glacier and Dundas Bays, reductions in population numbers would not be likely.

Alternative 2 – Effects on Marine Birds and Raptors.

Direct and indirect effects on marine birds and raptors — alternative 2 —

<u>Vessel disturbance</u>. Alternative 2 would reduce vessel numbers and associated levels of disturbance, however effects would likely be the same as alternative 1. There would likely be minor to moderate effects on murrelets, molting waterfowl, and sea ducks from vessel traffic. Effects from vessel traffic would have a moderate effect on murrelets in areas where murrelets and vessels are concentrated. Because effects of disturbance on bald eagles are expected to be negligible or minor, this alternative would comply with the Bald Eagle Protection Act. The overall amount of disturbance to marine birds and raptors under alternative 2 would decline from that under alternative 1, but would be moderate.

<u>Vessel wakes</u>. Because the largest vessel wakes expected in either Glacier Bay or Dundas Bay are less than 1 foot (0.3 meter) high at a distance of 500 feet (152.4 meters) from vessels, and because shore nesting birds typically nest greater that 1 foot (0.3 meter) above the highest tide level, effects of vessel wakes on nesting birds would be negligible.

<u>Propwash.</u>. The amount of propwash in alternative 2 would be lower than that occurring in alternative 1; therefore, any effects of propwash on marine birds and raptors would be minor under alternative 2.

<u>Fuel spills</u>. Alternative 2 would allow fewer seasonal-use days for cruise ships than would alternative 1. Charter vessel use days also would be reduced. This reduction in use days would result in a lower probability of a fuel spill compared to alternative 1; therefore, under alternative 2, any effects of fuel pollution on breeding seabirds would be minor to moderate, but would be major if a large spill occurred, although the potential for these effects would be less than for alternative 1.

<u>Bird/vessel collisions</u>. The decrease in vessel traffic would result in a decreased potential for bird/vessel collisions.

Cumulative effects on marine birds and raptors — alternative 2 — Cumulative effects under alternative 2 would be the same as with alternative 1. The actions, described in detail in alternative 1, would result in less disturbance, but effects would still be expected to be moderate, with populations of birds remaining healthy and no large areas (such as inlets) being avoided or abandoned by one or more species.

Impairment analysis for marine birds and raptors — alternative 2 — Overall effects would be moderate because of some reduction of local populations, but the effects on marine birds and raptors are not expected to result in an impairment of park resources.

Conclusion, marine birds and raptors — alternative 2 — This alternative would reduce vessel numbers and associated levels of disturbance, but overall effects would be similar as in alternative 1, with disturbance of murrelets on the water if vessel traffic is high. Propwash and vessel wakes are not expected to affect birds. Overall effects of vessel disturbance and fuel spills for alternative 2 would be minor, but effects would be less than those predicted for alternative 1.

Alternative 3 – Effects on Marine Birds and Raptors.

Direct and indirect effects on marine birds and raptors — alternative 3 —

<u>Vessel disturbance</u>. Overall disturbance to marine birds and raptors under alternative 3 would be greater than that for alternative 1. Seabird colonies would not be disturbed significantly by vessels. Murrelets on the water would be disturbed in areas of high vessel traffic. Bald eagles are not expected to be noticeably disturbed; therefore, this alternative would comply with the Bald Eagle Protection Act. Overall effects of vessel disturbance to other marine birds and raptors would be minor, or similar to alternative 1.

<u>Vessel wakes</u>. As explained under the effects analysis for alternative 1, because the largest vessel wakes expected in either Glacier Bay or Dundas Bay are less than 1 foot (0.3 meter) high within 500 feet (152.4 meters) of a vessel, and because shore nesting birds typically nest greater that 1 foot (0.3 meter) above the highest tide level, effects of vessel wakes on nesting birds would be negligible.

<u>Propwash</u>. Although the amount of propwash in alternative 3 would be higher than that occurring in alternative 1 (because of the increase in the total number of use days), any effects of propwash would still be minor.

<u>Fuel spills</u>. Alternative 3 would allow more seasonal-use days for cruise ships than would alternative 1. This increase in use days would result in a higher overall probability of significant effects of fuel pollution than alternative 1; although the probably of a large spill would be low. Any effects of fuel pollution on breeding seabirds, therefore, would be minor to moderate, but would be major if a large spill occurred. Overall risks of a spill are predicted to be slightly greater than risks for alternative 1.

<u>Bird/vessel collisions.</u> The potential increase in vessel traffic relative to alternative 1 would result in an increase in bird/vessel collisions.

Cumulative effects on marine birds and raptors — alternative 3 — Other actions that may effect birds are the same as described for alternative 1, and include disturbance of nesting birds, molting waterfowl, foraging murrelets, and all other marine birds and raptors. Cumulative actions include foot traffic, non-motorized vessels (especially kayaks), and vessel traffic from administrative vessels, including research vessels, helicopters and aircraft, and non-motorized vessels (kayaks) landing near seabird (mew gull and Arctic tern) colonies on glacial outwash plains.

Considered collectively with the direct and indirect effects of alternative 3, the above actions would result in a total greater sum of disturbance, but effects are still expected to be moderate, with populations of birds expected to remain healthy and no large areas (such as an inlet) being avoided or abandoned by one or more species. The overall effect is considered moderate.

Impairment analysis for marine birds and raptors — alternative 3 — Overall effects would be moderate because of some reduction of local populations, but the effects on marine birds and raptors are not expected to result in an impairment of park resources.

Conclusion, marine birds and raptors — alternative 3 — Based on the previous analysis, alternative 3 would have minor effects on most bird species. Vessel disturbance would have moderate effects on black oystercatchers, tufted puffins, breeding seaducks, and molting waterfowl. Fuel spills would have minor effects on seabirds, black oystercatchers, and seaducks and moderate to major effects on molting waterfowl, depending on the amount of fuel spilled and its location; however, the probability of a spill is low. The overall effects of vessel disturbance and vessel noise and from fuel spills would be slightly greater than those identified for alternative 1.

Alternative 4 – Effects on Marine Birds and Raptors.

Direct and indirect effects on marine birds and raptors — alternative 4 —

<u>Vessel disturbance</u>. Because vessel disturbance is assumed to be a dose–response relationship, it is assumed that the overall amount of disturbance to marine birds and raptors in alternative 4 would decline from that in alternative 1. Any effects of vessel disturbance would be considered minor for seabird colonies, and effects to murrelets on the water would be moderate, because areas of concentration would have moderate effects if vessel traffic were high. Because effects of disturbance on bald eagles are expected to be negligible or minor, this alternative would comply with the Bald Eagle Protection Act. Effects for other marine birds and raptors would be minor.

<u>Vessel wakes</u>. As explained under the effects analysis for alternative 1, because the largest vessel wakes expected in either Glacier Bay or Dundas Bay are less than 1 foot (0.3 meter) high, and because shore nesting birds typically nest greater that 1 foot (0.3 meter) above the highest tide level, effects of vessel wakes on nesting birds would be negligible.

<u>Propwash</u>. The amount of propwash in this alternative would be higher than that occurring in alternative 1 due to the increase in private vessels, which tend to have more effects since they travel closer to shore and they are present in greater quantity than any other vessel.

<u>Fuel spills</u>. Alternative 4 would allow fewer use days than alternative 1. This decrease in use days would result in a slightly lower overall probability of significant effects of fuel pollution than alternative 1. Any effects of fuel pollution on breeding seabirds, therefore, would be minor because the probability of a fuel spill is low.

<u>Bird/vessel collisions.</u> The decrease in vessel traffic would result in a decreased potential for bird/vessel collisions.

Cumulative effects on marine birds and raptors — alternative 4 — Other actions that may affect birds are the same as described for alternative 1, and include disturbance of nesting birds, molting waterfowl, foraging murrelets, and all other marine birds and raptors. Cumulative actions include foot traffic, non-motorized vessels (especially kayaks), and vessel traffic from administrative vessels, including research vessels, helicopters and aircraft, and non-motorized vessels (kayaks) landing near seabird (mew gull and Arctic tern) colonies on glacial outwash plains.

Impairment analysis for marine birds and raptors — alternative 4 — Overall effects would be moderate because of some reduction of local populations, but the effects on marine birds and raptors are not expected to result in an impairment of park resources.

Conclusion, marine birds and raptors — alternative 4 — Under alternative 4, overall effects of vessel disturbance and vessel noise would be lower than in alternative 1, with moderate effects on tufted puffin and marbled murrelet concentrations. Effects for other marine birds and raptors would be minor. The effects of a large fuel spill would be minor since the probability of a spill is low. As with all alternatives, effects from propwash and wakes would be negligible.

Alternative 5 – Effects on Marine Birds and Raptors.

Direct and indirect effects on marine birds and raptors — alternative 5 —

<u>Vessel disturbance</u>. Because alternative 5 allows the most use days for private vessels, the overall amount of disturbance to seabirds would be moderate and effects to murrelets on the water would be moderate, especially for areas of concentration if vessel traffic is high. The higher private vessel traffic, especially within the murrelet and vessel concentration area of Sitakaday Narrows, may cause sufficient disturbance to reduce foraging areas and/or efficiency and, therefore, reproductive success. Disturbance to breeding waterfowl would increase, since private vessel traffic may increase in remote bays or inlets currently used by molting waterfowl.

<u>Vessel wakes</u>. As explained under the effects analysis for alternative 1, because the largest vessel wakes expected in either Glacier Bay or Dundas Bay are less than 1 foot (0.3 meter) high, and because shore nesting birds typically nest greater that 1 foot (0.3 meter) above the highest tide level, effects of vessel wakes on nesting birds would be negligible.

<u>Propwash</u>. The amount of propwash in this alternative would be higher than that occurring in alternative 1 because of the increase in the number of use days. Charter and private and vessels, particularly ones small enough to enter shallow waters, stir up fine sediments when maneuvering near shore. Because this alternative allows for more private vessel use days, the number of incidents when propwash occurs would increase. The extent of this would be isolated and temporary, so the overall effect would be minor.

<u>Fuel spills</u>. This alternative would allow more use days than would alternative 1. This increase in use days would result in a higher probability of significant effects from fuel pollution than alternative 1. However, the overall effect is minor because the probability of a fuel spill is low.

<u>Bird/vessel collisions.</u> The potential increase in vessel traffic relative to alternative 1 would result in an increase in bird/vessel collisions.

Cumulative effects on marine birds and raptors — alternative 5 — Other actions that may affect birds are the same as described for alternative 1. Considered collectively with the direct and indirect effects of alternative 5, the above actions would result in a total greater sum of disturbance. With the increase of private vessels, molting waterfowl could abandon areas, and therefore effects are considered to be moderate. Cumulative effects add incrementally to these effects but not to the point of changing primary conclusions.

Impairment analysis for marine birds and raptors — alternative 5 — Overall effects would be moderate because of some reduction of local populations, but the effects on marine birds and raptors are not expected to result in an impairment of park resources.

Conclusion, marine birds and raptors — alternative 5 — Effects of vessel disturbance would be considered moderate for seabird colonies and effects to murrelets on the water would be moderate, especially for areas of concentration if vessel traffic is high. Higher traffic, especially within the murrelet and vessel concentration area of Sitakaday Narrows, may actually cause sufficient disturbance to reduce foraging areas and/or efficiency and, therefore, reproductive success. Effects on breeding waterfowl would be similar, (moderate) but greater than alternative 1, since private vessel traffic may increase in remote bays or inlets currently used by molting waterfowl, thereby causing these birds to abandon use of these areas during molting. As with the other alternatives, effects from propwash and wakes would be negligible.

Alternative 6 – Effects on Marine Birds and Raptors.

*Direct and indirect effects on marine birds and raptors — alternative 6 —*As with alternative 3, alternative 6 would allow the potential for cruise ship increases up to 184 from June through August. The effect on marine birds and raptors would be increased disturbance due to cruise ship passage up the Bay, particularly in Sitakaday Narrows, where murrelet and other marine birds are common.

Since cruise ships tend to travel in mid-channel, most effects would be to foraging birds. Molting waterfowl would not likely be affected, since they tend to frequent the quiet bays not visited by cruise ships.

Alternative 6 would also have the potential for more private vessels. This would increase potential disturbance to murrelets and molting waterfowl.

Placement of seasonal quotas on Dundas Bay for charter vessels and daily quotas for tour vessels would reduce disturbance of murrelets and brooding harlequin ducks from what would occur under the current situation of no quotas.

Cumulative effects on marine birds and raptors — alternative 6 — Cumulative effects would be the same as described under alternative 1. The incremental effects on marine birds caused by alternative 6 are not likely to result in significant cumulative effects.

Impairment analysis for marine birds and raptors — alternative 6 — Alternative 6 would not result in impairment of marine birds or raptors for the same reasons described previously for alternative 1.

Conclusion, marine birds and raptors – alternative 6 — Overall effects of disturbance of murrelets and molting waterfowl would increase due to increased private vessel numbers and potentially increased cruise ship numbers. Overall effects are considered moderate for murrelets, colonial nesting birds, and molting waterfowl.

Summary, Marine Birds and Raptors. All of the alternatives would result in moderate level effects on marine birds and raptors. The most notable effects would be disturbance of concentration areas of brood-rearing harlequin ducks, molting waterfowl, and foraging marbled and Kittlitz's murrelets. These species are particularly sensitive to vessel traffic and are expected to experience potential local population declines if continually disturbed by vessels. Existing regulations which specify approach limits in certain sensitive areas, would continue to provide protection to seabird colonies.

The level of disturbance is related to vessel numbers. The ultimate effect of this disturbance could be reduced energy intake (e.g., feeding) and/or increased energy expenditure (e.g. vessel avoidance behavior). Most wild animals operate under an extremely tight energy budget. Such energy budgets can become critical during high-energy demands, such as breeding, pregnancy, caring for young, molting, or during bouts of extreme weather. Animals subject to repeated disturbances might have lower energy reserves and consequentially lower reproduction and/or survival. Private vessels are the most likely to disturb marine birds, since these vessels travel widely throughout Glacier Bay, tend to travel closer to the shoreline than other vessel types, and are the most numerous. Alternatives 5 and 6 would allow the most private vessels and associated effects. This effect is still considered within the moderate range.

4.3.4 Marine Fishes

Issues of Concern Raised during Scoping. Specific concerns from the public regarding marine fish include:

- Noise and vibration from vessels could disturb, harm, or reduce marine fish populations.
- Airborne contaminants from ship stacks could be deposited in the marine environment and enter the marine food chains through ingestion or dermal contact.
- The presence of artificial light from vessels could alter behavior of marine fauna.
- Waves generated by wakes and propwash could increase turbidity, affecting the intertidal environment.
- Increases in unauthorized releases of ballast water could introduce invasive species into the marine environment.
- Invasive species could enter Glacier Bay on the hulls of cruise ships.

Regulatory Framework.

Federal Regulations — The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act; 16 USC § 1801-1882) establishes U.S. management authority over all fishing within the 200-mile (322-kilometer) Exclusive Economic Zone (EEZ), all anadromous fish throughout their migratory range, and all fish on the continental shelf. Additionally, the act mandates that eight regional fishery management councils be established to develop and prepare fishery management plans (FMPs) for the responsible management of exploited fish and invertebrate species in their regions.

When Congress reauthorized this act in 1996, the National Marine Fisheries Service was required to designate and conserve essential fish habitat (EFH) for species managed under existing fishery management plans. “Essential fish habitat,” as defined in the Magnuson-Stevens Act, includes “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” Essential fish habitat is being addressed through consultation with the National Marine Fisheries Service.

State of Alaska Regulations — The National Park Service and Alaska Department of Fish and Game maintain a Master Memorandum of Understanding related to fish and wildlife management in Alaska National Parks.

Currently, the state of Alaska and the U.S. are litigating the title to tide and submerged lands within the National Park and Preserve, and the case is before the U.S. Supreme Court (*Alaska v. United States*, No. 128, Original).

Methodology and Assumptions. Impacts on fish were determined based on a review of existing conditions, as reported in chapter 3, as well as a review of the literature and other information pertaining to the effects of vessel traffic on fish.

Table 4-18 lists the threshold criteria used to evaluate impacts.

TABLE 4-18: THRESHOLD CRITERIA FOR EFFECTS ANALYSIS ON MARINE FISHES

Negligible	No observable changes in marine fish distribution or abundance in Glacier Bay or Dundas Bay related to motorized vessel passage would occur.
Minor	Fish species would leave or avoid areas with excessive noise, contaminants, or fuel spills for the duration that the stressor would be present (e.g., as a vessel passes).
Moderate	Fish species would continuously avoid areas with excessive noise, contaminants, or fuel spills, even when the stressor was not present.
Major	Fish populations would decrease to the point that natural processes are altered and there would be continuous avoidance of areas with excessive noise contaminants, or fuel oil spills, even when the stressor was not present.

Alternative 1 (No Action) – Effects on Marine Fishes.

Direct and indirect effects on marine fishes — alternative 1 — Vessel traffic is not expected to significantly affect fish populations, and effects are predicted to be within the minor category for all alternatives, as defined in table 4-18.

<u>Noise and vibration.</u> Vessel traffic is known to disturb fish, primarily from noise and vibration. Noise has a greater effect on fishes with a swim bladder, because the bladder increases the fishes' sensitivity to noise (Enger and Anderson 1967). Fishes with swim bladders, called pelagic species, swim in the open water column. Fishes without swim bladders are called demersal, and typically live on or near the bottom. Pelagic fishes in Glacier and Dundas Bays are described in section 3 and include sand lance, capelin, walleye pollock, Pacific herring, and salmon. Demersal fishes include halibut, cod, rockfish.

Each vessel passage likely disrupts or displaces individual fish or schools of fish in Glacier and Dundas Bays. Cruise ships are the loudest vessel type in most frequencies throughout Glacier Bay, and therefore likely produce the greatest changes in fish behavior. All motorized vessels create noise and vibrations that likely cause reduced hearing ability and numerous avoidance behaviors in fish, such as schooling, startling, and fleeing (Scholik and Yan 2002, Pearson et al. 1992).

Based on fish distribution data from recent studies, fish are relatively abundant where vessel traffic occurs. Beach seine sampling conducted throughout Glacier Bay found higher numbers of fish in the lower Bay, where vessel traffic is concentrated, than farther up the Bay (Robards et al. 1999). Along the exposed western shoreline of Young Island, an area that receives some of the highest vessel traffic in Glacier Bay, fish populations were found to have the highest relative abundance in Glacier Bay, with only one site at the north end of the Beardslee Islands group having a higher catch. The largest pelagic catches were from Sitakaday Narrows, near the mouth of Glacier Bay, and in the middle Bay near Sebree Island (Litzow et al. 2002), areas where vessel traffic is relatively high. The Sitakaday Narrows station is similar to the beach seine study and located in the area most heavily used by vessels in Glacier Bay. Another study by Hooge and Taggert (1996) identified the movements of individual halibut, a demersal fish. The perimeters of individual home ranges for these fish were found to include high vessel use corridors.

The abundance of forage fish found along the shorelines and offshore at the entrance to Glacier Bay, where all vessel traffic passes, indicates that fish continue to inhabit waters within the planning area despite existing vessel traffic. Also supporting this conclusion is the presence of forage fish and halibut in another noisy environment — the middle portion of Glacier Bay, which is close to the cruise ship corridors. By inference, it appears that although the existing underwater noise environment associated with vessel passage could cause fish species or groups to temporarily avoid the area, there is probably no long-term avoidance effect.

However, this does not mean that vessel traffic has no effect on marine fishes. In fact, the data show that vessel traffic occurs where the highest concentration of fish occurs. Therefore, it is expected that fish are regularly disturbed by vessel traffic. It is also possible, although there is no way of knowing, that fish abundance might be higher in these areas without vessel traffic.

Recreational fishing and crabbing. Visitor activities in Glacier and Dundas Bays include recreational fishing and crabbing. Dundas Bay is a popular location to set crab pots while exploring the Bay. Salmon and halibut are also regularly fished for in both Dundas and Glacier Bays. These activities result in direct mortality to fishes, but probably not a significant reduction in abundance or population size. Most fishing occurs on charter and private vessels. Under alternative 1, use in Dundas Bay by charter vessels might substantially increase, particularly on peak use days when vessels go to Dundas Bay to escape winds or when fishing is particularly good. This would increase recreational fishing pressure. Certain specific locations, with high utilization by sport fishermen, possibly could see decreases in fish abundance, especially halibut. However, recreationally important fishes remain relatively abundant, and recreational fishing is not expected to have a significant impact on fish abundance; therefore, the effect is negligible.

Fuel spills. Fish may be adversely affected by other aspects of these alternatives, including fuel or contaminants that may be discharged from vessels. Generally, diesel fuel spills have little effect on fish species, as fuel floats on the water surface. The limited water-soluble fraction from diesel fuel could contaminate the water column for a short time. A large proportion of the diesel would evaporate over one or two days (Kennicutt and Sweet 1992). The effects of diesel fuel spills would, therefore, likely to cause little damage to fish.

Vessels discharge small quantities of toxins. Fish could contact or ingest these chemicals. However, based on the relatively good water quality reported for Glacier Bay, and the high volume of mixing that occurs, adverse effects to marine fish would be localized to the point of discharge. Effects would depend on the chemical discharged, but include morbidity or mortality, or fish could avoid an area with diminished water quality. Since the effect would be localized, the effect would be minor. These effects would be consistent across all alternatives. The effects of a potential fuel or contaminant spill to water quality and the risk of it occurring are described in sections 4.2.3 and 4.4.3.

Airborne contaminants. The air quality effects analysis determined that ambient air quality under all alternatives would not be considered harmful to human health or the environment (see section 4.2.2) and, therefore, are not considered to be at a level sufficient to harm fish health and are not addressed further in this section.

Artificial light. Artificial light is of little concern to fishes. Artificial light associated with vessels could attract fish and/or fish predators, and extend feeding periods. However, because day length is long during the visitor use season (a maximum of 18 hours per day in June and a minimum 13 hours per day in September), the effect of artificial light on marine fishes would be negligible under all alternatives. It will not be discussed further in this section.

Vessel wakes. Waves increase turbidity (suspended sediments) along the shorelines. Two sources of waves include vessel wakes and waves generated by wind. Turbidity caused by vessel wakes is not as likely to occur as is turbidity resulting from naturally occurring wind waves (see appendix G). Vessel wakes do not directly disturb open water communities because natural waves are commonplace in these areas. The effect of turbidity on fish includes a temporary reduction of hunting success for visual predators and feeding rates decrease. Overall effects of turbidity on fish would likely be negligible and are not discussed further.

Propwash. Propwash may mix the surface water deeper into the water column. This would not appreciably change the pelagic environment. Fishes are capable of quickly adjusting their depth if altered by the turbulence of propwash. The effect of propwash on fishes would likely be negligible because most fish would exhibit avoidance behavior around props. Therefore, propwash will not be discussed further.

Cumulative effects on marine fishes – alternative 1 — Marine fish resources that use Glacier and Dundas Bays were considered in the analysis of cumulative effects. Past, present, and reasonable foreseeable future actions considered include administrative and commercial fishing vessel traffic, commercial fishing within Glacier and Dundas Bays, commercial and sportfishing outside of Glacier and Dundas Bays, and natural phenomena.

Administrative and commercial fishing vessel traffic contribute vessel noise and disturbance that could disrupt fish behavior. Research activities include many fish captures, sampling, tagging, and other research activities.

Commercial fishing has perhaps the greatest direct effect on fish populations. Icy Strait and the outside waters are heavily fished. Commercial fishing in Glacier Bay catches fishes from Glacier Bay. However, commercial fishing in Glacier Bay is expected to eventually cease over the next few decades. Commercial fishers would fish immediately adjacent to and along the park boundary to target species migratory to and from the park. This could have implications on migratory species. The state of Alaska and NOAA Fisheries manage commercial fishing in different portions of Glacier National Park Preserve. Their actions affect fish populations throughout Alaska, along with the closely tied socioeconomic conditions related to commercial fishing and processing.

Vessel activity outside Glacier Bay and Dundas Bay directly reduce fish populations through commercial and sport-fishing catches. Increases in recreation and human population may increase pressure on fish resources through commercial and sport fishing.

Natural phenomena, such as global warming and long-term fluctuations in North Pacific water temperatures (often referred to as decadal shift), may change the structure of fish communities. Changes in kelp density by sea otters may change some fish populations in Glacier Bay and Dundas Bay. Otter predation may limit sea urchin populations, allowing more kelp growth. This, in turn, would provide more habitat for some fish species, potentially increasing populations. Globally, fisheries are declining, but fluctuate with global climate changes.

The contribution of effects of alternative 1 on fish is considered to be minor. The effects of these other activities on fish resources in Glacier and Dundas Bays are much greater in scope than those caused by alternative 1. The incremental contribution of alternative 1 to other effects on marine fish resources in Glacier and Dundas Bays from past, present, and reasonably foreseeable future actions is considered to be negligible.

Impairment analysis for marine fishes — alternative 1 — The potential effects to marine fish of implementing alternative 1 would be minor, therefore, this alternative would not impair marine fishes.

Conclusion, marine fishes — alternative 1 — Vessel traffic is expected to regularly disturb fish by creating noise and vibration. However, since it appears that fishes remain relatively abundant in areas with relatively heavy vessel traffic. Vessel discharge could cause localized morbidity or mortality or could cause fish to avoid an area. The overall effect is considered minor. No evidence suggests that vessel traffic in Glacier or Dundas Bays significantly harms fish populations or causes them to avoid habitat. The contribution of implementation of alternative 1 to cumulative effects on marine fish resources is negligible. Alternative 1 would not result in impairment of marine fish resources.

Alternative 2 – Effects on Marine Fishes.

Direct and indirect effects on marine fishes – alternative 2 — From June through August, alternative 2 would reduce vessel traffic from June 1 to August 31. Vessel operating requirements are the same as those in alternative 1. The decrease in cruise ship, charter vessel, and private vessel entries over the June 1 to August 31 season would decrease displacement or disruption of fishes, relative to alternative 1. The decrease in charter and private vessel entries in this alternative could lead to a reduction of fish harvested from Glacier and Dundas Bays. Overall, the effects of implementation of alternative 2 to marine resources would decrease compared to alternative 1, but the effects would continue to be minor because noise and vessel discharge could cause fish to avoid or leave an area.

Cumulative effects on marine fishes – alternative 2 — The effects of implementation of alternative 2 in conjunction with the past, present, and reasonably foreseeable actions described in alternative 1 is negligible with respect to the effects of these other actions.

Impairment analysis for marine fishes — alternative 2 — The potential effects to marine fish of implementing alternative 2 would be minor, therefore, this alternative would not impair marine fish.

Conclusion, marine fishes — alternative 2 — Underwater noise, vibrations, and discharges caused by vessels under alternative 2 would temporarily disturb or displace fish, but these effects would decrease compared to alternative 1. The overall effect is considered minor. The contribution of implementation of alternative 2 to other past, present, or reasonably foreseeable actions is negligible. Alternative 2 would not result in impairment to marine fish resources.

Alternative 3 – Effects on Marine Fishes.

Direct and indirect effects on marine fishes – alternative 3 — Alternative 3 would allow the same amount of vessel traffic from June 1 to August 31 as alternative 1, with the potential for increased cruise ship entries. Vessel operating requirements are the same as those in alternative 1. The potential increase in cruise ship entries over the June 1 to August 31 season would increase displacement or disruption of fishes. Sportfishing from charter and private vessels would be the same as alternative 1. Overall, the effects of implementation of alternative 3 to marine fish resources would increase compared to alternative 1, but the effects would continue to be minor because noise and vessel discharge could cause fish to avoid or leave an area.

Cumulative effects on marine fishes – alternative 3 — The effects of implementation of alternative 3 in conjunction with the past, present, and reasonably foreseeable actions described in alternative 1 is negligible with respect to the effects of these other actions.

Impairment analysis for marine fishes — alternative 3 — The potential effects to marine fish of implementing alternative 3 would be minor, therefore, this alternative would not impair marine fish.

Conclusion, marine fishes — alternative 3 — Vessel generated underwater noise, vibrations, and discharges under alternative 3 would temporarily disturb or displace fish and increase compared to alternative 1; however, the overall effect is considered minor. The contribution of implementation of alternative 3 to other past, present, or reasonably foreseeable actions is negligible. Alternative 3 would not result in impairment to marine fish resources.

Alternative 4 – Effects on Marine Fishes.

Direct and indirect effects on marine fishes – alternative 4. Vessel traffic would decrease under alternative 4 and speed limits would be imposed on all vessels. However, private vessel entries would increase. In addition, cruise ships and tour vessels would be excluded from Dundas Bay. The decrease in cruise ship, tour vessel, and charter vessel entries from May until the end of September would reduce displacement or disruption of fishes, relative to alternative 1. Sportfishing from charter vessels could decrease, but this decrease could be offset by the increase in private vessel entries. Overall, the effects of implementation of alternative 4 to marine fish resources would decrease compared to alternative 1, but the effects would continue to be minor because noise and vessel discharges could cause fish to avoid or leave an area.

Cumulative effects on marine fishes – alternative 4 — The effects of implementation of alternative 4 in conjunction with the past, present, and reasonably foreseeable actions described in alternative 1 is negligible with respect to the effects of these other actions.

Impairment analysis for marine fishes — alternative 4 — The potential effects to marine fish of implementing alternative 4 would be minor, therefore, this alternative would not impair marine fish.

Conclusion, marine fishes — alternative 4 — Vessel-generated underwater noise, vibrations, and discharges under alternative 4 would temporarily disturb or displace fish, but these effects would decrease compared to alternative 1; however, the overall effect is considered minor. The contribution of implementation of alternative 4 to other past, present, or reasonably foreseeable actions is negligible. Alternative 4 would not result in impairment to marine fish resources.

Alternative 5 – Effects on Marine Fishes

Direct and indirect effects on marine fishes – alternative 5 — Vessel traffic would be the same as alternative 1. Speed limits would be imposed on all vessels in certain areas. In addition, cruise ships would be excluded from Dundas Bay and tour vessels would be restricted to the non-wilderness waters of Dundas Bay. As discussed in alternative 1, fishes would be disrupted or displaced by all vessels, but the effect would increase with the increase in potential private vessel entries. Sportfishing from charter vessels would remain the same, but sportfishing from private vessels would increase. Overall, the effects of implementation of alternative 5 to marine fish resources would increase compared to alternative 1 and the effects would continue to be minor because noise and vessel discharges could cause fish to avoid or leave an area.

Cumulative effects on marine fishes – alternative 5 — The effects of implementation of alternative 5 in conjunction with the past, present, and reasonably foreseeable actions described in alternative 1 is negligible with respect to the effects of these other actions.

Impairment analysis for marine fishes — alternative 5 — The potential effects to marine fish of implementing alternative 5 would be minor, therefore, this alternative would not impair marine fish.

Conclusion, marine fishes — alternative 5 — Vessel-generated underwater noise, vibrations, and discharges under alternative 5 would temporarily disturb or displace fish and increase compared to alternative 1; however, the overall effect is considered minor. The contribution of implementation of alternative 5 to other past, present, or reasonably foreseeable actions is negligible. Alternative 5 would not result in impairment to marine fish resources.

Alternative 6 – Effects on Marine Fishes.

Direct and indirect effects on marine fishes – alternative 6 — Vessel traffic would be the same as alternative 1 with a potential for an increase in cruise ship and private vessel entries, speed limits would be imposed on all vessels in certain areas. In addition, cruise ships would be excluded from Dundas Bay and tour vessels would be restricted to the non-wilderness waters of Dundas Bay. Fish would be disrupted or displaced by all vessels, but the effect would increase with the increase in potential cruise ship and private vessel entries. Sportfishing from charter vessels would be consistent with alternative 1, but sportfishing from private vessels would increase. Overall, the effects of implementation of alternative 6 to marine fish resources would increase compared to alternative 1, but the effects would continue to be minor because noise and vessel discharges could cause fish to avoid or leave an area.

Cumulative effects on marine fishes – alternative 6 — The effects of implementation of alternative 6 in conjunction with the past, present, and reasonably foreseeable actions described in alternative 1 is negligible with respect to the effects of these other actions.

Impairment analysis for marine fishes — alternative 6 — The potential effects to marine fish of implementing alternative 6 would be minor, therefore, this alternative would not impair marine fish.

Conclusion, marine fishes — alternative 6 — Vessel generated underwater noise, vibrations, and discharges under alternative 6 would temporarily disturb or displace fish and increase compared to alternative 1; however, the overall effect is considered minor. The contribution of implementation of alternative 6 to other past, present, or reasonably foreseeable actions is negligible. Alternative 6 would not result in impairment to marine fish resources.

Summary, Marine Fishes. Effects on marine fish are expected to be minor for all alternatives. Vessel traffic under any of the alternatives would generate underwater noise and vibration that temporarily displace or disturb fish. The degree of displacement or disturbance would depend on the volume of vessel traffic. Implementation of alternatives 2 and 4 would decrease the overall vessel traffic relative to alternative 1 and therefore the disturbance of fish would decrease. Alternative 3 and 6 would increase the number of cruise ship entries could result in an increased displacement or disruption of fish.

The increases in private vessel seasonal-use days under alternatives 4, 5, 6 could result in more sport fishing and therefore increased fish catch and reducing local abundance of species such as halibut.

4.3.5 COASTAL/SHORELINE ENVIRONMENT AND BIOLOGICAL COMMUNITIES

4.3.5 Coastal/Shoreline Environment and Biological Communities

This section evaluates the probable effects of implementing the alternatives on coastal communities in Glacier Bay and Dundas Bay. There is no regulatory framework for this section, since there are no regulations for coastal communities that are related to the potential effects of the alternatives.

Issues Raised during Scoping Process. Other issues raised by the public concerning coastal communities include the following:

- Vessel wakes could erode portions of the shoreline.
- Traffic at popular drop-off locations could be changed, resulting in increased physical disturbances and disturbance of intertidal communities.
- Waves could alter the behavior of terrestrial mammals that feed, roam, or sleep on the shoreline.
- Increases in unauthorized releases of ballast water could introduce invasive species into the marine environment in the park.
- Invasive species could enter the park on the hulls of cruise ships.

Methodology and Assumptions. The primary effects from cruise ships on the coastal environment in the park are physical disturbance from motorized vessel wake/waves and from vessel landings.

Bilge water and attachment to the hulls of vessels are potential vectors for invasive species. An extensive study in the Port of Valdez (Hines and Ruiz 2000) found 15 invasive species, with none of them having reached a post-larval stage. As with the Port of Valdez, there is a potential for introductions to occur in the park's waters, however, the potential appears to be very small. Compliance with existing controls on bilge water discharge would eliminate the medium for the introduction of invasive species. The potential for importation of invasive species on ship or other vessel hulls is not known, but the evidence from the Port of Valdez suggests that it is very minor.

Concerns regarding ballast water discharge into Glacier Bay or Dundas Bay will not be treated in this analysis because ballast water is not discharged in the Bays. Ballast water is taken on by ships to maintain sufficient stability when empty. Tankers and cargo ships typically take on ballast before ocean crossings, and discharge it before fueling or taking on cargo. When cruise ships or other vessels enter Glacier Bay and Dundas Bay they have less fuel and other materials than when they started their journey, and they are not likely to take on fuel while in the park, so they have no need to discharge ballast. Since there is no ballast water discharge, the potential for invasive species importation does not exist for this vector.

At this time, the only known invasive marine species that is found in Glacier Bay and Dundas Bay is the softshell clam (*Mya areanaria*) (Carlton 1992). Carlton (1992) and O'Clair and O'Clair (1998) explain that it was likely first brought to the west coast of the U.S. along with oyster spat destined for San Francisco Bay, possibly as early as the 1850s. From there the clam spread north, reaching Southeast Alaska in the 1950s. The method of expansion is not known.

A key part of the evaluation of wake-related effects to the shoreline and associated biological community was the evaluation of the physical effects to the coastline habitat (see appendix G). The technical memorandum in appendix G provides a detailed methodology for analysis of vessel wake effects on the shoreline that is applied to all sites and used for all alternatives, as well as the results for each alternative.

Physical environment — The primary potential effect to the coastline from implementation of all the alternatives is erosion. Substrate erosion could make the physical environment unsuitable for use or habitation by wildlife. Erosion induced by vessel wakes is a function of 1) the proximity of the vessel to the shore and 2) the vessel's speed. Although vessel displacement is a factor at the vessel itself, within 500 feet (152 meters) from the vessel, displacement has no effect on the height of the wake.

The analysis used examined vessel wakes 500 feet (152 meters) from the vessel. Any loss of material from erosion is of greatest concern when material is not available from another source to replenish the material that was lost. Since erosion also occurs in natural systems, it first must be determined whether the erosion is due to vessel wakes or is a naturally occurring phenomenon. A coastal geomorphological analysis was used to identify those coastal areas most likely to be affected by vessel wakes. This analysis determined the potential of a vessel wake to erode the shoreline at a faster rate than under background conditions taking into account the composition of the shoreline. These data then were compared to determine which intertidal communities would be affected, the extent of the effects, and the lateral distance of the effects.

A literature search was conducted to identify any existing evaluation models that were directly applicable to this project. Since no models were found to be directly applicable, a model was developed based on the theories underlying several existing models. Twenty-two (22) sites where vessels travel within 2,000 feet (610 meters) of the shoreline were identified. Research indicated that the wakes produced from vessels traveling at distances greater than 2,000 feet (610 meters) from the shore do not affect the shoreline. For each site, the wave climatology was developed. The wave climatology describes the natural level of impact from natural wind waves over a one-year period at a site. A site-specific energy index was calculated by comparing the energy generated by vessel wakes to natural wind waves. This index was used to discern the effect due to natural wind wave energy from the effect due to vessel wakes and to compare different sites with different wave climatologies.

A model was derived from existing models and information that used a “design wake,” which captures the wake characteristics of all vessels that may use Glacier Bay. The wake height, and thus the energy of the wave *at the vessel*, depends on vessel draft (depth, also referred to as displacement) and vessel speed through the water. A larger vessel produces a larger wake *at the vessel* than a smaller vessel when they are both traveling at the same speed. Vessel wakes dissipate in energy as they travel away from the vessel track. Research shows that all vessels have an approximately 1-foot (0.3-meter) wake 500 feet (152 meters) from the vessel when the vessel is traveling at 10 knots and that maximum wave height is achieved at a speed of 10 knots. The model assumes a 1-foot (0.3-meter) wake 500 feet (152 meters) from the vessel track since vessels typically are greater than 500 feet (152 meters) from shore when traveling at speeds around 10 knots. This is considered a “safe” assumption because vessels typically travel at distances greater than 500 feet (152 meters) from shore when at cruising speeds.

It is also important to understand that the model is not sensitive to what may be perceived as large increases in vessels. The model provides a comparison between the natural wind wave climate and the number of waves generated by vessels. The natural wind wave climatology looks at a full year of effects at each specific beach. The orientation of the beach to the wind is a significant factor in determining the beach-specific wind wave climatology. The model then looks at the number of vessels passing within 2,000 feet of the specific beach. This distance is used as an estimate of the vessels’ distance for all the alternatives at a specific beach. The analysis for each alternative examines the number of vessels allowed according to the permits and estimates how many are likely to pass within 2,000 feet of the specific beach. This number is converted into the number of waves each vessel would produce and compared to the number of waves expected to be produced naturally. This ratio provides the basis for the ranking of negligible, minor, moderate, and high for vessel wakes.

The erosion potential of the 22 sites was assigned using substrate composition and beach slope data (Sharman et al. 2002; see figure 3-11). Sites were selected by examining vessel track data supplied by the Park Service and choosing locations where vessels traveled within 2,000 feet (610 meters) of the shoreline. Each site also was assigned a vessel wake energy index. A beach with moderate erosion potential (sediments) that was not affected by a significant number of vessel wakes would have negligible potential for erosion. Conversely, if the same site was affected by an increase in the number of vessel wakes (meaning more vessels are traveling within 2,000 feet [610 meters] of the shoreline at that site), there would be an increased potential for erosion; however, a site with negligible erosion potential (rocky substrate) that is subject to a large number of vessels traveling within 2,000 feet (610 meters) of the shoreline would not be potentially affected by those wakes since the substrate is resistant to erosion.

It is important to note that this evaluation examined energy over a one-year period and may not provide all the information necessary to evaluate a site during a specific season. For example, shore-nesting birds may build nests close to the high tide line. In general, waves would not swamp a nest during the typical nesting season; however, a nest could be swamped due to wakes if there is a high tide (or spring high tide) concurrent with a vessel traveling close to the shoreline. It also is possible for a nest to be swamped in a natural setting if there was a summer storm at the same time as a high tide. The analysis was conducted for two time periods: June through August (the summer season), and May and September, to account for the shoulder season.

Analysis of Dundas Bay is limited to a general evaluation of the likely affects. Data collection and mapping of substrate types was completed in the fall of 2002. Dundas Bay tends to have finer sediments and larger sandy beach areas than Glacier Bay. Dundas Bay has not been under the influence of glaciers for approximately 800 years, and therefore, more closely reflects a system influenced by wind and water than by glaciers. The Outer Waters Vessel Activity Survey provides information on the types of vessels using Dundas Bay in 2001 and 2002, including some place mapping to show ranges of movement. The data are not sufficient to use in the model, but are sufficient to provide an assessment of potential erosion to the shoreline. The current use of Dundas Bay is increasing and mapping indicates that almost the entire bay is used. The main users are private vessels, but use by unclassified vessels (smaller vessels that are motorized and non-motorized), tour vessels, and NPS administrative vessels is showing an upward trend. Commercial fishing vessels also use Dundas Bay.

Biological environment — The primary effect of cruise ship movement on the park's intertidal environment is physical disturbance from motorized vessel wake/waves, which can result in changes in intertidal community structure or the physical removal or crushing of some invertebrates or plant species.

To evaluate the effects to the shoreline biological community from waves, the results of the coastal geomorphological analysis were compared to the existing conditions of the coastal habitats described in the Coastal Resources Inventory, as well as to other intertidal surveys conducted in the park to determine which intertidal communities would be affected, the extent of the effects, and the lateral distance of the effects (Sharman et al. 2002). Consistent with the Coastal Resources Inventory database, a shoreline segment of 0.2 kilometer (0.124 mile) was selected as a measurement unit for analysis. It was assumed, based on professional judgment, that effects to a coastline segment less than 0.2 kilometer long is not likely to have an effect on the functioning of the intertidal coastal ecosystem of Glacier Bay.

Large changes in substrate (losses or deposition) from erosion could affect soft substrate communities by subjecting them to smothering, loss of habitat, or increased loss to predation. Clam population data for soft substrate communities (Bodkin and Kloecker 1999) were used to investigate erosion-caused changes in these communities. Clams are long-lived members of soft or mixed substrate communities. The population data for six species of clams were grouped by location (potential for wave impacts). The data for sites facing open water were further separated into those meeting the criteria defined in the coastal geomorphic analysis as being most likely to be affected by vessel wakes. The population patterns among the three groups were compared to identify effects from vessel wakes.

Threshold criteria — Table 4-19 lists the threshold criteria used in this evaluation to assess the effects to both the physical and biological coastline environment.

TABLE 4-19: THRESHOLD CRITERIA FOR EFFECTS ANALYSIS ON COASTAL/SHORELINE ENVIRONMENT AND BIOLOGICAL COMMUNITIES

Negligible	No readily identifiable change in the vertical zonation patterns or loss of dominant community members would occur. Erosion would be limited to current levels and there would be no physical changes to the coastline.
Minor	Changes to the community structure would be localized (less than 0.2 kilometer [0.124 mile] of continuous shoreline or less than 1.0 kilometer [0.62 mile] of shoreline within a 10-kilometer [6.2-mile] segment of shoreline). Changes would consist of the loss of one dominant community member. Effects would be for two years or less. Erosion would be slightly greater than current levels and there would be no perceptible change to the coastline.
Moderate	Changes to the community structure would be localized (less than 0.2 kilometer [0.124 mile] continuous or less than 1 kilometer [0.62 mile] within a 10-kilometer [6.28-mile] segment of shoreline). There would be a loss of one dominant community member. Effects would last longer than two years. There would be visible changes to the coastline, but they would not be long term due to natural sediment transport of materials from other locations.
Major	Changes to the community structure would occur over a large area (greater than 0.2 kilometer [0.124 mile] continuous or greater than 1 kilometer [0.62 mile] within a 10-kilometer [6.28-mile] segment of shoreline), result in a loss of more than one dominant community member. Effects would last longer than two years. There would be visible changes to the coastline that would not be remedied through natural sediment transport of materials from other locations.

Alternative 1 (No Action) — Effects Analysis on Coastal/Shoreline Environment and Biological Communities.

Direct and indirect effects on coastal/shoreline communities – alternative 1 —

Physical coastline. The potential effects on the physical coastline if alternative 1 is implemented are summarized in table 4-20. Table 1 in appendix H details the overall erosion potential of these sites under alternative 1. These sites are representative of areas most likely to be negatively affected by vessel wakes due to the proximity of the coastline to vessel routes. Site 18, located in Tarr Inlet, potentially could have an overall moderate effect, most likely due to high vessel traffic in this area; this site is a narrow channel with a pebble substrate. The potential, however, may not be realized because it is based on conservative assumptions about vessel traffic in the shoulder seasons. In addition, increased vessel traffic would not change this effect.

TABLE 4-20: COMPARISON OF SIX ALTERNATIVES – POTENTIAL EFFECTS ON THE PHYSICAL COASTLINE AT 22 SITES IN GLACIER BAY NATIONAL PARK AND PRESERVE

Site[1]	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
1	Minor	Minor	Minor	Negligible	Minor	Minor
2	Minor	Minor	Minor	Minor	Minor	Minor
3	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
4	Minor	Minor	Minor	Minor	Minor	Minor
5	Minor	Minor	Minor	Minor	Minor	Minor
6	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
7	Minor	Minor	Minor	Minor	Minor	Minor
8	Minor	Minor	Minor	Negligible	Minor	Minor
9	Minor	Minor	Minor	Minor	Minor	Minor
10	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
11	Minor	Minor	Minor	Minor	Minor	Minor
12	Minor	Minor	Minor	Minor	Minor	Minor
13	Minor	Minor	Minor	Minor	Minor	Minor
14	Minor	Minor	Minor	Minor	Minor	Minor
15	Minor	Minor	Minor	Minor	Minor	Minor
16	Minor	Minor	Minor	Minor	Minor	Minor
17	Minor	Minor	Minor	Minor	Minor	Minor
18	Moderate	Moderate	Moderate	Minor	Moderate	Moderate
19	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
20	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
21	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
22	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

[1]See figure 3-11 for site locations.

Since multiple sites would have minor erosion potentials, the overall potential effect of alternative 1 on the coastal physical environment would be minor.

The amount of vessel use in Dundas Bay under Alternative 1 is not likely to affect the shoreline. However, if all the vessels permitted were to enter Dundas Bay, there could be a significant effect to the shoreline in the form of erosion of the sandy beaches.

<u>Biological coastal environment</u>. The results of the coastal geomorphological analysis indicate that implementation of alternative 1 would not result in erosion that would alter the shoreline, but individual shorelines may experience a greater degree of erosion depending on how close vessels approach the shore, vessel speed, and the beach's substrate. Those intertidal communities occupying the shorelines with the highest erosion potential are the most subject to physical disturbance. In these situations, shore sediments could be resuspended or relocated, uncovering sediment-dwellers and leaving them susceptible to predation; however, invertebrates living in the soft sediments also are subject to these effects from natural wave action. The results of the clam study in Glacier Bay and Dundas Bay (Bodkin and Kloecker 1999) showed no patterns among the clam populations that could be related to vessel wakes.

In addition, the size and frequency of the vessel wakes would be unlikely to change the behavior of shoreline mammals. Under the current vessel management plan, black bears and other smaller mammals are often seen foraging at the water's edge during low tide. Tidal changes are more likely to influence behavior than vessel wakes.

Fuel spills are another source of potential effects to shoreline communities in Glacier Bay and Dundas Bay. The most likely source of a fuel spill is diesel fuel from a grounded or otherwise damaged cruise ship or smaller vessel. The potential for this occurrence is discussed in section, 4.4.3, "Vessel Use and Safety." Diesel fuel is predominantly volatile, so much of it would evaporate from the water surface within two to three days (Kennicutt and Sweet 1992).

The results of monitoring programs at several diesel fuel spills have been followed over time. Mitchell et al. (1970) tracked the effects of a large (60,000-barrel) diesel spill by the *Tampico Maru* in 1957. Approximately one-third of the fuel spilled initially, with the other two-thirds spilling during the following nine months. During a visit to the wreck one month after the grounding, severe mortalities were found in intertidal and shallow subtidal (to 15-foot depths) communities. Mortalities included fishes, mussels, and tidepool inhabitants. At that time, four animal species and 13 plant species were found remaining near the wreck. Algae recolonized the area more rapidly than invertebrates, presumably due to a lack of grazing. Within four years, approximately 90% of the biota had recolonized the area, although abundances of some species appeared low even after 12 years.

In 1989, the *Bahia Paraiso* struck a reef in the Antarctic, spilling approximately 5,300 barrels of diesel fuel. Kennicutt et al. (1991) reported that the effects of the spill were restricted to within a few kilometers of the wreck. The intertidal received the greatest impact, with oiled macroalgae, limpets, birds, and sediments. Clams and fishes were found with oil residues in their guts, believed to have come from contaminated sediments. Visible oil was gone within a few weeks from most shorelines. Macro algae were resilient, with rapid recoveries, some within a matter of days. Limpet losses were approximately 50% after the initial spill. Limpet recovery was only partial after one year, with the greatest recovery along those shorelines receiving the greatest wave impact energy. Sediments appeared to be free of the diesel fuel from the wreck when sampled after one year.

This research indicates that the intertidal environment initially would be profoundly affected by a fuel spill; however, within several years after a fuel spill occurs, recovery would begin to occur; therefore, the effects of a fuel spill would not be permanent if spill cleanup was conducted quickly. Since the probability for a spill or a collision is low (see section 4.4.3, "Vessel Use and Safety"), then the potential effects to the coastal community are negligible.

These analyses indicate that the potential effects of alternative 1 to the biological coastal environment would be negligible. Table 4-21 compares the effects of alternative 1 on both the physical and biological aspects of the park's coastal community with the other alternatives.

TABLE 4-21: COMPARISON OF THE SIX ALTERNATIVES' EFFECTS ON COASTAL COMMUNITY RESOURCES

Effect	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Physical	Minor	Minor	Minor	Minor	Minor	Minor
Biological	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Overall	Minor	Minor	Minor	Minor	Minor	Minor

Cumulative effects to coastal/shoreline communities — alternative 1 — Cumulative effects were evaluated to coastal/shoreline environments of Glacier and Dundas Bays. Current and foreseeable activities other than those related to this alternative that could affect coastal communities, include beaching or landing of vessels, or floatplanes landing on beaches. Vessels usually land along sand or gravel beaches, which are areas of high erosion potential. Cobble, boulder, and bedrock substrates are likely to cause vessel damage, although landings are made along rocky shorelines in Glacier Bay, as well. Regular beaching of vessels can lead to erosion both during the actual beaching and while leaving the site. Vessel beaching and leaving could supplement the degree of erosion occurring from vessel wakes. While the vessels are beached, vessel hulls also may damage invertebrates living in the soft sediments, and strong currents caused by backing a vessel off a beach may resuspend and relocate large amounts of fine sediments. The resuspension and relocation may uncover sediment-dwellers and leave them susceptible to predation; however, the areas involved are small when compared to the size of the park; therefore, the effects to the coastal biological communities would be negligible.

Increasing changes in sea otter populations are another source of disturbance that may add to cumulative effects to shorelines and shallow subtidal areas within Glacier Bay and Dundas Bay. The sea otter population in Glacier Bay has been increasing rapidly (Bodkin et al. 2001). Only five sea otters were counted in 1995. By 2001 the sea otter count was 1,590. Sea otters are known to eat a wide variety of invertebrates, as well as fishes (Riedman and Estes 1988; Kvitek et al. 1993; Kodkin et al. 2001). Common invertebrate prey throughout their range include abalone, crabs, and urchins. They also eat octopus, kelp crabs, snails, mussels, barnacles, scallops, sea stars, chitons, and echurioid worms. Bodkin et al. (2001) list prey from five phyla: sponges, mollusks, peanut worms *(Echiura)*, crustaceans (arthropoda), sea stars, sea cucumbers; and sea urchins *(echinodermata)* and fishes *(chordata)*. Clams were the most commonly eaten prey taken in Glacier Bay and Dundas Bay (Bodkin et al. 2001), as well as in larger areas of Southeast Alaska (Kvitek et al. 1993). The effect of sea otter expansion into Glacier Bay and Dundas Bay is likely causing a decrease in prey item populations and a reorganization of some benthic and intertidal communities. This may include lower numbers of clams and urchins, and increases of some algal species consumed by the urchins. Past actions, such as the glacial retreat, created the shoreline as it is today. No other known activity has attributed to cumulative effects on the coastal/shoreline environment.

The cumulative effects on the coastal environment from implementing alternative 1 in combination with past, present, and reasonable foreseeable actions would be no different from the identified direct effects, and therefore, the effects would be minor.

Impairment analysis for coastal/shoreline communities — alternative 1 — Impairment of the coastal environment would result from a long-term major effect. In this case, impairment would mean the structure of the intertidal community would change over a large area, or there would be a loss of a vertical zonation community, or there would be a loss of more than one dominant community member. In addition, there would be visible changes to the coastline that could not be remedied through natural sediment transport of materials from other locations. The analysis of the potential effects of implementing alternative 1 concluded that the effects would be minor; therefore, alternative 1 would not result in the impairment of coastal community resources.

Another mitigation measure to limit the potential for erosion is to limit the number of permitted vessel beaching locations to those areas where the erosion potential is negligible.

Conclusion, coastal/shoreline environment and biological communities — alternative 1 — The implementation of alternative 1 would have a minor effect on the coastal communities within Glacier Bay, in general and Dundas Bay. Effects would include erosion in areas with high potential for erosion or high vessel traffic but that would not result in alteration of the shoreline. There would not likely be changes to shoreline biological communities. Cumulative effects would not significantly contribute to direct effects to coastal community resources. Moreover, the implementation of alternative 1 would not impair coastal community resources in the park.

Alternative 2 – Effects Analysis on Coastal/Shoreline Environment and Biological Communities.

Direct and indirect effects on coastal/shoreline communities — alternative 2 —

<u>Physical coastline</u>. The erosion potentials of vessel wakes generated under alternative 2 are the same identified for alternative 1 and would be minor to negligible (see table 4-20). Table 2 in appendix H details the overall erosion potential of these sites under alternative 2. The effects to the shoreline would be that erosion would occur in areas with high erosion potential and high vessel traffic, but the changes to the shoreline would not be perceptible.

The amount of vessel use in alternative 2 is not likely to affect the Dundas Bay shoreline; however, if all the vessels permitted were to enter the Bay, there could be erosion of sandy beaches.

The effect of vessel wakes on the shoreline under alternative 2 would be the same as for alternative 1; therefore, the effect to the physical coastal environment from the implementation of alternative 2 would be minor, based on the number of sites that would have minor erosion potentials.

Biological coastal environment. The results of the coastal geomorphological analysis for alternative 2 are similar to those for alternative 1; therefore, it can be inferred that the effects to the biological coastal environment would be similar as well, with the degree of sediment erosion, resuspension, or relocation being the same as current conditions and not significantly different from natural wave action. In addition, it is unlikely that the size and frequency of the vessel wakes would change the behavior of shoreline mammals; rather tidal changes are more likely to influence behavior than vessel wakes. The probability of a fuel spill is low. The potential effects of alternative 2 to the biological coastal environment would be negligible.

*Cumulative effects on coastal/shoreline communities — alternative 2 —*The past, present, and reasonable foreseeable actions are the same as those described in alternative 1. These would not significantly alter the direct and indirect effects on coastal communities resources of Glacier Bay and Dundas Bay. Therefore, the combined effects of other actions and the implementation of alternative 2 are minor.

Impairment analysis for coastal/shoreline communities — alternative 2 — The implementation of alternative 2 potentially would result in minor effects to the coastal community; therefore, this alternative would not result in impairment of coastal community resources in the park.

Conclusion, coastal/shoreline environment and biological communities – alternative 2 – The potential effects of alternative 2 on coastal community resources would be imperceptible changes to shoreline due to vessel wake induced erosion and these would have minor effects to these resources. Cumulative effects would not contribute significantly to direct and indirect effects to coastal community resources. Moreover, the implementation of alternative 2 would not impair coastal community resources in the park.

Alternative 3 – Effects Analysis on Coastal/Shoreline Environment and Biological Communities.

Direct and indirect effects on coastal/shoreline communities — alternative 3 —

Physical coastline. The erosion potentials of the implementation of alternative 3 are the same as described for alternative 1. The potential effects of alternative 3 on the physical coastline are summarized and compared to the other alternatives in table 4-20. Table 3 in appendix H details the overall erosion potential of these sites under alternative 3.

The vessel use in Alternative 3 is not likely to affect the Dundas Bay shoreline; however, if all the vessels permitted were to enter the Bay, there could be erosion of sandy beaches.

The effect of vessel wakes on the shoreline under alternative 3 would be the same as for alternative 1. Effects would be that erosion would occur in some locations with high erosion potential and high vessel traffic, the changes to the shoreline would not be perceptible. Based on the number of sites that would have minor potential for erosion, the effect to the physical coastal environment from implementing alternative 3 would be minor.

Biological coastal environment. The results of the coastal geomorphological analysis for alternative 3 are the same as described for alternative 1. The effects to the biological coastal environment would be similar as well. Sediment erosion, resuspension, or relocation would be the same as current conditions and therefore, not significantly different from natural wave action. Given that black bears and other smaller mammals forage in the intertidal zone during low tide under current management conditions, the vessel wake effects would not be likely to change the behavior of shoreline mammals. In addition, the probability for a fuel spill is low. The potential effects to the biological coastal environment of alternative 3 would be negligible. Table 4-21 compares the effects of alternative 3 on both the physical and biological aspects of the park’s coastal community with the other alternatives.

Cumulative effects on coastal/shoreline communities — alternative 3 — Past, present, and foreseeable actions that would affect these resources are described in alternative 1 and would not significantly alter the direct and indirect effects on coastal community resources of Glacier Bay and Dundas Bay. Therefore, the contribution of other actions in conjunction with implementation of the alternative on the effects to coastal community resources are minor.

Impairment analysis for coastal/shoreline communities — alternative 3 — Implementation of alternative 3 would result in minor potential effects to the coastal community; therefore, this alternative would not result in impairment of coastal community resources in the park.

Conclusion, coastal/shoreline environment and biological communities — alternative 3 — The potential effects of alternative 3 on coastal community resources would be imperceptible changes to the shoreline due to vessel wake induced erosion and would have minor effects to these resources. Cumulative effects would not contribute significantly to direct effects to coastal community resources. Moreover, the implementation of alternative 3 would not impair coastal community resources in the park.

Alternative 4 – Effects Analysis on Coastal/Shoreline Environment and Biological Communities.

Direct and indirect effects on coastal/shoreline communities — alternative 4 —

<u>Physical coastline</u>. Like alternative 1, the erosion potentials produced under alternative 4 would be negligible to minor. The potential effects of alternative 4 on the physical coastline are summarized and compared to the other alternatives in table 4-20. Table 4 in appendix H details the overall erosion potential of these sites under alternative 4.

Implementation of alternative 4 would not likely change the use of Dundas Bay in the short term. The primary user of Dundas Bay is private vessels, which would continue to have unlimited use under this alternative. The small increase in use by tour vessels in 2002 would be eliminated with the implementation of alternative 4. Charter vessels would have a quota implemented, which may reduce the number of vessels in Dundas Bay over the long term. This alternative limits the potential effects of vessel wakes to the shoreline by limiting the number of vessels.

Alternative 4 would have a vessel wake-induced effect on the shoreline of Glacier Bay that is similar to alternative 1 and less in Dundas Bay. Erosion would occur, but the effects would be imperceptible. No sites would have greater than minor effects under this alternative. Although more sites would have negligible effects under this alternative than under the other alternatives, the effects to the physical coastal environment from the implementation of alternative 4 would be minor based on the number of sites that would have minor erosion potentials.

<u>Biological coastal environment</u>. The results of the coastal geomorphological analysis for alternative 4 were similar to those for alternative 1, but the effects to the biological coastal environment would be slightly greater in intensity due to increased private vessel seasonal-use days and elimination of entry limits. Sediment erosion, resuspension, or relocation would be slightly greater than current conditions; however, the disturbance to the intertidal environment would not change the community structure. In addition, the physical disturbance caused by terrestrial mammals that forage in the intertidal zone during low tide would not be likely to change. Also, the probability of a fuel spill is low; therefore, the potential effects to the biological coastal environment would be negligible. Table 4-20 compares the effects of alternative 4 on both the physical and biological aspects of the park's coastal community with the other alternatives.

Cumulative effects on coastal/shoreline communities — alternative 4 — The effects of past, present, and foreseeable other actions on these resources are described in alternative 1 and would not contribute significantly to the direct and indirect effects on coastal community resources of Glacier Bay and Dundas Bay. Therefore, the combined effects of the implementation of alternative 4 and other actions are minor.

Impairment analysis for coastal/shoreline communities — alternative 4 — Minor potential effects to the coastal community would result from implementation of alternative 4; therefore, this alternative would not result in impairment of coastal community resources in the park.

Conclusion, coastal/shoreline environment and biological communities — alternative 4 — The potential effects of alternative 4 on coastal community resources would be imperceptible changes to the shoreline due to vessel wake induced erosion and would be considered minor; however, the effects to the coastal community resources may be slightly greater with the increase in private vessels use in the lower Bay. Cumulative effects would not contribute significantly to direct effects to coastal community resources. Moreover, the implementation of alternative 4 would not impair coastal community resources in the park.

Alternative 5 – Effects Analysis on Coastal/Shoreline Environment and Biological Communities.

Direct and indirect effects on coastal/shoreline communities — alternative 5 —

<u>Physical coastline</u>. Similar to alternative 1, the erosion potentials for alternative 5 would range from negligible to moderate. The potential effects of alternative 5 on the physical coastline are summarized and compared to the other alternatives in table 4-20. Table 5 in appendix H details the overall erosion potential of these sites under alternative 5.

Implementation of alternative 5 would have similar effects as alternative 4 in Dundas Bay. Alternative 5 employs quotas for tour vessels and charter boats while prohibiting cruise ships completely. There are not limits on the use of Dundas Bay by private vessels. Alternative 5 also restricts access to the upper portions of the Bay to tour vessels and charter boats. This alternative limits the potential effect of vessel wakes to the shoreline by limiting the number of vessels.

The vessel wake-induced shoreline effects for alternative 5 would be similar to those identified for alternative 1. Effects would be that erosion would occur to some locations with high erosion potential and vessel traffic, but the changes to the shoreline would be imperceptible. Alternative 5 permits the most number of vessels when the vessel entry numbers are averaged over the entire year. The potential effects to the physical coastline of alternative 5 would be minor.

<u>Biological coastal environment</u>. The coastal geomorphological analysis for alternative 5 is slightly greater than those described for alternative 1. The effects to the biological coastal environment would be similar, but slightly greater due to an increase in private vessel seasonal-use days and the elimination of entry limits. Sediment erosion, resuspension, or relocation would be slightly greater than current conditions; however, the disturbance to the intertidal environment would not be expected to change the community structure. In addition, the foraging behaviors of terrestrial mammals would not likely change their behavior. Also, the probability of a fuel spill is low; therefore, the potential effects to the biological coastal environment of alternative 5 would be negligible. Table 4-20 compares the effects of alternative 5 on both the physical and biological aspects of the park's coastal community with the other alternatives.

Cumulative effects on coastal/shoreline communities — alternative 5 — Past, present, and foreseeable actions that would affect these resources are described in alternative 1. Their effects would not be expected to contribute significantly to the direct effects on coastal communities resources of Glacier Bay and Dundas Bay. Therefore, the combined effect on these resources of the implementation or alternative 5 and these other actions would be minor.

Conclusion, coastal/shoreline environment and biological communities — alternative 5 — The potential effects of alternative 5 on coastal community resources would be minor. Cumulative effects would not contribute significantly to direct effects to coastal community resources. Moreover, the implementation of alternative 5 would not impair coastal community resources in the park.

Alternative 6 — Effects Analysis on Coastal/Shoreline Environment and Biological Communities.

Direct and indirect effects on coastal/shoreline communities — alternative 6 —

Physical coastline. The erosion potentials produced under alternative 6 would be negligible to minor. The potential effects of alternative 6 on the physical coastline are summarized and compared to the other alternatives in table 4-20. The overall erosion potential is provided in table 4 in appendix H.

Implementation of alternative 6 would not likely change the use of Dundas Bay in the short term. The primary user of Dundas Bay is private vessels, which would continue to have unlimited use under this alternative. Alternative 6 employs quotas for tour vessels and charter boats while prohibiting cruise ships completely. There are not limits on the use of Dundas Bay by private vessels. Alternative 6 also restricts access to the upper portions of the Bay to tour vessels and charter boats. This alternative limits the potential effect of vessel wakes to the shoreline by limiting the number of vessels.

Alternative 6 would have a vessel wake-induced effect on the shoreline of Glacier Bay that is similar to alternative 1 and less in Dundas Bay. Erosion would occur in some locations with high erosion potential and high vessel traffic, but the changes to the shoreline would be imperceptible. Although more sites would have negligible effects under this alternative than under the other alternatives, the effects to the physical coastal environment from the implementation of alternative 6 would be minor based on the number of sites that would have minor erosion potentials.

Biological coastal environment. The results of the coastal geomorphological analysis for alternative 6 were similar to those for alternative 1, but the effects to the biological coastal environment would be slightly greater in intensity due to increased private vessel seasonal-use days and elimination of entry limits. Sediment erosion, resuspension, or relocation would be slightly greater than current conditions; however, the disturbance to the intertidal environment would not change the community structure. In addition, the physical disturbance to terrestrial mammals that forage in the intertidal zone during low tide would not be likely to change. Also, the probability of a fuel spill is low; therefore, the potential effects to the biological coastal environment would be negligible. Table 4-21 compares the effects of alternative 6 on both the physical and biological aspects of the park's coastal community with the other alternatives.

Cumulative effects on coastal/shoreline communities — alternative 6 — Past, present, and foreseeable actions that could affect these resources are described in alternative 1. Their effects would not contribute significantly to the direct or indirect effects on coastal community resources of Glacier Bay and Dundas Bay. Therefore, the combined effect of the implementation of alternative 6 and these other actions is minor.

Impairment analysis for coastal/shoreline communities — alternative 6 — Minor potential effects to the coastal community would result from implementation of alternative 6; therefore, this alternative would not result in impairment of coastal community resources in the park.

Conclusion, coastal/shoreline environment and biological communities — alternative 6 — The potential effects of alternative 6 on coastal community resources would be minor; however, the effects to the coastal community resources may be slightly greater with the increase in private vessels use in the lower Bay. Cumulative effects would not contribute significantly to direct effects to coastal community resources. Moreover, the implementation of alternative 6 would not impair coastal community resources in the park.

Summary, Coastal/Shoreline Environment and Biological Communities. While some shoreline erosion may occur, the overall effect of vessel traffic on shorelines was found to be minor across all alternatives, with no real difference in the amount of expected effect between alternatives in Glacier Bay and Dundas Bay.

4.4.1 CULTURAL RESOURCES

4.4 HUMAN ENVIRONMENT

4.4.1 Cultural Resources

This subsection evaluates the probable effects of implementing the alternatives on the following cultural resources: archaeological resources, historic structures, ethnographic resources, and the cultural landscape (collectively referred to as "historic property"). This subsection describes the regulatory framework used for assessing the effects of the proposed alternatives on cultural resources; characterizes the direct, indirect, and cumulative effects of the proposed alternatives; discusses the potential for the proposed alternatives to impair the park's cultural resources and values; and provides a conclusion summarizing the results of this evaluation.

Issues of Concern Raised During Scoping. Information was sought from individuals and organizations, including Native American organizations. The issues identified during the scoping process include the following:

- air and water pollution could defile sacred elements of Glacier Bay, including the glaciers, mountain goats, and harbor seals.
- effects on harbor seals could change opportunities for traditional seal hunting.
- waves generated from vessels could erode portions of the shoreline, thus changing the geological composition of the shoreline, and possibly exposing anthropological and archaeological resources present in interstadial geologic layers, including preglacial forests.
- increase in traffic at popular drop-off locations could increase physical disturbances and potential vandalism of anthropological resources.

Regulatory Framework. The relevant regulations for this evaluation of effects on cultural resources are NEPA and section 106 of the National Historic Preservation Act (NHPA). NEPA requires a review of project and program effects on the cultural environment, which generally includes historic properties, other culturally valued places, cultural use of a biophysical environment, and sociocultural attributes (e.g., social cohesion, social institutions, life ways, religious practices, and/or other cultural institutions). CEQ regulations require that the effects of alternatives and their component actions be disclosed. For this analysis, an effect is considered adverse (for section 106) and major (for NEPA) when the effect diminishes the significant characteristics of a "historic property" to the extent that it is no longer considered eligible for the National Register of Historic Places.

Section 106 of the National Historic Preservation Act requires that prior to the approval of an undertaking, the lead federal agency must take into account the effects of the undertaking on "historic properties" and provide the Advisory Council on Historic Preservation (ACHP) with a reasonable opportunity to comment with regard to the undertaking. As defined by the National Historic Preservation Act (NHPA section 800.16[y]; 36 CFR 800.3[a][1]), an action is an undertaking if it is done by or for a federal agency; is carried out with federal assistance; requires a federal permit, license, or approval; or is subject to federal delegation or oversight. The evaluation process involves (NHPA, 16 USC 470a, Title I, section 101):

- the identification and evaluation of "historic properties" in the area of potential effect (APE).
- the identification and evaluation of the effects of the undertaking on "historic properties."
- the development and implementation of agreements (done in consultation with the state historic preservation office [SHPO] and other concerned parties) regarding the means by which adverse effects on such properties will be considered (e.g., the 1995 programmatic agreement among the Park Service, the Advisory Council on Historic Preservation, and the National Conference of Historic Preservation Officers [NCHPO]).

- the provision for the disposition of Native American cultural items from federal or tribal land in a manner consistent with section 3(c) of the Native American Graves Protection and Repatriation Act (NAGPRA; 25 USC 3002[c]; NHPA section 110[a][2]).

Methodology and Assumptions. All parks, including those established primarily for their natural or recreational resources, have responsibilities to identify "historic properties" potentially affected by their undertakings (NPS, ACHP, and NCHPO 1995). For the purposes of section 106 of the National Historic Preservation Act, "historic properties" are defined as prehistoric and historic districts, sites, buildings, structures, and objects listed or eligible for inclusion on the national register, including artifacts, records, and material remains related to the property (NHPA, 16 USC 470w, section 301.5). The Park Service subdivides cultural resources ("historic properties") into five categories: archaeological resources, prehistoric and historic structures, ethnographic resources, cultural landscapes, and museum objects (NPS 2001d, 1997a). For the purposes of this effects analysis, cultural resources are equivalent to "historic properties" and consist of four property types: archaeological resources, historic structural resources (HSR), ethnographic resources, and cultural landscapes; museum objects are not considered in this analysis (NPS 2002d).

The assessment of effects on cultural resources is based on the regulations of the Advisory Council on Historic Preservation (36 CFR 800). The steps involve:

1. determining whether the action being considered is an undertaking as defined by the National Historic Preservation Act.
2. coordinating with other reviews (e.g., NEPA, Native American Graves Protection and Repatriation Act, American Indian Religious Freedom Act [AIRFA], and Archaeological Resources Protection Act [ARPA]), identifying the state historic preservation officer and other likely consulting parties, and planning to involve the public.
3. identifying "historic properties" using the secretary of the interior's standards (36 CFR 800.4). This identification involves:
   - establishing the area of potential effect.
   - reviewing available data.
   - seeking information from others.
   - identifying issues.
   - gathering information from Native American organizations that may place a religious or cultural significance on "historic properties" (e.g., ethnographic resources/traditional cultural properties and cultural landscapes) in the area of potential effect.
   - evaluating all "historical properties" (e.g., cultural resources) for national register eligibility on the basis of their significance (e.g., historical, archaeological, and/or cultural; see 36 CFR 60.4).

The Park Service determined that the proposed action is an "undertaking." During the scoping process and the development of the section 106 consultation, the second and third steps were addressed. Although few formal determinations of eligibility have been made for historic properties in the park, all are considered potentially eligible for the national register. The EIS defined the area of potential effect as Glacier Bay and Dundas Bay. A literature search was completed to access available data.

Analysis of effects on the full range of historic properties varies with resource type. Potential effects on tangible resources (archaeological sites and historic structures) can be analyzed using physical parameters (e.g., cubic meters of erosion and intact structural components), whereas effects on the intangible aspects of ethnographic resources (traditional cultural properties [TCPs] and cultural landscapes) are quantifiable in terms of people's perceptions and assumed responses, and is, by nature, a much more subjective exercise. For example, a perception that the ethnographic resource is degraded (polluted and desanctified) may elicit a behavioral response of decreased visitation or cessation of traditional activities that could result in the loss of knowledge of and cultural association with a site or sites — the key attributes that give traditional cultural properties and cultural landscapes their national register significance. In this regard, the Huna Tlingit perception of ecological “pristineness” is a paramount attribute in the connection they feel to their homeland, and the potential degree to which the proposed alternatives degrade that “pristineness,” and therefore influence Huna Tlingit responses to them, determines the effects to be analyzed.

The cultural resources threshold criteria (see table 4-22) address the effects of the proposed alternatives on “historic properties” in the area of potential effect (e.g., archaeological, historic structural and ethnographic resources, and cultural landscapes). In the following analysis, “historic properties” in the area of potential effect were evaluated with respect to their eligibility for the national register and whether the effects due to the implementation of the proposed alternatives would change the eligibility of that “historic property.” For a cultural resource (e.g., districts, sites, buildings, structures, and objects) to be eligible for the National Register of Historic Places, it must possess integrity of location, design, setting, materials, workmanship, feeling, and/or association. In addition, the cultural resource must:

- be associated with events that have made a significant contribution to the broad patterns of our history.
- be associated with the lives of persons significant in our past.
- embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction.
- yield, or be likely to yield, information important in prehistory or history (36 CFR 60.4).

Table 4-22 lists the specific threshold criteria used in this evaluation.

TABLE 4-22: THRESHOLD CRITERIA FOR CULTURAL RESOURCES EFFECTS ANALYSIS

Negligible	Perceptible and/or measurable effect would not occur; effect would occur to a single "historic property”; any effect would last less than two years. The eligibility (e.g., integrity and association) of a “historic property” (i.e., cultural resource) eligible for or listed on the National Register of Historic Places would not be affected.
Minor	Perceptible and/or measurable effect would occur; effect would occur to a single “historic property”; effect would last less than two years. The eligibility (e.g., integrity and association) of a “historic property” (i.e., cultural resource) eligible for or listed on the National Register of Historic Places would not be affected.
Moderate	Perceptible and/or measurable effect would occur; more than one “historic property” or a district would be affected; duration would be two years or longer; the character of a “historic property” or district would be affected; the integrity and association of a “historic property” or district eligible for or listed on the National Register of Historic Places would be affected, but national register eligibility would not be affected.
Major	Perceptible and/or measurable effect would occur; multiple “historic properties” or a district would be affected; duration would be two years to permanent; the character of a “historic property” or district would be affected; the integrity and association of a “historic property” or district eligible for listing on the national register would be affected to the extent that it would no longer be eligible for listing on the National Register of Historic Places.

The following analysis assumes that the effects of implementing the alternative are comparable to the effects on the existing management system.

Alternative 1 (No Action) — Effects on Cultural Resources. Alternative 1 (the no-action alternative) would maintain current vessel quotas and operating requirements (1996 levels).

Direct and indirect effects on cultural resources — alternative 1 —

<u>Archaeological and historic structural resources</u>. Archaeological resources are prehistoric Native American cultural resources and historic archaeological resources of Native American and Euro-American origin. Due to the geologic processes encountered in the park, most prehistoric archaeological sites are located on or near a terrace (e.g., the Spruce Terrace) that stands above and removed from the current beach and wake-affected zone. Historic structural resources are the remains of structures that housed humans and their activities in the past and are listed on the List of Classified Structures. Historic structural resources are still standing; if collapsed or otherwise open to the elements, they fall into the archaeological resources category. The park's policy on historic structures, based on the 1984 general management plan (NPS 1984), outlined a policy of "benign neglect," directing the Park Service to allow historic structures to deteriorate naturally, eventually to be reclaimed by the landscape. According to the general management plan, these sites should be managed as "discovery sites," with no on-site interpretation, reconstruction, or stabilization.

Nine archaeological sites in Glacier Bay were evaluated for effects of erosion and contamination (JUN-001, JUN-026, JUN-050, XMF-062, XMF-063, XMF-081, XMF-082, XMF-083, and XMF-084). The two historic structural resources documented for Glacier Bay, the Ibach Cabin and a shed in Reid Inlet, also were evaluated. Because the current effect of wakes on the coast is minimal (PND 2002) and no documented archaeological resources and historic structural resources are located in the wake-affected zones, vessel wakes would have a negligible effect on archaeological resources and historic structural resources located near the coast. Although accidental oil discharges/fuel spills could contaminate archaeological sites and historic structures along the coastlines of the park, the sites are sufficiently distant from the shoreline to be safe.

The duration of alternative 1 would be long term. The area affected would be the waters and coastal areas of Glacier Bay and lower Dundas Bay. The effect on archaeological resources and historic structural resources would not be perceptible in vessel wake zones and would have no effect on national register eligibility for potentially eligible archaeological sites and historic structural resources. Given the park's current policy, the low number and ruinous condition of the documented historic structural resources in Glacier Bay, and the low potential for damage to undocumented historic structural resources and archaeological resources due to erosion from vessel wakes and contamination from oil discharges / fuel spills, alternative 1 would have negligible effects on archaeological and historic structural resources (see table 4-22).

<u>Ethnographic resources</u>. Ethnographic resources consist of traditional arts, Native languages, religious beliefs, special places in the natural world, structures with historic associations, traditional cultural properties, natural materials, and consumptive uses (discussed in the next subsection; NPS 1997a). A traditional cultural property is a "historic property" that is eligible for inclusion on the National Register of Historic Places because of its association with cultural practices or beliefs of a living community that are rooted in that community's history and important in maintaining the continuing cultural identity of the community (Parker and King 1998a; NPS 2001d). For a discussion of ethnographic resources / traditional cultural properties, see "Subsection 3.4.1. Cultural Resources."

Huna Tlingit culture is a recognized ethnographic cultural resource in the park (Howell 2002). The Huna Tlingit perceive Glacier Bay to be the cradle of their culture. It is the place where the Huna Tlingit evolved from the animals, mountains, and ice; gave identity to Huna Tlingit clans; and gives order to Huna Tlingit social relations, today and into the future. Glacier Bay has sustained the Huna Tlingit nutritionally and spiritually for generations. The Huna Tlingit refer to Glacier Bay as their most important place, their "homeland," their "Ice Box," their "Garden of Eden," and their "Holy Land." The Huna Tlingit believe that it is imperative that the ancestral homeland remains unpolluted, and that the subsistence food base remains pure (Hoonah Indian Association [HIA] 2002). Continued access, participation in traditional cultural activities rooted in the park, and intergenerational transference of the cultural meanings of ancestral places in the park maintain the continuing cultural associations with Glacier Bay and the Huna Tlingit's cultural identity. See subsection 3.4.1, "Cultural Resources," for further discussion about the Huna Tlingit relationship with Glacier Bay.

From the perspective of the Huna Tlingit (scoping), alternative 1 would affect ethnographic resources in the park by the diminution of the quality of resources, and thus degrade the Huna Tlingit ancestral homeland. If the ancestral homeland is degraded by air or water pollution, the threat of a fuel spill, or other perceived degrading vectors, Huna Tlingits may become disconnected from their homeland and may become disinclined to visit and conduct traditional activities. Therefore, relationships with the homeland are susceptible to deterioration, resulting in the erosion of cultural identity. Continued cultural identity of the community with ethnographic resources (i.e., traditional cultural properties) is necessary for national register eligibility. Conversely, a lack of cultural identity with ethnographic resources results in ineligibility for the national register. Currently, the Huna Tlingit have retained their cultural identity with Glacier Bay.

Six potential traditional cultural properties in Glacier Bay were evaluated for potential effects of alternative 1 (TCP ID #1 [Bartlett Cove], TCP ID #2 [Point Gustavus], TCP ID #4 [Berg Bay], TCP ID #5 [South Marble Island], TCP ID #6 [Sealer's Island], and TCP ID #7 [Tidewater Glaciers]. The Huna Tlingit believe that they are "stewards" of Glacier Bay and have expressed concerns about the effects of contamination (air and water pollution) and harm or displacement of marine mammals (e.g., seals and whales) associated with cruise ships (HIA 2002). Alternative 1, while supported by the Hoonah Indian Association (HIA 2002), may have a moderate effect on the ethnographic landscape (e.g., traditional cultural properties) in that it would affect the relationship between the Huna Tlingit and the traditional cultural properties because cruise ships and other vessels lessen the perceived environmental quality of the park.

The effect of alternative 1 would be long term, would encompass all of Glacier Bay, and would potentially affect the integrity and association of eligible or potentially eligible ethnographic resources/traditional cultural properties in Glacier and Dundas Bays; however, the effects of alternative 1 would not affect these ethnographic resources' eligibility for the national register because the Huna are likely to maintain their cultural identity with Glacier Bay. As long as the community maintains its cultural identity with traditional Glacier Bay places and activities, the ethnographic resource (e.g., traditional cultural properties) will continue to be eligible for the national register. Thus, the effect of alternative 1 on ethnographic resources would be moderate (see table 4-22).

<u>Cultural landscapes</u>. Cultural landscapes are "historic properties" that are geographic areas, including natural and cultural resources, associated with historic events, activities, and/or people. At the broadest scale, the cultural landscape encompasses entire landscapes (e.g., the entirety of Glacier Bay) or component landscapes (e.g., Dundas Bay or Bartlett Cove). The following discussion summarizes environmental consequences of alternative 1 on cultural landscapes in Glacier and Dundas Bays. For further discussion of cultural landscapes, see subsection 3.4.1.

The effects analysis for ethnographic resources also applies to cultural landscapes, because the cultural landscape is an extension of the ethnographic resource. The Glacier Bay cultural landscape is a compilation of all landscape features, cultural resources, and natural resources that combined have meaning and significance to the Huna Tlingit. Alienation of the Huna Tlingit from the resources and landscape of the park would change their relationship to their homeland, their traditional places, and the basis of their cultural identity. The effect of alternative 1 would be long term, would encompass all of Glacier Bay, and may affect the integrity and association of eligible or potentially eligible cultural landscapes in Glacier and Dundas Bays. Effects of alternative 1, however, would not affect these cultural landscapes' eligibility for the national register because the Huna Tlingit are likely to maintain their cultural identity with Glacier Bay. Alternative 1 would have a moderate effect on cultural landscapes (see table 4-22).

Cumulative effects on cultural resources — alternative 1 — Cumulative effects on cultural resources were considered for those cultural resources present on the shorelines of Glacier and Dundas Bays. Passengers offloaded from tour and charter vessels, kayakers, and other backcountry visitors have the potential to cumulatively alter eligibility of cultural resources for the national register through looting, vandalism, and/or unintentional damage to cultural resources. The Park Service has reported minor vandalism at exposed cultural resource sites (NPS 1995a).

Due to the effects of alternative 1 in conjunction with effects from other present and foreseeable projects and past damage to cultural resources, the Huna Tlingit may perceive diminished opportunities for spiritually connecting with their landscape and sharing their culture with others due to the perceived diminished integrity of their ancestral homeland as park use increases (i.e., more vessels and tourists result in a less pristine environment). Increases in vessel and visitor traffic to the park have the potential to further alienate the Huna Tlingit from their ancestral homeland by diminishing the quality of the relationship between the Huna Tlingit and the park. If this effect is severe enough that the relationships with the cultural resources (e.g., ethnographic resources and cultural landscapes) decline to the point that there is no cultural identity with them, these resources and landscapes would no longer be eligible for the national register.

The Huna Tlingit believe they have been alienated or expelled from the park due to park designation, subsistence limitations, and prior access limitations (e.g., some Huna Tlingit are unwilling to compete for limited private vessel entry permits during the busy summer season; Howell 2002). Huna Tlingit access issues are being resolved through government-to-government negotiations between the Park Service and the Hoonah Indian Association. The Park Service has been working with the Huna Tlingit to encourage participation in currently authorized activities, such as berry picking and fishing, while exploring resumption of others, such as gull-egg gathering. These negotiations, in addition to multiple studies, educational programs, and increased Huna Tlingit participation in all aspects of park planning and management, illustrate the importance of Tlingit culture in the mission and purpose of the park.

Impairment analysis for cultural resources — alternative 1 — An effect may constitute an impairment “to the extent that it affects a resource or value whose conservation is necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park; key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or identified as a goal in the park’s general management plan or other relevant NPS planning documents” (NPS 2000b). The park’s purpose and mission statement states that the park will recognize and perpetuate “values associated with the Tlingit homeland”; preserve “historic value”; protect, restore, and maintain “cultural resources and [their] associated values in good condition”; and manage these “resources within their broader ecosystem and cultural context” (NPS 1997c, 1998a).

Based on the overall severity (moderate), duration (long-term), and timing of the effect (June through August); the effects of alternative 1 on ethnographic resources and cultural landscapes (e.g., perception of degradation of connection to the ethnographic resource and/or cultural landscape); and the cumulative effects of alternative 1 (moderate; NPS 2000b), alternative 1 would not result in impairment of cultural resources in the park.

Conclusion, cultural resources — alternative 1 — The potential effects of alternative 1 would be negligible for eligible or potentially eligible archaeological and historic structural resources, but moderate for eligible or potentially eligible ethnographic resources (e.g., traditional cultural properties) and cultural landscapes due to the unavoidable perceived degradation of the Huna Tlingit homeland by vessel traffic. The overall effect of alternative 1 on cultural resources would be moderate. The cumulative effect of alternative 1 would be moderate. Alternative 1 would not impair cultural resources in the park.

Alternative 2 – Effects on Cultural Resources. Under this alternative, vessel management would revert to the quotas and operating requirements established in 1985, reversing the increases defined in the 1996 decision (107 cruise ships between June 1 and August 31). Alternative 2 represents a decrease in vessel traffic from alternative 1.

Direct and indirect effects on cultural resources — alternative 2 —

<u>Archaeological and historic structural resources</u>. The potential changes to archaeological resources and historic structural resources as a result of alternative 2 are the same as those of alternative 1. The effects of vessel wakes and potential fuel spills would be negligible because the known archaeological and historic structural resources are physically above the area affected by wave/wake action. Alternative 2 would have no effect on national register eligibility for potentially eligible archaeological sites and historic structural resources, and would have a negligible effect on known archaeological resources and historic structural resources despite the long duration and large area of potential effect (see table 4-22).

<u>Ethnographic resources</u>. Alternative 2 would have a moderate effect on ethnographic resources. Although alternative 2 would decrease cruise ship traffic from alternative 1, and thus present a reduced threat of pollution (air and water), contamination (fuel spills), and marine mammal injuries, factors that could enhance the Huna Tlingit relationship with their homeland. The reduction is not sufficient to reduce the effect to minor, because those potential threats would still be noticeably present. Alternative 2 would not affect the integrity and association of the eligible or potentially eligible ethnographic resources and would not effect their eligibility for the national register because the Huna Tlingit are likely to maintain their cultural identity with Glacier Bay. Thus, the effect of alternative 2 on ethnographic resources would be moderate (see table 4-22).

<u>Cultural landscape</u>. Alternative 2 would have a moderate effect on cultural landscapes in Glacier Bay because the Huna Tlingit have maintained their connection to the Bartlett Cove cultural landscape as discussed in alternative 1. Although the effects of alternative 2 on the Glacier Bay cultural landscapes would be long term and encompass all of Glacier Bay, they would not affect the integrity and association of eligible or potentially eligible cultural landscapes in Glacier Bay, and, thus, would not affect these cultural landscapes' eligibility for the national register. Thus, Alternative 2 would have a moderate effect on the Glacier Bay cultural landscape (see table 4-22).

Cumulative effects on cultural resources — alternative 2 — Alternative 2 would have the same cumulative effects as alternative 1; however, the cumulative effects would be reduced due to the proposed decrease in vessel traffic/quotas.

Impairment analysis for cultural resources — alternative 2— Though the duration is long term, the overall severity of the alternative 2 effect is negligible for archaeological and historic structural resources and moderate for ethnographic resources and cultural landscapes. Thus, no impairment to these resources would result from alternative 2.

Conclusion, cultural resources — alternative 2 — The potential effects of alternative 2 would be negligible for eligible or potentially eligible archaeological and historic structural resources, and moderate for eligible or potentially eligible ethnographic resources (e.g., traditional cultural properties) and cultural landscapes due to the unavoidable perceived degradation of the Huna Tlingit homeland by vessel traffic. The overall effect of alternative 2 on cultural resources would be moderate. The cumulative effects of alternative 2 would be minor. Alternative 2 would not result in impairment to cultural resources.

Alternative 3 – Effects on Cultural Resources. Alternative 3 allows for an increase in vessel traffic up to the quotas authorized in the 1996 vessel management plan (or two ships a day, every day, from June 1 through August 31). Alternative 3 proposes a 32% increase in vessel traffic/quotas from alternative 1.

Direct and indirect effects on cultural resources — alternative 3 —

Archaeological and historic structural resources. Despite the increase in vessel traffic/quotas proposed under alternative 3, the effects to archaeological resources and historic structural resources would be the same as those of alternative 1. As with alternative 1, archaeological and historic structural resources in Glacier Bay could be disturbed or destroyed by erosion caused by cruise ship induced wakes on coastal archaeological and historic sites and contamination from possible oil discharge or fuel spills. According to "Subsection 4.4.6. Coastal/Shoreline Environments and Biological Communities," the erosion potential would be the same as that for alternative 1, and although erosion would increase slightly, there would be no visible changes to the shoreline. The wave action and the potential for contamination to these resources, therefore, are the same as those of alternative 1, and the effect on archaeological resources and historic structural resources would be negligible.

Ethnographic resources. Alternative 3 would have a moderate effect on the ethnographic resources in Glacier Bay because it would increase the effects from alternative 1 due to the 32% increase in vessel traffic/quotas. Under existing conditions, the Huna Tlingit perceive the environment of the park as degraded as described under alternative 1. Because of the vessel increase, alternative 3 has the potential to have a moderate effect on ethnographic resources (e.g., traditional cultural properties) in that it could adversely affect the relationship between the Huna Tlingit and the traditional cultural properties if cruise ships further degrade perceived environmental quality in the park; however, the level of increase would not be sufficient to cause Huna Tlingits to abandon such ingrained cultural traditions.

Alternative 3 could potentially affect the integrity and association of eligible or potentially eligible ethnographic resources to the extent that perceived degradation of the environment reduces the integrity of the Huna Tlingit relationship with their homeland. Alternative 3 would not affect these ethnographic resources' eligibility for the national register, however, because the Huna Tlingit are likely to maintain their cultural identity with Glacier Bay. As long as the community maintains its cultural identity with traditional Glacier Bay places and activities, the ethnographic resource (e.g., traditional cultural properties) will continue to be eligible for the national register. Thus, the effects of alternative 3 on ethnographic resources would be moderate.

Cultural landscape. Alternative 3 would have a moderate effect on cultural landscapes because cultural landscapes are an extension of ethnographic resources and the Huna Tlingit have maintained their connection to the Bartlett Cove cultural landscape (see alternative 1).

Cumulative effects on cultural resources — alternative 3 — Alternative 3 would have a similar cumulative effect as alternative 1, although the effect would be somewhat greater due to the increase in vessel traffic/quotas. The cumulative effects of the actions external to this plan (e.g., increased tourism, tourists who go ashore, restricted access to the park, and subsistence limitations) could significantly alter the effects on the cultural resources of Glacier Bay and Dundas Bay; therefore, the cumulative effect would be moderate.

Impairment analysis for cultural resources — alternative 3 — Despite the long duration, the overall severity of the effect on archaeological and historic structural resources for alternative 3 is negligible. For ethnographic resources and cultural landscapes, the severity of the effect is moderate, the duration is long term, the timing of the effect is June through August (a period of Huna Tlingit use of the park), the effects include Huna Tlingit perception of a diminution of their connection to their homeland, and the cumulative effects would be moderate (see table 4-22). Because the overall severity of alternative 3 is moderate**,** this alternative would not result in impairment on cultural resources in the park.

Conclusion, cultural resources — alternative 3 — The potential effects of alternative 3 would be negligible for eligible or potentially eligible archaeological and historic structural resources, but moderate for eligible or potentially eligible ethnographic resources (e.g., traditional cultural properties) and cultural landscapes due to unavoidable perceived degradation to the Huna Tlingit homeland by vessel traffic. The overall effect of alternative 3 on cultural resources would be moderate. The cumulative effects of alternative 3 would be moderate. Alternative 3 would not result in impairment to cultural resources in the park.

Alternative 4 – Effects on Cultural Resources. Alternative 4 decreases cruise ship vessel quotas to pre-1985 levels and reduces daily vessel quotas for tour, charter, and private vessels from the current conditions. Alternative 4 extends the vessel seasonal restrictions for all vessel classifications to May 1 (instead of June 1) until September 30 (instead of August 31), proposes vessel quotas for charter vessels in Dundas Bay (a daily vessel quota of three and a seasonal-use day limit of 459), restricts tour vessels from entering Dundas Bay, closes wilderness waters to cruise ships and tour vessels and proposes to identify a cruise ship route. This alternative also modifies vessel-operating requirements (e.g., vessel speeds, whale water boundaries, and vessel operations).

Direct and indirect effects on cultural resources — alternative 4 —

<u>Archaeological and historic structural resources</u>. Alternative 4 would have a negligible effect on archaeological resources through erosion or contamination. The effects of alternative 4 on archaeological resources in Glacier Bay would be less than those of alternative 1 (which are negligible) due to a longer but restricted entry season, slower vessel speeds, and additional restricted waters. Alternative 4 could affect, through vessel wakes and contamination, 15 coastal archaeological sites in Dundas Bay, 9 archaeological sites in Glacier Bay, and 4 historic structural resources in Dundas Bay (see figure 3-16). As with the other alternatives, because the known archaeological and historic structural resources within Glacier and Dundas Bays are located above the wake zone, there would be a negligible effect from vessel wakes and oil discharge or fuel spills. This alternative also would have a negligible effect on archaeological and historic structural resources in Dundas Bay because charter traffic is more limited under this alternative than with current conditions. Alternative 4 would have no effect on national register eligibility for potentially eligible archaeological sites and historic structural resources and thus would have a negligible effect on archaeological resources and historic structural resources despite the long duration and large area of potential effect (see table 4-22).

<u>Ethnographic resources</u>. Alternative 4 would have a moderate effect on the ethnographic resources in Glacier Bay. The effects of alternative 4 on ethnographic resources in Glacier Bay would be less than those of alternative 1 due to longer restricted entry season, slower vessel speeds, and additional restricted waters. Alternative 4 also restricts cruise ships and tour vessels from and limits charter vessel entries for Dundas Bay, thus reducing potential effects on ethnographic resources. Alternative 4 would not affect the integrity and association of the eligible or potentially eligible ethnographic resources or their eligibility for the national register. Thus, the effects of alternative 4 on ethnographic resources would be moderate (see table 4-22).

<u>Cultural landscape</u>. Alternative 4 would have a moderate effect on the cultural landscapes in Glacier Bay because the Huna Tlingit have maintained their connection to the Bartlett Cove cultural landscape. Alternative 4 would have less of an effect on the Bartlett Cove cultural landscape than alternative 1. The park has documented a cultural landscape in Dundas Bay that contains the archaeological remains of two Huna Tlingit villages with accompanying oral history and other cultural resources (e.g., cemetery, house pilings, smokehouse debris, and fragments of a dugout canoe), stone cairns (believed to be Tlingit shrines), traditional berry-picking areas (one Native name for the area translates as "Berry Land"), and was known historically as a place for harvesting seals and salmon. Alternative 4 would result in a moderate effect on the Dundas Bay cultural landscape because of proposed limited vessel activity. The effects of alternative 4 would not affect these cultural landscapes' eligibility for the national register, and thus would have a moderate effect on cultural landscapes in the park.

Cumulative effects on cultural resources — alternative 4 — The cumulative effects of the actions external to this plan (e.g. increased tourism, tourists who go ashore, restricted access to the park, and subsistence limitations) would not significantly alter the effects on the cultural resources of Glacier Bay and Dundas Bay; therefore, the cumulative effect would be moderate.

Impairment analysis for cultural resources — alternative 4 — Although the duration would be long term and the timing of the effect is a period of Huna Tlingit use of the park (May through September), the overall severity of effect of alternative 4 would be moderate. Thus, no impairment would occur to these resources under alternative 4.

Conclusion, cultural resources —– alternative 4 — The potential effects of alternative 4 would be negligible for eligible or potentially eligible archaeological and historic structural resources, and moderate for eligible or potentially eligible ethnographic resources (e.g., traditional cultural properties) and cultural landscapes due to the unavoidable perceived degradation of the Huna Tlingit homeland by vessel traffic. The contribution of cumulative effects from other actions would be moderate. The overall effect to cultural resources would be moderate, and no impairment would occur.

Alternative 5 – Effects on Cultural Resources. Alternative 5 maintains seasonal vessel entry quotas at current levels but extends the season for cruise ships and modifies vessel operating requirements for all vessels (e.g., vessel speeds, whale water boundaries, and vessel operations). For Dundas Bay, alternative 5 proposes 276 seasonal-use days and no daily vessel quota for charter vessels, allows one tour vessel into lower Dundas Bay per day, and restricts cruise ships and tour vessels from entering wilderness waters.

Direct and indirect effects on cultural resources — alternative 5 —

<u>Archaeological and historic structural resources</u>. Alternative 5 would have a negligible effect on archaeological resources in Glacier and Dundas Bays through erosion or contamination. Alternative 5 has the potential to affect nine coastal archaeological sites in Glacier Bay, 15 coastal archaeological sites in Dundas Bay, and four historic structural resources in Dundas Bay through vessel-induced wakes and contamination caused by possible fuel spills. Alternative 5 would cause a negligible effect to these resources even though the implementation of this alternative would result in erosion that is slightly greater that current levels, but there would be no perceptible change to the coastline (see subsection 4.4.6). As with the other alternatives, because the known archaeological and historic structural resources within Glacier and Dundas Bays are located above the wake zone, there would be a negligible effect from vessel wakes and oil discharge or fuel spills. The effect of alternative 5 on archaeological resources and historic structural resources would have no effect on national register eligibility for archaeological sites in Glacier and Dundas Bays. Thus, alternative 5 would have a negligible effect on known archaeological resources despite the long duration and large area of potential effect (see table 4-22).

<u>Ethnographic resources</u>. Alternative 5 could potentially affect eight traditional cultural properties in Glacier and Dundas Bays. Alternative 5 proposes maintenance of current vessel entries with a longer restricted entry season for cruise ships (May through September), decreasing potential perceived effects. The addition of vessel restrictions (e.g., no cruise ships or tour vessels in wilderness waters) may have beneficial effects for the relationship between the Huna Tlingit and the park by reducing potential effects. Alternative 5 would not affect the potential eligibility of the ethnographic resources / traditional cultural properties for the national register because the Huna Tlingit have maintained their cultural connection to the ethnographic resources. Thus, alternative 5 would have a moderate effect on ethnographic resources in Glacier and Dundas Bays.

<u>Cultural landscape</u>. Alternative 5 could potentially affect two cultural landscapes, Bartlett Cove and Dundas Bay, and would have a moderate effect on cultural landscapes in Glacier and Dundas Bays because cultural landscapes are an extension of ethnographic resources. Alternative 5 may affect the

integrity and association of eligible or potentially eligible cultural landscapes in Glacier and Dundas Bays, but would not affect these cultural landscapes' eligibility for the national register because the Huna Tlingit have maintained their cultural connection to the cultural landscape. Thus, alternative 5 would have a moderate effect on the Glacier Bay cultural landscape.

Cumulative effects on cultural resources — alternative 5 — Alternative 5 would have a similar cumulative effect as alternative 1, although the cumulative effect would be less due to the proposed decrease in vessel traffic/quotas in Dundas Bay and more stringent operating requirements. It is unlikely the cumulative effects would affect the eligibility of ethnographic resources and cultural landscapes so long as the Huna Tlingit desire to maintain their connection/relationship with culturally significant places in Glacier and Dundas Bays.

Impairment analysis for cultural resources — alternative 5 — Although the duration is long, the overall severity of alternative 5 would be negligible for archaeological and historic structural resources. For ethnographic resources and cultural landscapes, the severity of the effect would be moderate, the duration would be long term, the timing of the effect would be May through September (a period of Huna Tlingit use of the park), the effect would include the Huna Tlingit perception of degradation of connection to the ethnographic resource and cultural landscape, and the cumulative effect of alternative 5 would be moderate. Because the overall severity of alternative 5 would be moderate, this alternative would not result in impairment on cultural resources in the park.

Conclusion, cultural resources — alternative 5 — The potential effects of alternative 5 would be negligible for eligible or potentially eligible archaeological and historic structural resources, but moderate for eligible or potentially eligible ethnographic resources (e.g., traditional cultural properties) and cultural landscapes due to the unavoidable perceived degradation of the Huna Tlingit homeland by vessel traffic. The overall effect of alternative 5 on cultural resources would be moderate. The cumulative effects of alternative 5 would be moderate. Alternative 5 would not result in impairment of cultural resources in Glacier and Dundas Bays.

Alternative 6 — Effects on Cultural Resources. Alternative 6 allows for an increase in vessel traffic up to two ships a day, every day, from June 1 through August 31. Alternative 6 proposes a 32% increase in vessel traffic/quotas from alternative 1, but a speed limit would be imposed on large vessels.

Direct and indirect effects on cultural resources — alternative 6 —

<u>Archaeological and historic structural resources</u>. Despite the increase in vessel traffic/quotas proposed under alternative 6, the effects to archaeological resources and historic structural resources would be similar to those of alternative 1. Archaeological and historic structural resources in Glacier Bay could be disturbed or destroyed by erosion caused by cruise-ship-induced wakes on coastal archaeological and historic sites and contamination from possible oil discharge or fuel spills. According to "Subsection 4.4.6. Coastal/Shoreline Environments and Biological Communities," the erosion potential would be similar as that for alternative 5, and although erosion would increase slightly, there would be no visible changes to the shoreline. The wave action and the potential for contamination to these resources, therefore, are the same as those of alternative 1, and the effect on archaeological resources and historic structural resources would be negligible.

<u>Ethnographic resources</u>. Alternative 6 would have a moderate effect on the ethnographic resources in Glacier Bay because it would increase the effects from alternative 1 due to the 32% increase in vessel traffic/quotas. Under existing conditions, the Huna Tlingit perceive the environment of the park as degraded as described under alternative 1. Because of the vessel increase, alternative 6 has the potential to have a moderate effect on ethnographic resources (e.g., traditional cultural properties) in that it could adversely affect the relationship between the Huna Tlingit and the traditional cultural properties if cruise ships further degrade perceived environmental quality in the park; however, the

level of increase would not be sufficient to cause the Huna Tlingit to abandon such ingrained cultural traditions.

Alternative 6 could potentially affect the integrity and association of eligible or potentially eligible ethnographic resources to the extent that perceived degradation of the environment reduces the integrity of the Huna Tlingit relationship with their homeland. Alternative 6 would not affect these ethnographic resources' eligibility for the national register, however, because the Huna Tlingit are likely to maintain their cultural identity with Glacier Bay. As long as the community maintains its cultural identity with traditional Glacier Bay places and activities, the ethnographic resource (e.g., traditional cultural properties) will continue to be eligible for the national register. Thus, the effects of alternative 6 on ethnographic resources would be moderate.

<u>Cultural landscape</u>. Alternative 6 would have a moderate effect on cultural landscapes because cultural landscapes are an extension of ethnographic resources and the Huna Tlingit have maintained their connection to the Bartlett Cove cultural landscape (see alternative 1).

Cumulative effects on cultural resources — alternative 6 — Alternative 6 would have a similar cumulative effect as alternative 1, although the effect would be somewhat greater due to the increase in vessel traffic/quotas. The cumulative effects of the actions external to this plan (e.g., increased tourism, tourists who go ashore, restricted access to the park, and subsistence limitations) could significantly alter the effects on the cultural resources of Glacier Bay and Dundas Bay; therefore, the cumulative effect would be moderate.

Impairment analysis for cultural resources — alternative 6 — Despite the long duration, the overall severity of the effect on archaeological and historic structural resources for alternative 6 is negligible. For ethnographic resources and cultural landscapes, the severity of the effect is moderate, the duration is long term, the timing of the effect is June through August (a period of Huna Tlingit use of the park), the effects include Huna Tlingit perception of a diminution of their connection to their homeland, and the cumulative effects would be moderate (see table 4-22). Because the overall severity of alternative 6 is moderate**,** this alternative would not result in impairment on cultural resources in the park.

Conclusion, cultural resources — alternative 6 — The potential effects of alternative 6 would be negligible for eligible or potentially eligible archaeological and historic structural resources, but moderate for eligible or potentially eligible ethnographic resources (e.g., traditional cultural properties) and cultural landscapes due to the unavoidable perceived degradation of the Huna Tlingit homeland by vessel traffic. The overall effect of alternative 6 on cultural resources would be moderate. The cumulative effects of alternative 6 would be moderate. Alternative 6 would not result in impairment to cultural resources in the park.

The effect of implementation of all the alternatives on cultural resources would be negligible for eligible or potentially eligible archaeological and historic structural resources. All alternatives would have moderate effects on the eligible or potentially eligible ethnographic resources (e.g., traditional cultural properties) and cultural landscapes. Effects to these ethnographic resources and cultural landscapes would be that vessel traffic would result in unavoidable perceived degradation of the Huna Tlingit homeland. Cumulative effects would contribute additional minor to moderate effects. Implementation of any of the alternatives would not result in impairment

Summary, Cultural Resources. None of the alternatives would damage archaeological or historic resources because (a) they are exceedingly rare in Glacier Bay due since glaciers have recently scoured the entire Bay and (b) the few that are present are located well away from shorelines and the effects of vessels.

Effects to ethnographic resources relate to the integrity of traditional cultural properties, including cultural landscapes: namely the Ancestral Homeland of the Huna Tlingit. The effects, which include perceptions of the Huna Tlingit relate closely to vessel numbers. Therefore, Alternative 3 and 6 would have the greatest effect and alternative 4 the lowest. This effect is considered to be within the moderate range because it is expected that there would be a perceived degradation of cultural landscapes but not to the point of creating a disconnection of peoples from an Ancestral Homeland.

4.4.2 Visitor Experience

4.4.2 Visitor Experience

This section evaluates the potential effects of implementing the proposed alternatives on visitor experience.

Issues of Concern Raised During Scoping. The issues related to visitor experience that were identified during scoping are:

- the presence of large cruise ships could diminish the experience of other visitors from smaller vessels due to the visual effects and loss of wilderness experience.
- vessel noise could intrude on visitor solitude in Glacier Bay.
- the presence of vessels may provide a backcountry user with a greater sense of security knowing that help is nearby if an emergency occurs.
- the presence of vessels may scare wildlife and thereby could diminish the visitor experience of those expecting to see wildlife.

Additionally, the complexity of the current permitting system has long been a primary concern of NPS staff and visitors that visit Glacier Bay in private vessels. The current quota system requires NPS to ration permits to ensure that the seasonal limit is not reached too early, and due to this rationing, many boaters are denied permits during the high visitation periods mid-summer. This occurs even though the total seasonal limit has never been reached over any particular season. Some local area users have indicated to NPS staff that many local people do not even try to access Glacier Bay due to the perception that it is too difficult to get a permit.

Note that this subsection addresses the experiences of visitors. The effects of vessel quotas and operating requirements on the businesses that serve these visitors, including operators of cruise ships and tour and charter vessels, are addressed in vessel traffic and safety and in socioeconomics (subsections 4.4.3 and 4.4.5).

Regulatory Framework. Managing public uses of the national parks is one of the fundamental missions of the Park Service. The importance of visitor use and enjoyment is addressed under NPS policies (NPS 2001b) and essentially all other planning documents, including the park's general management plan (NPS 1984). The Organic Act of 1916, which created the Park Service and its mission, also mandates the Park Service to provide for the public's enjoyment of the parks.

Methodology and Assumptions. This evaluation of visitor experience focuses on two primary components: enjoyment and opportunity.

Enjoyment relates to the elements of a visit that are the main reasons and motivations of a person visiting Glacier Bay and/or Dundas Bay. Based on surveys conducted at the park and preserve, common motivations include visiting a well-known National Park; enjoying scenic beauty; viewing tidewater glaciers and wildlife; engaging in recreational activities such as kayaking, hiking, and exploring; and experiencing wilderness, unimpeded vistas, and natural sound or quiet. Enjoyment of a visitors experience depends on how well the actual experience reflects the expectations and motivations of the visitor as well as the overall satisfaction a visitor receives during and after their visit.

Opportunity was assessed by evaluating the choices of experiences available to visitors. For this assessment, opportunity was considered primarily a function of vessel quotas and closed waters. Some factors related to quality were also considered when evaluating opportunity as well. For example, human-caused sound might eliminate opportunities for solitude and enjoying natural quiet.

This evaluation focuses on how visitor experiences might be affected by actions related to vessel quotas and operating requirements (or, in the case of alternative 1, not taking action). Note that experiences related to weather or conditions and services on cruise ships, tour vessels, or charter vessels are not evaluated here.

This analysis is based on the general assumption that solitude, wildlife viewing, and natural vistas are primary experiences visitors seek at Glacier and Dundas Bays and that the presence of other vessels generally diminish these experiences. Still, some visitors do enjoy seeing other vessels under certain circumstances; these positive aspects of visitor-visitor encounters are mentioned here but are not evaluated in detail in this EIS.

Visitors were separated into five categories:

- cruise ship passengers,
- tour vessel passengers,
- charter vessel passengers,
- private vessel passengers, and
- backcountry users (e.g. kayakers, hikers)

Visitors to Bartlett Cove or the outer coast are not considered in this analysis. With the exception of cruise ship and tour vessel passengers, some visitors may participate in more than one category, since charter and private vessel passengers often participate in off-vessel activities.

Visitor opinions and overall impressions of the park were determined based on annual backcountry visitor surveys (NPS 2003c) and on two larger studies: one conducted in 1989 (Johnson 1990) and another in 1999 (Littlejohn 2000). The 1989 study, *Glacier Bay National Park Tour Boat Passenger Visitor Survey*, measured the effect of vessel sightings on the experience of tour vessel passengers while viewing Grand Pacific Glacier. The 1999 *Bartlett Cove Visitor Study* provides the results of 545 questionnaires distributed to visitors at Bartlett Cove, but did not include cruise ship passengers.

The Alaska Travel Industry Association's *Images of Alaska 2000* (GMA Research Corporation 2001), and earlier editions, were used to determine the importance of visiting national parks while in Alaska among past and prospective visitors. *The Backcountry Distribution and Use Report* (Kralovec 2001) was used to evaluate visitor reactions to seeing motorized vessels and aircraft.

Additional information regarding visitor experience for this EIS was based various forms of communication, which include personal communications with cruise line marketing and customer relations managers, tour vessel operators, and charter operators; written and oral comments received during the scoping period and on the DEIS; and comments made informally during public open houses. These communications provided qualitative data regarding visitor experience in Glacier and Dundas Bays.

Table 4-23 presents the threshold criteria that was used to describe the intensities of effects on visitor experience in terms of satisfaction (the feeling left after an enjoyable experience) and opportunity. The percentages presented are intended to provide a general indication of the severity of the effect and are reflective of typical visitor use surveys employed by Glacier Bay National Park and Preserve (as cited above). Current visitor satisfaction is estimated to be in the range of 95% either reporting good or very good experiences (NPS 2003c).

TABLE 4-23: THRESHOLD CRITERIA FOR VISITOR EXPERIENCE EFFECTS ANALYSIS

Negligible	Over 95% of people within each visitor type that visit Glacier Bay and/or Dundas Bay leave very satisfied with their experience, consistent with the resources and values of Glacier Bay National Park and Preserve. Experiences reflect these purposes and values (as described in chapter 1). Visitors leave with a better understanding and appreciation of the resources and values. Opportunities to visit Glacier and Dundas Bays remain unchanged in terms of types of experiences available (e.g., visitor type, such as backcountry, on-land wilderness, non-motorized vessels, tour vessels, private vessels, charter vessels and activity, such as wildlife viewing, fishing, hiking, viewing scenery, viewing and learning about geologic processes) and the capacity for each type of experience.
Minor	Between 90% and 95% of visitors within each visitor type leave satisfied from an experience consistent with park resources and values. Some visitors are irritated during their visit due to the effects of vessel traffic and operating requirements (e.g., noise, visual intrusion by vessels and/or stack emissions, loss of solitude, crowding, inconveniences, or other conditions that distract from enjoyment). However, overall conditions, as described under negligible above, remain intact. Opportunities to visit Glacier and or Dundas Bay decrease in one or more of the types of experiences available, but by less than 10%.
Moderate	Between 85% and 90% of visitors within each visitor type leave satisfied (consistent with park resources and values). Most visitors experience some irritation as a result of vessel traffic and/or regulations, but the overall experience of most visitors is positive and in line with the goals outlined in the general management plan. Opportunities to visit Glacier Bay and/or Dundas Bay decrease in one or more of the types of experiences available and decline by between 10% and 20%.
Major	Severe, obvious, decline in visitor satisfaction in one or more types of visitors (below 85%). Many visitors are irritated by vessel noise, crowding, impeded views, lack of opportunities, frustrations, and other negative experiences. Opportunities to visit Glacier Bay and/or Dundas Bay decrease in one or more of the types of experiences available and decline by between 10% and 20%.

Alternative 1 (No Action) — Effects on Visitor Experience.

Direct and indirect effects on visitor experience — alternative 1 —

<u>Quality of Experience.</u>

CRUISE SHIP PASSENGERS: Current vessel quotas and operating requirements that affect the experience of cruise ship passengers include:

- speed restrictions in designated and in temporary whale waters,
- approach distance limits to harbor seals hauled out on ice (in Johns Hopkins Inlet), and
- effects of other vessels, including crowding, noise, and stack emissions.

A primary motivation to visit Glacier Bay for those that travel via cruise ship is to view tidewater glaciers as well as the scenic beauty throughout Glacier Bay. While a modern cruise ship provides many amenities and comforts, the scale and setting of Glacier Bay provides cruise ship passengers with what can be considered a “wildland” experiences.

The primary activity for cruise ship passengers in Glacier Bay is sightseeing (particularly the tidewater glaciers), photography/video taping, and learning about the natural processes and natural and cultural history of Glacier Bay. NPS interpretation staff are on board each cruise ship and provide interpretation throughout the day. In addition, NPS materials about Glacier Bay are provided to cruise line operators, who in turn, distribute these materials the night prior to arrival at Glacier Bay.

Cruise ship companies often promote Glacier Bay as the highlight of a cruise package, describing the spectacular views and tidewater glaciers. This promotion, together with the overall renown of Glacier Bay, likely raises cruise ship passenger expectations and interest in Glacier Bay.

Cruise ship passengers focus on viewing tidewater glaciers more than any other visitor group. The sheer scale of the modern cruise ship, the typical mid-channel route, and need to remain in deep waters, limit other activities, including exploring near-shore areas and viewing wildlife (although some opportunistic marine wildlife viewing does occur).

The effect of current vessel quotas and operating requirements on cruise ship passenger experiences within Glacier Bay are as follows (see chapter 2 for more details on these requirements).

Current speed restrictions require cruise ships to travel no greater than 20 knots within the lower Bay and no greater than 10 knots where the superintendent has designated such a limit due to the presence of humpback whales (temporary whale waters). Outside of these areas, cruise ships travel at speeds up to 26 knots.

The presence of other vessels within Glacier Bay may also reduce the enjoyment of cruise ship passengers. Seeing another cruise ship or tour vessel, or many smaller vessels (charter or private vessels) might detract from the feeling of solitude and naturalness or may impede views. Cruise ship captains and tour vessel operators typically communicate with other cruise ships and tour vessels to avoid crowding, which reduces the overall likelihood of other vessels causing negative experiences with visitors aboard cruise ships. Remnant stack emissions from cruise ships and tour vessels may detract from the scenic beauty within the narrow fjords (see the air quality subsection 4.2.2). The frequency, duration, and intensity of such air quality problems are not known.

TOUR VESSEL PASSENGERS: Current vessel quotas and operating requirements that affect the experience of tour vessel passengers include:

- speed restrictions in designated and temporary whale waters,
- buffer distances from wildlife and wildlife areas, and
- effects of other vessels, including crowding, noise, and stack emissions.

The motivations behind visitors that access Glacier Bay via tour vessels are typically much broader than those of cruise ship passengers, and include many more expectations, destinations, and activities. Wildlife viewing is an important motivator, as is visiting shoreline areas. Tour vessel passengers also travel to the East Arm and upper Dundas Bay, which is designated wilderness.

Speed restrictions may reduce the ability of visitors on tour vessels to reach the tidewater glaciers in the upper Bay, cruise shorelines, or take advantage of opportunistic wildlife viewing.

Buffers around nesting seabird colonies and other sites make these areas less visible to tour vessel passengers, and some visitors may be disappointed that they cannot get as close at they would like to see or photograph these sites.

Other vessels are known to detract from the experience of many visitors aboard tour vessels. Littlejohn (2000) found that about one in every four private, charter, and tour vessel passenger reported negative impressions from the seeing cruise ships during their visit. About 1 in 8 visitors aboard tour vessel reported adverse effects from vessels other than cruise ships.

Other vessels, particularly other tour vessels and charter and private vessels, may also disturb wildlife and reduce the number of wildlife viewing events for tour vessel passengers. These other vessels can detract from the feeling of solitude for tour vessel passengers as well.

Still, based on survey questions related to the overall experience within Glacier Bay (NPS 2003c), the overall affect on visitor experience would be expected to be within the minor category, with visitor satisfaction ranging above 90%. This conclusion is based on the generally positive results of visitor surveys cited in the methodology section. In addition, the resources and setting of Glacier Bay generally supports enjoyable experiences for tour vessel passengers.

CHARTER VESSEL PASSENGERS: Visitors aboard charter vessels are often seeking a freer, more self-directed experience. Typical motivations include viewing glaciers, scenery, and wildlife. Charter vessels are also the most wide-ranging of vessels other than private vessels. They travel throughout Glacier Bay and also Dundas Bay, which is an attractive place for charter vessel operators to take their clients to view wildlife – particularly in the upper portions of the Bay.

The sights and sounds of other vessels might detract from some charter vessel passengers' enjoyment. The negative impression of other vessels might be somewhat greater for visitors using charter vessels than for visitors aboard cruise ships or tour vessels because, as small-vessel travelers, their experience is more likely to be dependent on an atmosphere of undisturbed wilderness. The sights and sounds of other vessels, especially cruise ships and the public address system of cruise ships and tour vessels are likely to detract from the feeling of solitude and natural quite for some visitors. Charter use in Dundas Bay is expected to increase over time under alternative 1, which could result in a decrease in the quality of experience there (see assumptions as the beginning chapter 4).

Noise is most likely to occur at popular stops along the route to upper Glacier Bay. These areas include:

- Sitakaday Narrows;
- Bartlett Cove;
- Gloomy Knob;
- South Marble Island;
- North Sandy Cove;
- McBride Inlet; and
- Tarr, Johns Hopkins, and Reid Inlets.

For all visitors traveling in motorized vessels, motor noise from each visitor's vessel is expected to mask sound from other vessels, when the vessel is traveling or idling with its motor engaged, but it also masks natural sounds and quiet. However, motor noise from other vessels is not masked for all visitors when their vessels are at anchor or drifting with their motor off. In addition, vessel passengers are often inside the cabin, or, if on deck, are exposed to wind that also masks sounds. Overall, sound levels at popular destinations, such as Tarr and Johns Hopkins Inlets, detract from some visitors' enjoyment of these areas. Charter vessels are more likely to anchor or shut down the engines, although larger vessels typically keep engines on to maintain power. With the engines shut down, visitors on vessels can hear other vessels at significant distances and for long periods of time. The cruise ships' and tour vessels' public address systems may be heard in several locations by visitors aboard charter vessels. In addition, tour and charter vessels dropping off groups for kayaking or shore-based activities would introduce concentrated areas of human-made sound, most of which would be voices.

PRIVATE VESSEL PASSENGERS: Of the four vessel types being considered for new quotas and operating requirements in this EIS, only on a private vessel do visitors maintain almost complete control of their activities and routes. Visitors' on private vessels motivations include wildlife viewing and exploration, as well as viewing the tidewater glaciers.

The independence of visitors aboard private vessel also increases their responsibilities to understand and follow NPS regulations. Private vessel operators must spend time learning the many regulations in place and are required to contact park headquarters and receive orientation to the park. As stated under issues, private vessel operators are often denied permits during peak-use periods of mid-summer. This situation, which would continue under alternative 1, likely detracts from the enjoyment of these visitors' experiences in Glacier Bay.

In addition to confusion regarding the many regulations private vessel operators are required to follow, many of the restrictions can detract from their experience by making areas off-limits or, as described for other visitor types, by making wildlife viewing more difficult.

Private vessel visitors are similar to charter vessel visitors in that they are seeking a more solitary wilderness experience. Some of these visitors would likely continue to be disturbed by the current level of vessel activity in the park. With the expected increases in the level of private vessels, visitors would be less able to get away from other vessels and their associated effect.

BACKCOUNTRY USERS: Backcountry users for this assessment are considered those visitors to Glacier or Dundas Bays (outside of Bartlett Cove) that travel on foot or on a non-motorized vessel (mostly kayaks). While backcountry users are the smallest visitor group to visit Glacier and Dundas Bay, yet providing backcountry experiences is fundamental to the purposes and values of Glacier Bay National Park and Preserve.

For backcountry users (non-motorized), an overall moderate level effect would occur due to the site and sound and emissions of cruise ships, and tour, charter, and private vessels. Motorized use of wilderness waterways would be seasonally restricted, except for the upper end of Dundas Bay and the Beardslee Entrance, to allow for increased opportunities to experience the Bay in the absence of motorized vessels. Alternative 1 also provides alternating seasonal closures for Waschusett and Muir Inlets, allowing opportunities for non-motorized recreation.

Motorized vessels can reduce the enjoyment of solitude and wilderness for backcountry visitors. Backcountry use is concentrated near shorelines. Motorized vessels, particularly charter and private vessels, travel along shorelines and may anchor for 12 hours or more near shorelines, producing sights, sounds, and exhaust. Some tour vessels create large waves that can swamp kayaks and other small vessels. The waves can also detract from feelings of solitude.

Vessel noise can be particularly disturbing to backcountry users. The magnitude of vessel-caused noise depends on the distance of the vessel from potential listeners, the type of vessel generating the sound, and the activity of the vessel. Vessel noise has been reported to travel well inland (two miles or more), depending on topography (NPS, Banks, pers. comm., 2003). Even visitors in non-motorized waters, which are intended to provide opportunities to enjoy public resources in the absence of vessel noise, may be subject to vessel sounds, especially if the visitors are near motorized waters.

Cruise ships mainly travel up the center of Glacier Bay, however in the narrower inlets they can, at times, travel very close to shore. Visitors at anchor, drifting, or on the shoreline can sometimes hear cruise ships for miles. The loudest sound from a cruise ship is its public address system, which can be heard for several miles in some instances. The same holds true for tour vessels. Most cruise ship and tour vessel passengers accept and enjoy the address system, so the primary effect is on visitors in other vessels or on the shore. Hearing a public address system can greatly reduce the feeling of solitude and naturalness for backcountry users.

Tour vessels, as well as charter vessels, often drop off kayakers. Drop offs of 10, or sometimes many more, kayakers can create quite a lot of noise. Such events could distract from other visitors' experience. The presence of tour vessels in the upper portion (wilderness waters) of Dundas Bay could reduce the wildland experience of visitors aboard charter vessels. Tour vessels can be quite large and imposing within the scale of Dundas Bay, especially the upper reaches.

Visitor use surveys conducted in 1979 and 1984 indicated that 55% and 60% of backcountry users, respectively, were disturbed by motorized watercraft during their visit to Glacier Bay (Johnson 1979; Salvi and Johnson 1985). In the 1984 study, when asked for recommendations for new regulations, 25% of the respondents suggested limiting watercraft, the most abundant suggestion. More than 63% of the respondents stated that the number of watercraft and aircraft sighted resulted in a strong or great contribution to their perception of being crowded. In 1979 and 1984, approximately 88% of respondents preferred to see no increase in cruise ships, 90% preferred to see no increase in tour vessels, and a substantial majority preferred to see no increase in other motorized vessel categories. In the 1999 Bartlett Cove visitor survey (Littlejohn 2000), when visitors were asked what they least liked about their visit to the park, 2% mentioned airplane and/or boat noise.

Opportunity —

<u>Cruise ships</u>. Currently, about half of the people who visit Alaska via cruise ships visit Glacier Bay, and over 90% of visitors to Glacier Bay travel via cruise ships. Under alternative 1, the current number of cruise ships would be maintained. Cruise ships quotas under alternative 1 might limit opportunities for visitors in the future if demand continues to increase (note that for some visitors, price may be the limiting factor, rather than availability; see socioeconomics). Because passenger capacity of cruise ships is increasing, however, the availability would increase before eventually leveling off. New cruise ship capacity is as high as 2,600 passengers. As an example of the effect of increasing capacity, the number of cruise ship passengers hit an all-time high in Glacier Bay in 2002, despite six cancellations and the lowest number of cruise ships visiting since 1996 (Parrish 2002).

Current operating requirements to protect harbor seals prohibit cruise ships from entering the upper reaches of Johns Hopkins Inlet from May 1 through August 31. In addition, cruise ships (and all motorized vessels) are required to remain 0.25 mile (0.4 kilometer) from harbor seals hauled out on ice from July 1 through August 31. This, according to comments from one cruise ship operator, greatly restricts the ability of cruise ships to enter Johns Hopkins Inlet and view the over 1-mile (1.5-kilometer) long Johns Hopkins Glacier, which is known for regularly "calving" ice and large ice floes. The effect on visitor experience for cruise ship passengers is the loss of seeing one of the larger and most active tidewater glaciers, as well as seeing harbor seals hauled out on ice (which can be one of the few opportunities for wildlife viewing while on board a cruise ship). However, Johns Hopkins Inlet often contains large amounts of floating ice, so use of this area is often limited by natural conditions. Most cruise ships visit Marjorie Glacier, another very active glacier, and the nearby Grand Pacific Glacier.

Tour vessels. Tour vessels are the second most popular way of visiting Glacier Bay. Visitors can board a daily tour vessel at Bartlett Cove. Other tours are available out of various ports including Juneau, Ketchikan, and Sitka. Alternative 1 would continue to offer 276 entries per season to tour vessels. In recent years, the number of actual tour vessel entries was substantially less than the number allowed (200 in 2002, 228 in 2001, and 224 in 2000). The primary day tour vessel meets the current level of demand (with daily departures throughout the summer, the vessel rarely runs at capacity); therefore, under alternative 1, sufficient opportunity for day vessel passengers to experience the park would continue until demand increases.

Charter vessels. Alternative 1 would offer 312 entries per season to charter vessels. In general, this limit would continue to meet charter vessel demand. From June through August 2001, 172 charter vessels entered Glacier Bay (out of the allowable 312) and 247 total use days (out of the allowable 552). However, the lower numbers are at least in part due to how charter permits are allocated and how those with permits are using them. Charter vessel use (and opportunities) for both Glacier and Dundas Bays is expected to increase independent of actions being considered in this EIS, since the Park Service plans to reallocate permits within the next few years.

Private vessels. While representing only a fraction of the total visitors to Glacier Bay, the ability to visit Glacier Bay on a private vessel is an important element of maintaining a range of high-quality visitor opportunities. Among visitors who experience the park in private vessels, alternative 1 would continue to offer 468 total entries from June through August. However, this limit has never been reached. Records indicate 414 private vessels entered the park in the 2000 season, followed by 385 in 2001. The current quota system requires the Park Service to ration permits to ensure that the seasonal limit is not reached too early. The current rationing is three entries per day from June 1 to June 10, six entries per day from June 11 to August 2, five entries per day from August 3 to August 15, and three entries per day from August 15 to August 31. Due to this rationing, many boaters are denied permits during the high visitation period of mid-summer. Some local area users have indicated to NPS staff that many local people do not even try to access Glacier Bay due to the perception that it is too difficult to get a permit.

In addition to the seasonal limit, there are also daily limits. Alternative 1 would continue to result in periods when the daily demand for park entry exceeds the number of allowable entries.

Backcountry visitors. Backcountry visitors are not limited by any actions being considered in this EIS. The Park Service is planning to develop a backcountry management plan, which would direct such use. Therefore, this analysis focuses on the loss of backcountry opportunities from an environmental standpoint, rather than for access. Alternative 1 includes many areas that are seasonally closed to motorized vessels, which provides opportunities for backcountry visitors some shelter from the sight, sounds, and air emissions of motorized vessels, although as described earlier, vessel-generated sound travels far and does enter into some seasonally closed areas.

Cumulative effects on visitor experience — alternative 1 — The cumulative effects area considered is Glacier and Dundas Bays. Other past, present, and reasonably foreseeable actions that disrupt visitor experiences in these areas are:

- administrative traffic.
- backcountry use and management area planning.
- flightseeing.
- new cruise ship port of call at Point Sophia.
- commercial fishing.

Backcountry use and management also greatly effect many types of visitors, but particularly backcountry visitors. Backcountry visitors are subject to various beach closures, as well as disturbance from other backcountry visitors. The presence of people on and near the shore might displace wildlife that otherwise would be available for other backcountry users, as well as people on vessels, to observe. Concentration of campers along the beach can detract from the enjoyment by all visitors aboard motorized vessels by detracting from the "natural beauty."

Other than vessels, the most notable sound source within Glacier Bay and, to a lesser degree, Dundas Bay, is aircraft. Aircraft landings in the park are infrequent, averaging fewer than one per day in Glacier Bay and fewer than two per day at Bartlett Cove. The development at Point Sophia could increase flight traffic over Glacier Bay. As a port of call for cruise ships, the operation there could develop a scenic flight program that would increase disturbance to visitors at Glacier Bay. This could eventually generate excessive noises near popular destinations, including the tidewater glaciers. The extent of this effect is unknown and cannot be predicted.

Finally, generators from Bartlett Cove operations can be heard for several miles, and backcountry users in the Beardslee Islands often complain about the noise, in particular that heard at night.

The overall cumulative effect on quality of visitor experience and visitor opportunities, considered collectively with the effects of alternative 1, would still be in the range of moderate for backcountry visitors and minor for others.

Impairment analysis for visitor experience — alternative 1 — Visitor experience is not a resource subject to impairment evaluation.

Conclusion, visitor experience — alternative 1 — Current regulations would continue to provide an overall enjoyable experience for the majority of visitors. The sight and sound of other vessels would likely detract from some visitor experiences. Closed waters and approach distance to nesting seabird colonies and other important sites would limit the available experiences for some visitors. Some visitors on private vessels would still be denied permits during the peak use period of mid-summer. Although some visitors would be irritated by some aspect of their visit to the park, it is expected that most visitors on motorized vessels would leave the park feeling satisfied with their visit. The effect would be in the minor range as presented in table 4-23. Backcountry visitors would continue to be moderately effected, due to their sensitivity to the sight and sound of vessels.

Under alternative 1, visitors using motorized vessels would continue to be provided with a wide range of park-related opportunities. The level of effect, however, would be minor rather than negligible since some vessel operators would be unable to obtain a permit during the peak visitor season. Backcountry visitors would continue to experience a loss of opportunity to experience solitude, resulting in a moderate effect.

Alternative 2 – Effects on Visitor Experience.

Direct and indirect effects on visitor experience —

Quality of experience. Alternative 2 would maintain existing operating requirements, so adverse effects on visitor enjoyment related to operating requirements would continue as described for alternative 1 and as summarized here. Speed restrictions in the lower Bay and in temporary whale waters would delay visitors en route to popular destinations. This would detract from some visitors' enjoyment. Buffers around nesting seabird colonies and other sites might disappoint some people wishing to get closer.

Because of lower cruise ship, charter vessel, and private vessel numbers in Glacier Bay, the effects of these vessels would decline over the existing management situation in Glacier Bay, but effects, as described under alternative 1, would still occur. Motorized vessels would still be common and would detract from the experience of some visitors. Impact mechanisms include visible haze from exhaust, noise from cruise ship and tour vessel public address systems, and noise from private and charter vessels (which might reduce wildlife along the shoreline and associated viewing opportunities).

The reduced quotas would improve the enjoyment of scenic vistas and feelings of wilderness for some visitors. All visitors might see more wildlife and hear less noise than would otherwise occur because of the reduced vessel numbers (over the existing quotas). Visitors aboard charter or private vessels generally visit Glacier Bay and Dundas Bay on smaller vessels and tend to seek a more remote, undisturbed experience when compared to the tour vessel or cruise passengers. A reduction of 23% of cruise ship entries could improve the experience for these visitors, at the tidewater glaciers, since fewer cruise ships would be present to interfere with the solitude and naturalness of these areas.

Use of Dundas Bay might increase over time, since no quotas are in place. Charter vessels would continue to potentially disturb wildlife in Dundas Bay, and tour vessels would continue to potentially disturb visitors aboard charter vessels and backcountry visitors in this area.

Opportunity. Among cruise passengers, alternative 2 would decrease the opportunity to visit the park, with 23% fewer seasonal entries by cruise ships allowed. This would represent a major adverse effect on the opportunity for cruise ship passengers to visit the park.

Because the number of tour vessel entries into Glacier Bay would remain the same in alternative 2 as in alternative 1, there would be no change in the opportunity for tour vessel passengers to visit the park.

Alternative 2 would create a moderate adverse effect on the opportunity for visitors to charter a vessel to visit the park, because it would decrease the allowable entries (compared to alternative 1) by 13%.

Among private vessel visitors, alternative 2 would create a moderate adverse effect on the opportunity to visit the park. The allowable entries would decrease by 13% from alternative 1. Problems with permit rationing would continue to deny some visitors in private vessels access to Glacier Bay.

More opportunities would be available to experience solitude under this alternative due to the 23% decrease in cruise ship use days, 7% decrease in charter vessel use days, and a 13% decrease in private vessel use days. As mentioned under alternative 1, approximately 88% of respondents to backcountry surveys (Johnson 1979; Salvi and Johnson 1985) preferred to see no increase in cruise ships, 90% preferred to see no increase in tour vessels, and a substantial majority preferred to see no increase in other motorized vessel categories.

Opportunities to engage in experiences that rely on a sense of wildness, remoteness, quiet, and solitude would slightly increase because of fewer vessels.

Cumulative effects on visitor experience – alternative 2 - Alternative 2 would reduce the contribution that vessel quotas and operating requirements make to cumulative effects. Administrative traffic would add to the overall effect of vessel traffic on visitor enjoyment.

Backcountry use and management also greatly effect many types of visitors, but particularly backcountry visitors. Backcountry visitors are subject to various beach closures, as well as disturbance from other backcountry visitors. Concentration of campers along the beach can detract from the enjoyment by all visitors aboard motorized vessels by detracting from the "natural beauty." Aircraft noise would add to vessel noise. The development at Point Sophia could increase flight traffic over Glacier Bay. Generators from Bartlett Cove operations can be heard for several miles, and backcountry users in the Beardslee Islands often complain about the noise, particularly noise heard at night.

The overall cumulative effect on quality of visitor experience and visitor opportunities, considered collectively with the effects of alternative 2, would still be in the range of minor for visitors aboard cruise ship, tour vessels, charter vessels, and private vessels and moderate for backcountry visitors (moderate because of their greater sensitivity to vessel-related disturbance).

Impairment analysis for visitor experience—– alternative 2 — Visitor experience is not a resource subject to impairment evaluation.

Conclusion, visitor experience — alternative 2 — Alternative 2 would improve visitor experience by reducing the sight and sound of vessel traffic. Existing frustrations with the permit system and regulations would continue among visitors wishing to travel to Glacier Bay in a private vessel. Potential conflicts between tour and charter vessels could occur in the upper reaches of Dundas Bay, where charter vessels create noise and may disturbed wildlife, while tour vessels present an intrusion of a large vessel into a wilderness setting, with potential additional noise intrusions from public address systems. Though the effects would be reduced from alternative 1 effects, the effects would still be minor for motorized vessel visitors and moderate for backcountry visitors for both quality of experience and opportunity.

Alternative 3 – Effects on Visitor Experience.

Direct and indirect effects on visitor experience — alternative 3 —

Quality of Experience. As with alternative 2, operating requirements would not change from the existing conditions, so the effects of alternative 3 related to operating requirements remain the same as described for alternatives 1 and 2. Namely, speed restrictions in the lower Bay and in temporary whale waters would delay visitors en route to popular destinations. This would detract from some visitor enjoyment. Buffers around nesting seabird colonies and other sites might disappoint some people wishing to get closer. With the potential increase in seasonal-use days, there could be fewer and potentially no days without cruise ships.

Fewer or no days without cruise ships would further detract from the wilderness experience of visitors, including the potential for visible haze from exhaust and noise from cruise ship public address systems.

Because this alternative includes provisions for additional increases in cruise ships and because cruise ships have a greater effect on backcountry visitors' ability to experience of solitude, the effects on backcountry visitors would be greater for this alternative than alternative 1. The increased number of cruise ships may lead to more backcountry visitors seeking non-motorized wilderness, leading to loss of solitude in those areas.

Noise from tour vessels, including public address systems, and noise and visual distractions caused by private and charter vessels (which might reduce wildlife viewing for visitors aboard tour vessels) would not change from that under the no-action alternative. Vessel use of the wilderness waters of Dundas Bay would continue to potentially disturb wildlife and associated wildlife viewing in this area.

<u>Opportunity</u>. Alternative 3 could increase opportunities to visit Glacier Bay by 33%. Because the number of tour, charter, and private vessel entries into Glacier Bay would remain the same as the existing situation, there would be no change in opportunity for these passengers to visit the park.

Cumulative effects on visitor experience — alternative 3 — Alternative 3 would increase the contribution that vessel quotas and operating requirements make to cumulative effects due to increases in cruise ship traffic. Administrative traffic would add to the overall effect of vessel traffic on visitor enjoyment. Backcountry use and management also greatly effect many types of visitors, but particularly backcountry visitors. Backcountry visitors are subject to various beach closures, as well as disturbance from other backcountry visitors. Concentration of campers along the beach can detract from the enjoyment by all visitors aboard motorized vessels by detracting from the "natural beauty." Aircraft noise would add to vessel noise. The development at Point Sophia could increase flight traffic over Glacier Bay. Generators from Bartlett Cove operations can be heard for several miles, and backcountry users in the Beardslee Islands often complain about the noise, particularly that heard at night.

The overall cumulative effect on quality of visitor experience and visitor opportunities, considered collectively with the effects of alternative 3, would still be in the range of minor for visitors aboard cruise ship, tour vessels, charter vessels, and private vessels and moderate for backcountry visitors (moderate because of their greater sensitivity to vessel-related disturbance).

Impairment analysis for visitor experience — alternative 3 — Visitor experience is not a resource subject to impairment evaluation.

Conclusion, visitor experience — alternative 3 — Among motorized vessel passengers, alternative 3 would lower the quality of the visitor experience with the increase in cruise ships, including increased visible haze and noise as well as decreased solitude when cruise ships are present due to the immense size of cruise ships. However, the effect would still be considered minor for motorized vessel visitors. For backcountry visitors this effect would be moderate. Opportunities to visit Glacier Bay via a cruise ship would be greatly increased, which would result in beneficial effects for cruise ship visitors.

Alternative 4 – Effects on Visitor Experience.

Direct and indirect effects on visitor experience — alternative 4 —

<u>Quality of experience.</u> Vessel operating requirements would be revised as listed in table 2-14. A primary change is that vessels 262 feet (80 meters) long or greater would be required to travel at 13-knots or less throughout Glacier Bay.

The direct effect of this limit would be that visitors aboard cruise ships would need to spend several additional hours in the Bay. This would result in visitors on other vessels seeing cruise ships longer and potentially later in the day and, for at least some cruise ship passengers, the additional transit time may seem too long, especially on the trip out of the Bay. A beneficial effect of increased time in the Bay would be the opportunity to provide more interpretation and take advantage of opportunistic wildlife viewing.

Among both charter vessel and private vessel passengers, alternative 4 would increase solitude over what would occur under the no-action alternative. As stated previously, these visitors tend to be seeking a more remote, undisturbed experience when compared to the tour vessel or cruise passenger market. The sight and sound of a large cruise ship represents an infringement upon this solitary experience. A decrease of 34% in the number of cruise ships would likely enhance the quality of experience for some of these visitors. The seasonal-use day limits in May and September would reduce the vessel-related effects for backcountry and other visitors for these months.

In addition, alternative 4 would prohibit tour vessels from Dundas Bay and the East Arm of Glacier Bay and would create daily limits for charter vessels in Dundas Bay, which would further improve the experience, including the absence of very large vessels (except for occasional large private vessels) and potentially increased wildlife sightings, for charter and private vessel passengers and for backcountry visitors.

<u>Opportunity</u>. Alternative 4 would reduce cruise ships by 34% from June through August and even more during May and September. Alternative 4 also would greatly reduce tour vessel passengers' opportunities to visit Glacier Bay with a 33% decrease in allowable tour vessel entries and a complete elimination of opportunities to visit Dundas Bay via a regularly scheduled tour vessel. Visitors wishing to charter a vessel would face a 17% decrease in charter vessel availability, so prime visitation dates may fill up earlier. Daily limits for charter vessels in Dundas Bay would reduce crowding in this area.

Three changes in the way vessel quotas are measured would improve opportunities and reduce frustrations for private vessel operators. Under alternative 4:

- the "based in Bartlett Cove" exemption would be eliminated,
- short-notice permits for private vessels would be made available (10 initially, and then adjusted annually through the park compendium as necessary), and
- the use of "seasonal entries" limits would be eliminated.

These actions would eliminate the need to "ration" entries to avoid running out of permits at the end of the season. This would simplify the regulations, reducing frustration of visitors in private vessels.

The opportunity to visit Dundas Bay would be reduced under alternative 4 for all vessel types except private vessels. While private vessels would continue to be allowed entry into Dundas Bay, tour vessels and cruise ships would be prohibited and charter vessels would be limited to three vessels per day. These restrictions, coupled with loss of opportunities for cruise ships and tour vessels in the East Arm, would create a moderate adverse effect on cruise ship and tour and charter vessel passengers. The establishment of daily limits for charter vessels in Dundas Bay could reduce visitor opportunity for charter vessel passengers in Dundas Bay. This would introduce complications in allocating and management of charter vessel permits which might reduce the number of charter operators that offer trips to Dundas Bay.

For backcountry visitors, this alternative would provide increased opportunities to experience solitude and increased enjoyment; therefore, it is anticipated that this alternative would increase the likelihood of a positive experience for non-motorized backcountry visitors.

Cumulative effects on visitor experience — alternative 4 — The overall cumulative effect on visitor experience includes the following:

- administrative traffic,
- backcountry use and management,
- flightseeing, and
- the new cruise ship port of call at Point Sophia.

The overall effect is expected to be within the moderate range for backcountry visitors, as described under the no-action alternative. Overall effects on visitor quality would be reduced over what would occur without action. The levels of traffic and operating requirements would contribute more disturbances than would be caused by these other actions. Considered collectively, the effect would still be within the minor range for visitors on cruise ships and tour, charter, and private vessels because visitors would continue to enjoy Glacier Bay. Loss of access would not be additive to the effects caused by the actions considered under this cumulative analysis.

Impairment analysis for visitor experience — alternative 4 — Visitor experience is not a resource subject to impairment evaluation.

Conclusion, visitor experience — alternative 4 — Alternative 4 would reduce the numbers of all vessel classes except private vessels, which would increase the quality of visitor experience and, therefore, reduce the effect of vessels, especially on charter and private vessel and backcountry visitors. Changes in the quota system (particularly the elimination of "seasonal entries") would benefit private vessels and simplify management because there would no longer be a need to ration permits to avoid running out of permits. The level of effect could continue to be minor. In terms of visitor opportunity, however, there would be major adverse effects for people wishing to visit Glacier Bay via cruise ship and tour vessel, and for people wishing to take a regularly scheduled tour vessel to Dundas Bay. Backcountry visitors would have a greater opportunity to experience solitude, especially in Dundas Bay.

Alternative 5 – Effects on Visitor Experience.

Direct and indirect effects on visitor experience — alternative 5 —

<u>Quality of experience</u>. Vessel operating requirements would be revised as listed in table 2-14. A primary change is that vessels 262 feet (80 meters) long or greater would be required to travel at 13-knots or less throughout Glacier Bay. The direct effect of this limit would be that visitors aboard cruise ships would need to spend several additional hours in the Bay. This would result in visitors on other vessels seeing cruise ships longer and potentially later in the day and, for at least some cruise ship passengers, the additional time may become too long, especially on the trip out of the Bay. A beneficial effect of increased time in the Bay would be the opportunity to provide more interpretation, as well as more opportunistic views of marine wildlife.

In addition, alternative 5 would prohibit tour vessels from wilderness waters of Dundas Bay and would set seasonal limits to charter vessels, which would further improve the experience for visitors on charter and private vessels, as well as for backcountry users. The improved experience would include the absence of very large vessels (accept for occasional large private vessels) and potentially increased wildlife sightings.

Reducing cruise ships during May and September would reduce the effect of cruise ships on backcountry and other visitors during these months.

Setting a seasonal limit on charter vessels in Dundas Bay during the period of June 1 to August 31 could increase the opportunities for solitude that many backcountry visitors seek by decreasing the total number of motorized vessels and the associated sounds, smells, and sightings. Also, if these charter vessels drop-off sea kayakers to Dundas Bay, limiting the numbers of these charter vessels could decrease the total numbers of sea kayakers in the Bay, as well. Due to a lack of monitoring, however, it is unclear what type of activities charter vessels currently bring to Dundas Bay.

Alternative 5 would change the vessel speed requirement to be measured "over the ground" rather than "through the water." This would make it easier for vessel operators, particularly private vessels, to follow the speed limits because most vessels operators now measure their speed as over the ground using GPS receivers.

<u>Opportunity</u>. Alternative 5 would have a moderate adverse effect on the opportunity for cruise visitors to experience Glacier Bay. Total allowable cruise entries for May through September would decrease 11%, from 261 in alternative 1 to 231.

Alternative 5 introduces no changes in the number of entries for tour vessels, charter vessels, and private vessels when compared to alternative 1 (the seasonal-use day limit for private vessels would be greater); therefore, it would represent negligible effects on the opportunity for passengers aboard these vessels to experience Glacier Bay.

Tour vessel visitors would no longer be able to visit wilderness waters of Dundas Bay.

Alternative 5 represents a minor beneficial effect on the opportunity to experience Dundas Bay for charter vessel passengers, because it does not limit daily charter entries; however, the seasonal-use days (276) would be limited.

Three changes in the way vessel quotas are measured would improve opportunities and reduce frustrations for private vessel operators. Under alternative 5:

- the "based in Bartlett Cove" exemption would be eliminated,
- short-notice permits for private vessels would be made available (10 initially, and then adjusted annually through the park compendium as necessary), and
- the use of "seasonal entries" limits would be eliminated.

These actions would eliminate the need to "ration" entries to avoid running out of permits at the end of the season. This would simplify the regulations, reduce or eliminate the frequency of private vessels denied access, and reduce frustrations of visitors in private vessels.

Cumulative effects on visitor experience — alternative 5 — The overall cumulative effect on visitor experience from

- administrative traffic,
- backcountry use and management,
- flightseeing, and
- the new cruise ship port of call at Point Sophia,

is expected to be within the moderate range for backcountry visitors, as described under the no-action alternative. The levels of traffic and operating requirements would contribute probably more disturbances than caused by these other actions. Considered collectively, the effect would still be within the minor range, because visitors would continue to enjoy Glacier Bay, except for backcountry users, where effects could range into the moderate category due to the sensitivity of backcountry users to vessel-related effects. Loss of access would not be additive to the effects caused by the actions considered under this cumulative analysis.

Impairment analysis for visitor experience–— alternative 5 — Visitor experience is not a resource subject to impairment evaluation.

Conclusion, visitor experience – alternative 5 – Under alternative 5, cruise ship passengers and tour vessel passengers would continue to see other vessels, but the effect to the quality of visitor experience would be negligible. Among visitors on charter and private vessels and in the backcountry, the reduction in cruise ships during May and September would have a minor beneficial effect. In terms of visitor opportunity, alternative 5 would slightly lower the opportunity for cruise visitors to experience Glacier Bay, which would be considered a minor effect. There would be beneficial effects on opportunity for tour vessel, charter vessel, and private vessel visitor opportunities in Glacier Bay with the elimination of entries and the increase in private vessel seasonal-use days. The opportunity for backcountry visitors to experience the park without the sight and sound of vessels would be moderate.

Alternative 6 – Effects on Visitor Experience.

Direct and indirect effects on visitor experience — alternative 6 — Vessel operating requirements would be revised as listed in table 2-14. A primary change is that vessels 262 feet (80 meters) long or greater would be required to travel at 13-knots or less throughout Glacier Bay. The direct effect of this limit would be that visitors aboard cruise ships would need to spend several additional hours in the Bay. This would result in visitors on other vessels seeing cruise ships longer and potentially later in the day and, for at least some cruise ship passengers, the additional time may become too long, especially on the trip out of the Bay. A beneficial effect of increased time in the Bay would be the opportunity to provide more interpretation, as well as more opportunistic views of marine wildlife.

In addition, alternative 6 would prohibit tour vessels from wilderness waters of Dundas Bay and would set seasonal limits to charter vessels, which would further improve the experience for visitors on charter and private vessels, as well as for backcountry users. The improved experience would include the absence of very large vessels (except for occasional large private vessels) and potentially increased wildlife sightings.

The effect of cruise ships would be expected to increase over the existing management situation. Large cruise ships entering the Bay and traveling up the Bay would increase, which could further detract from the wilderness/wildland experience of other visitors, including the potential for visible haze from exhaust, noise from cruise ship public address systems. This would add to the noise from tour vessels, including public address systems, and noise and visual distractions caused by private and charter vessels (which might reduce wildlife viewing for visitors aboard tour vessels). Vessel use of the wilderness waters of Dundas Bay would continue to potentially disturb wildlife and associated wildlife viewing in this area.

Because this alternative includes provisions for additional increases in cruise ships and because cruise ships have a greater effect on backcountry visitors' ability to experience of solitude, the effects on backcountry visitors would be greater for this alternative than alternative 1. The increased number of cruise ships may lead to more backcountry visitors seeking non-motorized wilderness, leading to loss of solitude in those areas.

Setting a seasonal limit on charter vessels in Dundas Bay during the period of June 1 to August 31 could increase the opportunities for solitude that many backcountry visitors seek by decreasing the total number of motorized vessels and the associated sounds, smells, and sightings. Charter vessels currently are bringing sportfishing, sightseeing, wildlife viewing, hiking, and kayaking visitors to Dundas Bay.

<u>Opportunity</u>. Total allowable cruise ship seasonal-use days would initially decrease opportunities to visit Glacier Bay during May and September. However, alternative 6 could increase opportunities to visit Glacier Bay via cruise ship by 33% during June through August.

Alternative 6 introduces no changes in the number of entries for tour vessels, charter vessels, and private vessels when compared to alternative 1 (the seasonal-use day limit for private vessels would be greater); therefore, it would represent negligible effects on the opportunity for passengers aboard those vessels to experience Glacier Bay. The elimination of entries would also allow vessels to leave and reenter the park on one permit and would have a positive effect on opportunity to visit the park.

Tour vessel visitors would no longer be able to visit wilderness waters of Dundas Bay.

Alternative 6 represents a minor beneficial effect on the opportunity to experience Dundas Bay for charter vessel passengers, because it does not limit daily charter entries; however, the seasonal-use days (276) would be limited.

Three changes in the way vessel quotas are measured would improve opportunities and reduce frustrations for private vessel operators. Under alternative 6:

- the “based in Bartlett Cove” exemption would be eliminated,
- short-notice permits for private vessels would be made available (10 initially, and then adjusted annually through the park compendium as necessary), and
- the use of “seasonal entries” limits would be eliminated.

These actions would eliminate the need to “ration” entries to avoid running out of permits at the end of the season. This would simplify the regulations, reduce or eliminate the frequency of private vessels that are denied access, and reduce frustrations of visitors in private vessels.

Cumulative effects on visitor experience — alternative 6 — The overall cumulative effect on visitor experience from

- administrative traffic,
- backcountry use and management,
- flightseeing, and
- the new cruise ship port of call at Point Sophia,

is expected to be within the moderate range for backcountry visitors, as described under the no-action alternative. The levels of traffic and operating requirements would contribute probably more disturbances than are caused by these other actions. Considered collectively, the effect would still be within the minor range, because visitors would continue to enjoy Glacier Bay, except for backcountry users, where effects could range into the moderate category due to the sensitivity of backcountry users to vessel-related effects. Loss of access would not be additive to the effects caused by the actions considered under this cumulative analysis.

Impairment analysis for visitor experience—– alternative 6 — Visitor experience is not a resource subject to impairment evaluation.

Conclusion, visitor experience – alternative 6 – Under alternative 6, cruise ship passengers and tour vessel passengers would continue to see other vessels, but the effect to the quality of visitor experience would be negligible. Among visitors on charter and private vessels, the potential increase in cruise ships would have a minor effect. For backcountry visitors, this effect would be moderate. In terms of visitor opportunity, alternative 6 would increase the opportunity for cruise visitors to experience Glacier Bay, which would be considered a beneficial effect. However, visitor opportunity on board cruise ships would be decreased in May and September due to a quota on seasonal-use days. There would be beneficial effects on opportunity for tour vessel, charter vessel, and private vessel visitor opportunities in Glacier Bay with the elimination of entries and the increase in private vessel seasonal-use days. The opportunity for backcountry visitors to experience the park without the sight and sound of motorized vessels would be moderate.

Summary, Visitor Experience. One of the important purposes of vessel quotas and operating requirements is to provide a range of enjoyable visitor experiences.

Under all alternatives, the sights and sounds of other visitors and their motorized vessels would detract from the enjoyment of some visitors. Backcountry visitors can be sensitive to this disturbance because they generally travel by non-motorized methods (e.g., kayaks or on foot), which does not mask the sound of vessels, and are more likely to be seeking natural quiet and solitude. However, the sound of other motorized vessels can also impact visitors in motorized vessels when their vessels are drifting without the motor engaged or at anchor.

Alternative 1 would maintain the current level of disturbance, which is considered within the moderate range for backcountry users. Alternative 2 would reduce vessel numbers and associated disturbances to visitors, but would also restrict access by reducing quotas. Alternative 3 would increase opportunities for people to visit Glacier Bay via cruise ship, but would detract from the experiences of other visitors due to the sights, and sounds of and visible haze from cruise ships. Alternative 4 would have the lowest amount of disturbance, but would also greatly reduce available permits for people wishing to visit Glacier Bay and/or Dundas Bay. Alternative 4 would improve enjoyment for visitors aboard charter and private vessels and backcountry users by closing all or a portion of the East Arm of Glacier Bay, the Beardslee Entrance, Fingers and Berg Bays, and Dundas Bay to cruise ships and tour vessels. This, however, would also reduce opportunities for people wishing to tour Glacier Bay or Dundas Bay in a cruise ship or tour vessel. However, because cruise ships do currently travel into these areas, the opportunity for cruise ships passengers to experience these areas would not be diminished under this alternative. Alternatives 5 and 6 would close to cruise ships and tour vessels the entrance Adams Inlet, Beardslee Entrance, and the wilderness waters of Dundas Bay. This would improve conditions for charter and private vessel users and backcountry users in these areas and would still keep the East Arm available for cruise ship and tour vessel passengers. Alternatives 5 and 6 would also increase nearshore disturbances caused by private vessels but would also reduce vessel-related disturbance in the wilderness waters of Dundas Bay by eliminating tour vessels there.

Under alternatives 1, 2, and 3 seasonal entries would still be required for all vessel classes. This could result in some private vessel visitors being denied entry during the peak visitation period of mid-summer. Under alternatives 4, 5, and 6, three changes in the way vessel quotas are measured would improve opportunities for private vessel visitors. The ‘based in Bartlett Cove’ exemption would be eliminated, short-notice permits for private vessel would be available, and the use of ‘seasonal entries’ would be eliminated. These actions would simplify the regulations, reduce frustration of visitors in private vessels, and provide increased opportunity for private vessel visitors to experience Glacier Bay during the peak summer months. These alternatives also would simplify whale water designations to make them easier to follow and more reflective of actual conditions.

Alternatives 4 would increase wilderness and solitude in the wilderness waters of Dundas Bay and the East Arm of Glacier Bay north of Muir Point by prohibiting cruise ships and tour vessels. Alternatives 5 and 6 would restrict tour vessels and cruise ships from the wilderness waters of Dundas Bay and the entrance to Adams Inlet and Beardslee Entrance in Glacier Bay. These actions would increase opportunities for solitude and to experience wilderness in these areas for other charter and private vessel visitors and backcountry visitors.

A 13-knot speed limit would be set for large vessels under alternatives 4, 5, and 6. This would add about 3 hours to the amount of time visitors on cruise ships would remain in Glacier Bay. This additional time could either enhance or detract from the cruise ship passengers visit. Some visitors may enjoy and appreciate the extra time spent in Glacier Bay observing the scenery and wildlife. For other visitors this additional time may appear to be an annoyance and delay them from their future itinerary. The increased time cruise ships spend in Glacier Bay could also increase the exposure other visitors have to the sights and sounds of cruise ships.

4.4.3 Vessel Use and Safety

4.4.3 Vessel Use and Safety

This subsection evaluates the probable effects of implementing the alternatives on vessel use and safety in Glacier Bay and Dundas Bay.

Issues of Concern Raised during Scoping. The issues related to vessel use and safety that were identified during scoping include:

- Increasing vessels or vessel speed could increase the risk of vessel-vessel and vessel-marine mammal collisions.
- The 10-knot vessel speed restriction could decrease maneuverability of large vessels, causing an increased risk to visitor safety.
- The 10-knot speed limit in whale waters should be retained and a 14-knot vessel speed restriction should be instituted in non-whale waters to protect whales transiting throughout the park.
- Smaller vessels are more maneuverable than larger vessels and should be allowed to travel at faster speeds because they could avoid most potential hazards.
- Waves generated from larger vessels could swamp kayaks or small vessels on the water. Additionally, these waves could swamp landed kayaks and small vessels. All vessels are vulnerable in ice-filled waters. Protocols should be developed to limit the possibility of accidents and reduce the possible incidence of oil spills in ice-filled waters.
- Increasing fines for noncompliance of regulations (e.g., excess emissions), could decrease the incidence of regulations violations and increase safety throughout the park.
- Increasing the user friendliness of the operating requirements could increase the possibility that vessel operators would adhere to the rules and decrease the possibility of accidents.
- Cruise and tour vessels should have strict protocols and routes to minimize the risk of vessel groundings that could cause resource damage or risks to visitor safety.

Regulatory Framework.

Marine Safety Regulations. The following is a discussion of marine safety regulations applicable to most vessels operating in the park. These regulations serve to ensure that vessels operate with appropriate safety standards to provide for the protection of the passengers, other vessels, and the environment.

All vessels operating offshore, including those operating under foreign registrations, are subject to the requirements that are applicable to vessel construction, condition, and operation. The U.S. Coast Guard conducts compliance inspections of vessels to verify that foreign-flagged vessels operating in U.S. waters comply with applicable international conventions, and with all U.S. laws and regulations (required under Title 46 of the U.S. Code). The purpose of these inspections is to establish that the vessel is properly built and equipped and that the crew possesses adequate knowledge and training to operate the vessel safely.

When vessels do not comply with applicable laws or regulations, the U.S. Coast Guard imposes controls to bring them into compliance. The U.S. Coast Guard’s responsibility is to identify and eliminate substandard ships from U.S. waters. In general, a vessel is substandard if the hull, machinery, or equipment, including that related to lifesaving, firefighting, and pollution prevention, is below the standards required by U.S. laws or international conventions.

The International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78) regulates pollution and spills from ships. MARPOL 73/78 contains measures to prevent accidental and operational causes of marine pollution. Regulations covering design, equipment, operations, and survey requirements for the prevention of pollution are provided in five annexes to the convention. These annexes include regulations for prevention of pollution by oil (1983), regulations for the control of pollution by noxious liquid substances (1987), and regulations for the prevention of pollution by garbage (1988). Fuel and other spills from vessels are described in detail in the water quality section (see subsection 3.2.4)

The International Convention on Standards of Training, Certification and Watchkeeping (STCW 78) sets forth training, certification, and qualification requirements for shipboard personnel. It establishes basic principles to be observed in keeping navigational and engineering watches, and specifies minimum knowledge required for certification of the crew. STCW 78 was completely amended and revised in 1995. The training required under this convention includes oil spill prevention and countermeasures. This series of regulations is consistent and in many cases more stringent than U.S. guidelines. U.S. Coast Guard reviews the ship's compliance with these international agreements during compliance inspections.

The Convention on the International Regulations for Preventing Collisions at Sea, 1972, sets forth the basic "rules of the road," such as rights-of-way, safe speed, action to avoid collision, and procedures to observe in narrow channels and restricted visibility. The convention also details the technical parameters of navigation lights, shapes, and sound signals.

Special vessel construction standards are established in regard to watertight integrity and carriage of dangerous articles and substances aboard foreign vessels. These regulations are set forth in 46 USC 2101(12) and 3306(a)(5), and 49 USC 1801-1812. In addition, the load line requirements for foreign vessels pertaining to the maximum draft permitted for safe operating conditions are set forth in 46 USC 5101-5116 and in the International Convention on Load Lines, 1966. All of these regulations are intended to require ships to operate with adequate equipment and under safe conditions.

Park Service Boating and Water Use Regulations. NPS posted in the *Federal Register* volume 68 no. 165 (Tuesday August 26, 2003) proposed new rules on boating and water use. The proposed regulations provide greater consistency with U.S. Coast Guard and state laws and regulations and are designed to be more understandable to the public.

Park Boating Safety Regulations. Park boating regulations limit the number of vessels that can be in the park at any one time through vessel quotas. In addition, there are the following speed restrictions:

- From May 15 through August 31 in the waters of the lower Bay motor vessel are restricted to a speed through the water of no more than 20 knots or no more than 10 knots when the superintendent has designated a maximum speed of 10 knots (due to the presence of whales); and
- From July 1 through August 31, motor vessels are restricted to a speed through the water of 10 knots in Johns Hopkins Inlet south of an imaginary line running due west from Jaw Point.

Implementation of the vessel quotas and speed restrictions serve to supplement the U.S. Coast Guard and MARPOL safety regulations to minimize the potential for collisions and groundings.

Methodology and Assumptions. The evaluation of the potential effects on vessel use and safety focused on many of the issues raised during public scoping. The analysis of the effects of implementing the alternatives on the overall safety of vessels, vessel traffic, and the risks of major vessel accidents is based on vessel traffic and safety data and known factors related to vessel incidents. Vessel traffic and safety data obtained through interviews with park staff and vessel operators and park incident records related to vessel accidents. Park records are assumed to contain all major incidents since major incidents are easily detectable and normally involve radio transmissions from the vessels involved. For this analysis, any vessel collision, grounding, or other vessel incident that results in the death or serious injury of individuals on board the vessel, or the subsequent discharge of at least 25 gallons (95 liters) of fuel oil into the water is classified as a “major” incident. Minor incidents are assumed to be under-reported in the more remote areas of Glacier and Dundas Bays, but overall records are assumed to form a good representation of overall vessel incidents.

A fire or explosion could result in the loss of life and/or severe damage to the vessel. A fire or explosion could cause the release of hazard materials to the sea or air. A risk of a marine fire, or explosion, while present, is low because the types of activities that commonly contribute to marine fire and explosion do not occur. The fuel used for the marine vessels is diesel, which is a fire hazard when exposed to standard temperature and pressure conditions; however, diesel fuel is considered a combustible substance, rather than flammable, according to U.S. Department of Transportation (DOT) regulations. The Department of Transportation defines flammable liquids as those with a flash point below 37.8 degrees Celsius (°C; 100° Fahrenheit [F]) and combustible liquids as those with a flash point between 37.8 degrees Celsius (100°F) and 75.5 degrees Celsius (200°F).

For each effects analysis, use was assumed to be at the maximum level allowed during seasons when limits are in place. Factors related to traffic patterns were based on tracking records and known vessel use patterns, as illustrated in chapter 3. The vessel safety analysis was based on known factors related to vessel incidents, considered collectively with the specific operating conditions in place and proposed for the particular alternative being evaluated.

This analysis assumes that each vessel present in the park represents an extremely small but measurable risk of being involved in a major accident. As a result, greater numbers of vessels necessarily result in a corresponding increase in the overall risk of major accidents. Depending upon circumstances, however, it is possible for the overall risk of major accidents to remain low or extremely low despite incremental increases in the number of vessels allowed within Glacier Bay; however, small boat capsizings are a concern because large vessel wakes are often generated well after the originating vessel has passed through an area, and they are often unanticipated.

The wave propagation of high-speed catamaran vessels operating in Glacier Bay, such as *Spirit of Adventure*, has not been studied. There is anecdotal evidence from observers in Glacier Bay that wakes from distant vessels can cause enough wave disturbance at the shore to swamp beached vessels and kayaks. However, this phenomenon is not completely understood on the basis of present research, literature, and the model presented herein. New studies of high-speed vessels could provide answers to these questions. Studies are likely underway as this has been an issue with the high-speed passenger only ferries in the Puget Sound, Washington but none have been published at the writing of this EIS.

Determinations regarding the overall significance of effects were based on the effects thresholds listed in table 4-24.

TABLE 4-24: THRESHOLD CRITERIA FOR THE VESSEL USE AND SAFETY EFFECTS ANALYSIS

Negligible	The risk of vessel accidents leading to serious injury, death, or fuel oil spills over 25 gallons would be extremely low.
Minor	The risk of vessel accidents leading to serious injury, death, or fuel oil spills over 25 gallons would be low.
Moderate	A slightly elevated risk of vessel accidents leading to serious injury, death, or fuel oil spills over 25 gallons would exist.
Major	A significantly elevated risk of vessel accidents leading to serious injury, death, or fuel oil spills over 25 gallons would exist.

The following analysis assumes that the effects of alternative 1, the no-action alternative, are equivalent to existing conditions.

Alternative 1 (No Action) - Effects on Vessel Use and Safety.

Direct and indirect effects on vessel use and safety – alternative 1. The section describes the effects of the implementation of alternative 1 on overall safety of vessels, vessel traffic, and the risks of major vessel accidents.

Overall Vessel Safety and Vessel Traffic. Since the vessel management plan was implemented in 1996, no cruise ships have been involved in collisions or groundings; however, there were two onboard fires. One fire was in a trashcan, while the other involved inhalation injuries. A commercial crab-fishing vessel, fishing in the winter, sank, and one tour vessel had grounded. In a separate incident, another tour vessel struck an iceberg in Tarr Inlet and suffered hull damage. There was no fuel spill associated with this incident. Twenty-one other vessels (mostly private vessels) have grounded, but with only minor damage reported. Other types of accidents commonly reported include vessels going adrift or dragging anchor and minor collisions. Table 4-25 lists 58 vessel incidents recorded by the Park Service between 1994 and 2001.

TABLE 4-25: SUMMARY OF VESSEL-RELATED INCIDENTS AT GLACIER BAY, 1994-2001

Date	Incident	Description	Location
15-Feb-94	Vessel Accident	fishing vessel sinks during crab season – fuel spill	Strawberry Island
25-May-94	Vessel Grounding	private vessel grounds – damage and diesel spill	Bartlett River
30-May-94	Vessel Adrift	private vessel runs out of fuel – no damage	North Passage
28-Jun-94	Vessel Accident	NPS vessel strikes rock – damage	Beardslee Islands
26-Jul-94	Vessel Grounding	charter vessel scrapes rock – no damage	Geikie Inlet
11-Aug-94	Vessel Grounding	inflatable tender grounds – no damage	Bartlett Cove
01-Sep-94	Vessel Grounding	charter vessel scrapes rock – no damage	Fingers Bay
18-May-95	Vessel Grounding	private vessel drags anchor at low tide – no damage	Bartlett Cove
05-Jun-95	Vessel Adrift	private dinghy anchored in closed area drags anchor	Bartlett Cove
11-Jun-95	Vessel Fire	tour vessel suffers smoke damage from electrical short in engine	Bartlett Cove
13-Jun-95	Vessel Grounding	private vessel grounds, then refloats – no damage	Bartlett Cove
04-Jul-95	Vessel Adrift	private vessel has engine problems – towed in by NPS	Young Island
04-Jul-95	Vessel Fire	private vessel fire in engine compartment – engine damage	Lower Bay
13-Jul-95	Vessel Grounding	anchored charter vessel grounds and refloats	Gloomy Knob
16-Jul-95	Vessel Grounding	fishing vessel runs aground and refloats – hull damage	Point Carolus
20-Jul-95	Vessel Grounding	private sailboat runs aground and refloats – no damage	Blue Mouse Cove
26-Jul-95	Vessel Adrift	anchored charter vessel drags anchor – no damage	Bartlett Cove
20-Aug-95	Vessel Accident	dinghy capsizes and dumps operator – no injuries/damage	Bartlett Cove
06-Jul-96	Vessel Grounding	private vessel grounds then refloats – no damage	Bartlett River Cut
26-Aug-96	Vessel Accident	tour boat strikes iceberg and suffers hull damage	Tarr Inlet
24-Jun-97	Vessel Adrift	private vessel w/engine problems towed in by NPS	Reid Inlet
23-Jul-97	Vessel Adrift	research skiff w/engine problems towed in by NPS	Garforth Island
28-Aug-97	Vessel Adrift	charter vessel drags anchor/strikes vessel – minor damage	Bartlett Cove
15-Feb-98	Vessel Grounding	fishing vessel strikes reef – minor fuel spill	Beardslee Islands
20-May-98	Vessel Accident	anchored private vessel drags anchor – minor damage	Bartlett Cove
26-May-98	Vessel Grounding	private vessel strikes rock – minor damage	North Fingers Bay
08-Jun-98	Vessel Grounding	private sailboat grounds while docking – no damage	Bartlett Cove
15-Jun-98	Vessel Adrift	research vessel out of gas gets NPS tow	Strawberry Island
15-Jun-98	Vessel Grounding	private vessel strikes rock – minor damage	South Fingers Bay
12-Aug-98	Vessel Accident	tour boat wraps buoy line around prop – minor damage	Bartlett Cove
12-Jun-99	Vessel Aground	tour boat strikes rock, remains grounded – minor fuel spill	Dundas Bay
08-Jul-99	Vessel Adrift	anchored skiff drags anchor, striking vessel – minor damage	Bartlett Cove
17-Jul-99	Vessel Adrift	private vessel w/stuck rudder gets tow by tour boat	Lone Island
17-Sep-99	Vessel Adrift	anchored private vessel drags anchor – no damage	Bartlett Cove
23-May-00	Vessel Fire	cruise ship suffers fire onboard – damage and inhalation injuries	Tarr Inlet
04-Jun-00	Vessel Adrift	private vessel w/engine problems gets tow to dock by NPS	Lester Island
04-Jun-00	Vessel Grounding	tour boat strikes sandbar – no damage	Reid Inlet
13-Jun-00	Vessel Fire	cruise ship reports trashcan fire on board – minor damage	Tarr Inlet

TABLE 4-25: SUMMARY OF VESSEL-RELATED INCIDENTS AT GLACIER BAY, 1994-2001

Date	Incident	Description	Location
05-Jul-00	Vessel Grounding	private vessel runs aground – minor damage	N. Fingers Bay
14-Jul-00	Vessel Adrift	private sailboat w/engine problems gets towed in by NPS	Bartlett Cove
17-Jul-00	Vessel Adrift	NPS vessel runs out of gas	Ripple Cove
03-Aug-00	Vessel Grounding	private vessel grounds on rocks – minor damage	Hugh Miller Rocks
14-Aug-00	Vessel Accident	private vessels collide while anchoring – minor damage	Bartlett Cove
07-Sep-00	Vessel Adrift	anchored private vessel drags anchor – no damage	Bartlett Cove
16-Sep-00	Vessel Accident	anchored NPS skiff capsizes – no damage	Tidal Inlet
25-Sep-00	Vessel Grounding	private vessel strikes reef – minor damage	Berg Bay
11-Mar-01	Vessel Grounding	private vessel breaks dock lines and drifts – major salvage	Bartlett Cove
16-May-01	Vessel Blackout	cruise ship Regal Princess suffers brief power outage	Up Bay
01-Jun-01	Vessel Adrift	anchored private boat drags anchor – no damage	Bartlett Cove
07-Jun-01	Vessel Grounding	private vessel strikes submerged reef – minor damage	Fingers Bay
23-Jun-01	Vessel Adrift	anchored private boat drags anchor – no damage	Bartlett Cove
06-Jul-01	Vessel Adrift	anchored tugboat drags anchor/ snags hydrophone cable	Bartlett Cove
15-Jul-01	Vessel Adrift	anchored private boats repeatedly contact/minor damage	Bartlett Cove
21-Jul-01	Vessel Grounding	private vessel strikes rock on floodtide – no damage	Muir Point
24-Jul-01	Vessel Accident	anchored private boats repeatedly contact/minor damage	Bartlett Cove
10-Aug-01	Vessel Accident	door damage to docked private vessel from water wake	Bartlett Cove
07-Sep-01	Vessel Adrift	anchored oil spill response barges drag anchor/no damage	Bartlett Cove
07-Sep-01	Vessel Adrift	anchored private vessel drags anchor – no damage	Bartlett Cove

Based on an analysis of vessel accidents in the park between 1994 and 2001, cruise ships, tour vessels, charter vessels, and private vessels have a good safety record for operations in Glacier Bay. The U.S. Coast Guard has concluded that traveling on a cruise ship from a U.S. port is the safest form of transportation available (USCG 1995). Additionally, this report found that there appears to be no evidence of trends or heightened risks associated with oceangoing cruise ships from U.S. ports. Clearly, cruise ship operations are not without risks. In 1994, a crew member from a cruise ship drowned after falling into the water during a personnel transfer operation involving an NPS interpreter. A cruise ship fire in Tarr Inlet in May 2000 resulted in damage to the vessel, as well as smoke inhalation injuries. An analysis of the available vessel accident data suggests that experiencing Glacier Bay and Dundas Bay from a vessel is a safe activity under current vessel quotas and operating restrictions. Given the low incidence of injury, the effect of implementation of alternative 1 on overall vessel safety would be negligible.

Current controls on vessel entry strictly limit the density of vessels in Glacier Bay. Excluding commercial fishing vessels and administrative vessels, the density of vessels in Glacier Bay at full capacity is estimated to be one vessel for every 12.3 square miles (31.9 square kilometers) of water. Although this calculation assumes a uniform distribution of vessels, it illustrates the relatively low density of vessels within Glacier Bay. The areas of Glacier Bay most likely to experience higher densities are:

- the inlets containing tidewater glaciers at Tarr Inlet and Johns Hopkins Inlet in the West Arm, and
- Bartlett Cove in the vicinity of Park Headquarters.

Because most administrative and support functions associated with vessel activity in Glacier Bay occur at Bartlett Cove, vessels tend to congregate in this area. Vessel accident data shows a concentration of minor vessel incidents in the Bartlett Cove, but not Tarr Inlet. The congestion in these locations has not translated into major vessel incidents; therefore, under alternative 1, the effect of vessel traffic would be negligible.

Risk of major vessel accidents. The International Regulations for Preventing Collisions at Sea, 1972 (72 COLREGS) seek to reduce the risk of collision. The 72 COLREGS apply to all of the waters within the park (see 33 CFR 80.1705). Professional and recreational vessel operators are required to understand and comply with the 72 COLREGS; however, as with the risk of fire and explosion, the risk of collision is present. The risk of collisions is increased with additional marine traffic, navigational hazards, or severe weather conditions. These risks are reduced through the use of navigational aids and weather restrictions.

Of the 58 vessel incidents recorded by the Park Service between 1994 and 2001, 25 occurred in Bartlett Cove (see accident data in table 4-25). The majority of these incidents involved vessels dragging anchor or otherwise operating at slow speed with minor or no damage. The large number of vessel incidents in Bartlett Cove is understandable given the operating patterns of vessels within Glacier Bay. Bartlett Cove is the center of vessel operations within Glacier Bay. Most charter vessels depart from this location and private vessels are required to check in with NPS officials at the Bartlett Cove Visitor Center to obtain a permit before operating in other areas of Glacier Bay. Tour vessels, including the daily tour vessel *Spirit of Adventure,* also pick up and discharge passengers at the Bartlett Cove Public Use Dock, further contributing to vessel congestion. There is no requirement for cruise ships to enter Bartlett Cove and, historically, they have not done so. Higher vessel densities also occur at the popular tidewater glaciers at Tarr Inlet and Johns Hopkins Inlet. Despite the higher concentrations of vessels, few major accidents were reported in these areas between 1994 and 2001.

Vessel speed limits would remain the same as in existing regulations and the park compendium (see appendix B). For vessels with traditional propellers and rudders, it can be difficult to maintain control when the vessel proceeds with the current unless adequate speed through the water is maintained. A 10-knot speed limit through the water generally provides sufficient steerageway to maintain control of these vessels. The park superintendent may impose a speed limit of 10 knots in lower Glacier Bay whale waters due to the presence of whales. The success of these whale water speed restrictions is examined in greater detail in the discussion on marine mammals (see subsection 4.3.2). There were no reports of high-speed collisions between vessels in Glacier Bay or Dundas Bay between 1994 and 2001.

The accident data from 1994 through 2001 does not show any significant collisions between vessels underway in Glacier Bay or Dundas Bay. Vessel groundings were more common during this period with a total of 22. Two tour vessels have grounded on rocks in Glacier Bay and Dundas Bay. The *Wilderness Adventurer* grounded in Dundas Bay during 1999. An estimated 25 to 30 gallons (95 to 114 liters) of mixed lubrication oil and diesel leaked from the vessel. The *Yorktown Clipper* grounded in 1993; the ship released an estimated 50 gallons (189 liters) of diesel into Glacier Bay.

Table 4-26 lists the vessels that entered Glacier Bay in 1999, their sizes, draft, number of visits, and maximum number of gallons of fuel stored onboard.

TABLE 4-26: PHYSICAL VESSEL STATISTICS FOR 1999 GLACIER BAY ENTRIES

Vessel type	Size Range[a]	Draft (feet)	Annual Visits	Maximum Fuel Onboard (gallons)[b]
Cruise Ship (19 ships operated by 10 companies)	4,500- 109,000 GT, 295-951 feet	20-28	217	405,000 – IFO
Small Passenger Vessel (13 vessels operated by 5 companies)	18-120 GT, 25-219 feet	6-15	297	12,000 - diesel
Fuel Barge	Approximately 250 feet	13 (loaded)	12 (Bartlett Cove)	1.5 million (2 x 750,000) – non-persistent oil
Commercial Fishing Vessel	20-50 feet	4-8	By permit	Less than 4,000 – diesel

Source: Eley 2000.

a. Size ranges based on 2002 entries
b. A spill of this maximum amount would essentially require total break-up of the vessel and/or fuel tank.

GT = gross tons.
IFO = intermediate fuel oil.

Based on park incident records, less than one powered grounding in five results in any fuel spill. No cruise ship collisions or groundings were reported during the 1994–2001 period. No major fuel spills during this period caused by collisions and groundings occurred.

A concern expressed by the public was the possibility of a fuel spill in ice-filled water near the glaciers. In 1996, a tour vessel struck an iceberg and suffered hull damage but no fuel spill occurred. Even with the most current spill cleanup technology, cleanup of a fuel spill in ice-filled waters would be difficult. The water quality section of this chapter concludes that a fuel release in ice-filled waters constitutes a potential major effect due to the lack of effective clean up technology and the direct effect of spilled fuel on water quality and wildlife resources. A recent report concluded, however, that the probability of a fuel spill as a result of a collision with ice in Glacier Bay is low (Eley 2000). Eley (2000) reported the following observations of marine pilots who regularly operate in Glacier Bay:

- the southernmost boundary for ice in Glacier Bay during the cruise ship season is Composite Island.
- north of Composite Island, cruise ships travel at maneuvering speed of less than 8 knots during daylight.
- ice not pushed away from the hull by Lattimer flow makes only incidental contact with the cruise ship.

While no fuel spills have occurred in ice-filled waters, the potential effects to water quality and wildlife resources are major. Although no major fuel spills have occurred in ice-filled waters in Glacier Bay, the possibility that such a spill could occur still exists. The probability of such a spill, however, is low; therefore, the effect of the implementation of alternative 1 on the risk of a major vessel accident is minor.

Implementing alternative 1 would have negligible effects on vessel safety and vessel traffic, but the risk of a major vessel accident is minor due to the remote possibility of a fuel spill in ice-filled waters; therefore, the overall direct and indirect effect would be expected to be minor.

Cumulative effects on vessel use and safety — alternative 1. Within the navigable waters of Glacier and Dundas Bays, current or foreseeable activities other than those proposed in this plan could affect vessel safety, specifically the presence of commercial fishing and administrative vessels in the park. No past activities are anticipated to affect vessel safety. Commercial fishing is currently occurring in the park, but will decrease over time. The above analysis of effects already accounts for the presence of commercial fishing and administrative vessels since they have been operating in the park during the period analyzed; therefore, the contribution of this activity is already addressed and would not provide additional effects.

Impairment analysis for vessel use and safety – alternative 1. Vessel safety is not a park resource and, therefore, cannot be impaired.

Conclusion, vessel use and safety – alternative 1. The direct and indirect adverse effects of implementing alternative 1 on vessel safety would be a low risk of a fuel spill in ice-filled waters; therefore, the effect to vessel use and safety is minor. The cumulative effects of other activities would not alter this effect. Impairment is not applicable to this topic and mitigation is not necessary. The overall effect of implementing alternative 1 on vessel traffic and safety would be minor.

Alternative 2 - Effects on Vessel Use and Safety.

Direct and Indirect Effects on Vessel Use and Safety – Alternative 2. The overall direct and indirect effects of alternative 2 on vessel use and safety would be very similar to that described for alternative 1, but are not identical.

<u>Overall vessel safety and vessel traffic</u>. Alternative 2 would result in incremental improvements in vessel safety and slight reductions in overall vessel traffic over alternative 1. There would be days when overall vessel traffic would be equivalent to current levels, but there would be more days when the maximum daily quota would not be reached because of seasonal entry and seasonal-use day restrictions. With fewer cruise ships entering Glacier Bay and the reduction in the number of charter vessel and private vessel seasonal entries and seasonal-use days, vessel traffic would be reduced. Alternative 2 would expose Glacier Bay to fewer overall vessel entries. These reductions would result in a marginal improvement in vessel safety; therefore, the effect would be negligible. No changes would occur in Dundas Bay.

<u>Risk of major vessel accidents</u>. Relative to alternative 1, implementing alternative 2 would result in a marginal decrease in the risk of cruise ship-related accidents because cruise ships would be present on fewer days. There would be a corresponding marginal reduction in the overall risk of fuel spills from cruise ships because 23% fewer cruise ship visits to Glacier Bay would occur. There would be no change in Dundas Bay. The reductions in vessel traffic in Glacier Bay would decrease the risks of collisions, groundings, and fuel spills from alternative 1, and the effect of implementation of this alternative would be negligible.

The direct and indirect effects of implementation of alternative 2 would have negligible effects on vessel safety, vessel traffic, and the risk of a major vessel accident due to the reduction of vessel traffic; therefore, the overall direct and indirect effects would be expected to be negligible.

Cumulative effects on vessel use and safety – Alternative 2. The presence of administrative vessels and activities such as commercial fishing could affect vessel safety and traffic. As discussed in alternative 1, these effects are accounted for in the above analysis and would not contribute to any additional direct effects; therefore, the contribution of this activity is already addressed and would not provide additional effects.

Impairment analysis for vessel use and safety — alternative 2 — Vessel safety is not a park resource and, therefore, cannot be impaired.

Conclusion, vessel use and safety — alternative 2 — Implementation of alternative 2 would have negligible direct and indirect adverse effects on vessel traffic and safety. Effects would include an improvement in vessel safety, a decrease in the risk of collisions, and a reduction in vessel traffic. The cumulative effects of other activities would not alter this effect. Impairment is not applicable to this topic and mitigation is not necessary. The overall effect of implementing alternative 2 on vessel traffic and safety is negligible.

Alternative 3 - Effects on Vessel Use and Safety.

Direct and indirect effects on vessel use and safety — alternative 3 — The overall direct and indirect effects of alternative 3 on vessel use and safety are expected to be very similar to those discussed for alternative 1.

Overall vessel safety and vessel traffic. Alternative 3 would increase vessel traffic because more cruise ships would enter Glacier Bay; however, no changes would occur in Dundas Bay. Vessel traffic and congestion would be identical to current "high-use" days when two cruise ships call on Glacier Bay. The cruise ship industry attempts to stagger the entry of cruise ships into Glacier Bay, which has served to reduce congestion caused by two cruise ships attempting to visit the same area simultaneously. Overall, cruise ship operations from U.S. ports are very safe. The effects of implementing alternative 3 on vessel traffic and safety are expected to be negligible.

Risk of major vessel accident. There could be a marginal increase in the risk of cruise ship related accidents because there would be more cruise ships calling on Glacier Bay each season. There could also be an increase in the overall risk of fuel spills from cruise ships because there could be 45 additional cruise ship entries each season. The overall risk of vessel accidents and fuel spills would remain extremely low under alternative 3. Current vessel operating requirements (mandatory use of pilots, staggered cruise ship entry schedule) have successfully reduced the risk of accidents involving cruise ships. There have been no collisions, groundings, or fuel spills from cruise ships in Glacier Bay; however, there is a low probability of a fuel spill in ice-filled waters. The effects of implementing alternative 3 on major vessel accidents would be similar to alternative 1; therefore, the effect would be minor.

The direct and indirect adverse effects on vessel safety and vessel traffic of implementing of alternative 3 would be negligible, but the risk of a major vessel accident would be minor due to the low probability of a fuel spill in ice-filled waters; therefore, the overall effect would be expected to be minor.

Cumulative effects on vessel use and safety — alternative 3 — Activities such as commercial fishing and the presence of administrative vessels could affect vessel safety and traffic. As discussed in alternative 1, the effect of commercial fishing and administrative vessels is accounted for in the above analysis and would not contribute any additional direct effects.

Impairment analysis for vessel use and safety — alternative 3 — Vessel safety is not a park resource and, therefore, cannot be impaired.

Conclusion, vessel use and safety — alternative 3 — The direct and indirect adverse effects of implementing alternative 3 on vessel safety would be a low risk of a fuel spill in ice-filled waters; therefore, the effect to vessel use and safety is minor. The cumulative effects of other activities would not alter this effect. Impairment is not applicable to this topic and mitigation is not necessary. The overall effect of implementing alternative 3 on vessel traffic and safety would be minor.

Alternative 4 - Effects on Vessel Use and Safety.

Direct and indirect effects on vessel use and safety — alternative 4 — The overall direct and indirect adverse effects of alternative 4 on vessel use and safety are expected to be negligible, but positive.

<u>Overall vessel safety and vessel traffic</u>. Alternative 4 results in a proportional decrease in vessel traffic. Although the daily vessel quota for cruise ships would remain two, cruise ships entries into Glacier Bay would average no more than one per day between May and September, thus reducing the volume of traffic.

Restricting cruise ships and tour vessels from Dundas Bay could reduce congestion in this relatively small (37.2 square miles [96.3 square kilometers]) body of water. Restricting tour vessels from Dundas Bay represents a change from current practice since tour vessels currently use this area. Under alternative 4, Dundas Bay would experience less vessel congestion due to the prohibition on cruise ships and tour vessels and restriction of charter vessels to a maximum of three.

Alternative 4 proposes changes to vessel speed limits in Glacier Bay. Vessels under 262 feet (80 meters) long would be limited to 20 knots (through the water) in lower Bay whale waters from May 1 to September 30 unless the superintendent had designated a 10-knot speed (through the water) due to the presence of whales. For all other areas of the park, vessel speed would be unlimited for vessels under 262 feet (80 meters) in length. However, the superintendent has the authority to impose temporary speed restrictions anywhere in Glacier Bay and Dundas Bay. In these areas, vessel speeds for all vessels would be 10 knots or less. Vessels greater than or equal to 262 feet (80 meters) long would be limited to 13 knots (through the water) year-round throughout Glacier Bay unless the superintendent has designated a 10-knot speed (through the water) due to the presence of whales. The higher speed limits for smaller vessels results, in part, from the fact that these vessels are more maneuverable than larger vessels and can slow down or stop in a shorter distance to protect whales and other marine life. These speed limits, as measured through the water, are adequate to provide steerageway for vessels with traditional propellers and rudders proceeding with the water current.

It is an accepted fact of vessel operations that smaller vessels are more maneuverable than larger ones, all other things being equal. Generally smaller vessels can turn sharper and slow down faster than larger vessels. This increased maneuverability can help a smaller vessel avoid a hazard sighted in its path, whereas a larger vessel might not be able to avoid the same hazard under identical conditions. Although some larger vessels are built with specialized thrusters or rudders to improve their stopping and turning characteristics, as a general rule, smaller vessels are more maneuverable than larger ones.

Alternative 4 prohibits cruise ships from entering wilderness areas, but would allow them to enter the West Arm, Tarr Inlet, and Johns Hopkins Inlet up to Jaw Point. Cruise ships and tour vessels also would not be allowed into the East Arm (tour vessels would be allowed in the entrance waters of East Arm). Most importantly, for vessel traffic and safety is the fact that alternative 4 formally defines cruise ship routes (typically in mid-channel). A cruise ship route would be drawn using the current typical cruise ship traffic pattern. While this measure is being proposed for a number of different reasons, it results in a significant improvement in vessel safety. Formally defining cruise ship routes at or near mid-channel significantly reduces the risk that the ship will run aground and potentially cause a fuel spill. This measure also provides an increased margin of safety in the event the cruise ship temporarily loses power. A position in mid-channel provides the ship's crew more time to restore power before the ship drifts toward submerged hazards or the exposed shoreline. Formally designating the cruise ship route also would remove the temptation of a vessel master to bring the ship closer to shore (toward more hazardous waters) to provide passengers with a better view of wildlife or scenery. Formally designating cruise ship routes would represent a significant contribution to vessel safety in Glacier Bay, a beneficial effect.

The reductions in vessel entries in conjunction with the speed limits and cruise ship route designations will increase vessel safety and decrease vessel traffic, resulting in negligible effects.

<u>Risks of major vessel accidents</u>. Reductions in the numbers of vessels visiting Glacier Bay could result in a marginal decrease in the overall risk of major vessel accidents corresponding in magnitude to the reduction in vessel use. Excess speed was not indicated as a primary cause in any of the major vessel incidents listed in the 1994 through 2001 Glacier Bay vessel accident data. Reducing vessels over 262 feet (80 meters) in length to a maximum speed of 13 knots while in whale waters (unless a 10-knot maximum speed has been designated by the park superintendent) is not expected to result in a measurable improvement in vessel safety. Formally designating cruise ship routes is, however, expected to contribute significantly to overall vessel safety by providing a larger margin of safety, especially with respect to groundings. Implementing alternative 4 would result in decreased vessel traffic, improved vessel traffic routing, and marginal improvements in vessel safety resulting in negligible effects, since decreased vessel traffic and speed limits would increase overall vessel safety.

Cumulative effects on vessel use and safety — alternative 4 — The presence of administrative and commercial fishing vessels in the park could affect vessel safety. As discussed in alternative 1, the effect of the presence of these vessels is accounted for in the above analysis and would not contribute any additional direct effects.

Impairment analysis for vessel use and safety — alternative 4 — Vessel safety is not a park resource and, therefore, cannot be impaired.

Conclusion, vessel use and safety — alternative 4 — Implementation of alternative 4 would have positive direct and indirect effects on vessel traffic and safety, because the number of vessels in the Bay would be decreased and operating requirements would be established. Effects would include decreased vessel traffic, increased vessel safety, and decreased risk of vessel accidents. The cumulative effects of other activities would not alter this effect. Impairment is not applicable to this topic and mitigation is not necessary; therefore, the overall effect of implementing alternative 4 on vessel traffic and safety would be positive.

Alternative 5 - Effects on Vessel Use and Safety.

Direct and indirect effects on vessel use and safety — alternative 5 — The overall direct and indirect effects of alternative 5 on vessel traffic and safety are expected to be moderate due to the potential change in vessel safety resulting from a change of how speed is measured.

<u>Overall vessel safety and vessel traffic.</u> Under alternative 5, vessels under 262 feet (80 meters) long would be limited to 20 knots (over the ground) in the lower Bay whale waters from May 15 to September 30, unless the superintendent has designated a 10-knot speed (over the ground) due to the presence of whales. Vessels greater than or equal to 262 feet (80 meters) long would be limited to 13 knots (over the ground) year-round throughout Glacier Bay, unless the superintendent has designated a 10-knot speed (over the ground) due to the presence of whales. For all other areas of the park, vessel speed would be unlimited for vessels under 262 feet (80 meters) in length. However, the superintendent has the authority

to impose temporary speed restrictions anywhere in Glacier Bay and Dundas Bay. In these areas, vessel speeds for all vessels would be 10 knots or less.

Alternative 5 prescribes that vessel speed will be measured “over the ground.” This change would allow vessel operators to use installed GPS units to calculate vessel speed. Measuring vessel speed “over the ground” could be problematic for some vessels transiting through whale waters. In cases where a vessel is proceeding with the current (of up to 8 knots in some locations), a 10-knot speed over the ground may be insufficient to maintain adequate steerageway. Without adequate steerageway, a vessel may be extremely difficult to steer or the operator may totally lose control of the vessel. This represents a potential safety hazard for vessels proceeding down current but measuring vessel speed over the ground. In some cases, a vessel might be proceeding at only 2 knots through the water (10 knots over ground minus 8 knots of current) and force the vessel operator to invoke a deviation from the vessel operating requirements. This proposed operational requirement may cause a significant impediment to vessel safety because it may be inadequate to maintain control, given existing current patterns.

Vessel entries into Dundas Bay are not separately regulated under the current Glacier Bay vessel management plan. Prohibiting cruise ships and restricting tour vessels from Dundas Bay could reduce congestion in this relatively small (37.2 square miles [96.3 square kilometers]) body of water. Restricting tour vessels from Dundas Bay to one per day in only non-wilderness waters represents a change from current practice since tour vessels currently use this area. Under alternative 6, Dundas Bay would experience less vessel congestion due to the prohibition of cruise ships and the restriction of tour and charter vessels.

Implementing alternative 5 is expected to produce a minor to moderate effect on vessel traffic and safety. This minor to moderate effect is driven almost entirely by the expected reduction in safety that would be caused by measuring vessel speed “over the ground” as opposed to “through the water.” A 10-knot vessel speed over the ground may be inadequate for some vessels to maintain control while proceeding with a strong (up to 8 knots in some places) current.

<u>Risk of major vessel accident</u>. Measuring vessel speeds “over the ground” could increase the risk of major vessel accidents. Under alternative 5, the overall risk of major vessel accidents would be expected to increase incrementally over current conditions. Conversely, vessel accident rates and the risk of fuel spills are expected to be similar to those described for alternative 1, since daily vessel quotas are nearly identical. The effects of implementing alternative 5 on major vessel accidents would be minor due to the low probability of a fuel spill in ice-filled waters.

Cumulative effects on vessel use and safety — alternative 5 — Commercial fishing and administrative vessels in the park could affect vessel safety. As discussed in alternative 1, the effect of commercial fishing is accounted for in the above analysis and would not contribute to any additional direct effects.

Impairment analysis for vessel use and safety — alternative 5 — Vessel safety is not a park resource and, therefore, cannot be impaired.

Conclusion, vessel use and safety — alternative 5 — Implementation of alternative 5 would have minor to moderate direct and indirect adverse effects on vessel traffic and safety. Effects include a decrease in vessel safety due to the change in measuring vessel over ground and a low probability of a fuel spill in ice-filled waters. The cumulative effects of other activities would not alter this effect. Impairment is not applicable to this topic. Mitigation is necessary. The overall effect of implementing alternative 5 on vessel traffic and safety would be minor to moderate.

Alternative 6 - Effects on Vessel Use and Safety.

Direct and indirect effects on vessel use and safety — alternative 6 — The overall direct and indirect effects of alternative 6 on vessel use and safety are expected to be very similar to those discussed for alternative 1.

Overall vessel safety and vessel traffic. Alternative 6 would increase vessel traffic because more cruise ships would enter Glacier Bay. Vessel traffic and congestion would be identical to current “high-use” days when two cruise ships call on Glacier Bay. The cruise ship industry attempts to stagger the entry of cruise ships into Glacier Bay, which has served to reduce congestion caused by two cruise ships attempting to visit the same area simultaneously. Overall, cruise ship operations from U.S. ports are very safe. The effects of implementing alternative 6 on vessel use and safety are expected to be negligible.

Prohibiting cruise ships and restricting tour vessels from Dundas Bay could reduce congestion in this relatively small (37.2 square miles [96.3 square kilometers]) body of water. Restricting tour vessels from Dundas Bay to one per day in only non-wilderness waters represents a change from current practice since tour vessels currently use this area. Under alternative 6, Dundas Bay would experience less vessel congestion due to the prohibition on cruise ships and the restriction of tour and charter vessels.

Alternative 6 proposes the same vessel speed limits as alternatives 4 and 5. Vessel speed limits would apply from May 15 through September 30. Vessels under 262 feet (80 meters) in length would be limited to 20 knots in lower Bay whale waters (through the water) unless the superintendent had designated a 13-knot speed (through the water) due to the presence of whales. For all other areas of the park, vessel speed would be unlimited for vessels under 262 feet (80 meters) in length. However, the superintendent has the authority to impose temporary speed restrictions anywhere in Glacier Bay and Dundas Bay. In these areas, vessel speeds for all vessels would be 13 knots or less. Vessels greater than or equal to 262 feet (80 meters) long would be limited to 13 knots (through the water) throughout Glacier Bay. The higher speed limits for smaller vessels results, in part, from the fact that these vessels are more maneuverable than larger vessels and can slow down or stop in a shorter distance to protect whales and other marine life. These speed limits, as measured through the water, are adequate to provide steerageway for vessels with traditional propellers and rudders proceeding with the water current.

Generally smaller vessels can turn sharper and slow down faster than larger vessels. This increased maneuverability can help a smaller vessel avoid a hazard sighted in its path, whereas a larger vessel might not be able to avoid the same hazard under identical conditions. Although some larger vessels are built with specialized thrusters or rudders to improve their stopping and turning characteristics, as a general rule, smaller vessels are more maneuverable than larger ones.

The reductions in speed limits will increase vessel safety, resulting in negligible effects.

Risk of major vessel accident. There could be a marginal increase in the risk of cruise-ship-related accidents because there could be more cruise ships calling on Glacier Bay each season. There could also be an increase in the overall risk of fuel spills from cruise ships because there could be 45 additional cruise ship entries each season. The overall risk of vessel accidents and fuel spills would remain extremely low under alternative 6. Current vessel operating requirements (mandatory use of pilots, staggered cruise ship entry schedule) have successfully reduced the risk of accidents involving cruise ships. There have been no collisions, groundings, or fuel spills from cruise ships in Glacier Bay; however, there is a low probability of a fuel spill in ice-filled waters. The effects of implementing alternative 6 on major vessel accidents would be similar to alternative 1; therefore the effect would be minor.

The direct and indirect adverse effects on vessel safety and vessel traffic of implementing alternative 6 would be negligible, but the risk of a major vessel accident would be minor due to the low probability of an accidental fuel spill in ice-filled waters; therefore, the overall effect would be expected to be minor.

Cumulative effects on vessel use and safety — alternative 6 — Activities such as commercial fishing and the presence of administrative vessels could affect vessel safety and traffic. As discussed in alternative 1, the effect of commercial fishing and administrative vessels is accounted for in the above analysis and would not contribute any additional direct effects.

Impairment analysis for vessel use and safety — alternative 6 — Vessel safety is not a park resource and, therefore, cannot be impaired.

Conclusion, vessel use and safety — alternative 6 — The direct and indirect adverse effects of implementing alternative 6 would be minor. Effects would include an increase in vessel safety and a decrease in vessel traffic due to speed limitations and a low probability of fuel spills in ice-filled waters. The cumulative effects of other activities would not alter this effect. Impairment is not applicable to this topic and mitigation is not necessary. The overall effect of implementing alternative 6 on vessel traffic and safety would be minor.

Summary, Vessel Use and Safety. The effects to vessel safety and use are summarized below according to vessel safety and traffic and the risk of major vessel accidents. Vessel safety and traffic reflects the number of vessels in Glacier and Dundas Bays and the speed at which the vessels travel. Alternative 1 reflects existing conditions and projected increases to fill vessel quotas. Given that there have been no major accidents since this management strategy was implemented and a good safety record from 1994-2001, the effect on vessel safety due to the implementation of alternative 1 would be negligible. The relative change in vessel safety between alternatives 1, 2, and 3 would be reflected in the number of vessels in Glacier Bay at any one time. The decrease in vessels in alternative 2 could increase the relative level of vessel safety and the increase in vessels in alternative 3 could decrease the relative level of safety compared to alternative 1.

Alternatives 4, 5, and 6 have vessel quotas for Dundas Bay as well as Glacier Bay and revised operating requirements. The decrease in the number of vessels, the designated vessel routes, and the speed limits included in alternative 4 could increase vessel safety by decreasing and controlling vessel traffic Glacier Bay. Restricting cruise ships and tour vessels from Dundas Bay in alternative 4 could reduce vessel congestion in that area and prevent groundings. Dundas Bay is poorly charted and contains many navigational hazards and shallow areas that could pose safety hazards to cruise ships and tour vessels.

The vessel quotas in alternatives 5 and 6 are comparable to current high use days; therefore, their effects are similar to alternative 1. However, alternative 5 measures vessel speed over the ground whereas alternative 6 would measure vessel speed through the water. The measurement of vessel speed over the ground could decrease vessel safety under alternative 5 because vessel maneuverability can be, at times, compromised when vessels try to maintain their speed over the ground and travel with currents. Under alternative 5 and 6 the restriction of cruise ships and tour vessels from Dundas Bay wilderness waters could increase vessel safety compared to alternative 1.

The risk of a major vessel accident is similar among all the alternatives. The history of vessel incidents shows that there have been no major accidents, however, the potential still exists. The worst case accident scenario for Glacier Bay would be a major fuel spill in ice-filled waters. Therefore, the risk of an accident increases with an increase in the number of vessels that can enter ice-filled water. Under alternative 1, the risk of such an accident is low and classified as minor. Because of the decreased number of total vessels under alternatives 2 and 4, the risk of an accident in ice filled waters would be reduced to extremely low.

The increases in the number of vessels per season in alternatives 3, 5, and 6 incrementally increases the probability of accident to minor effect.

However, under alternatives 1, 2, and 3 all vessels would be able to travel at unlimited speeds throughout Glacier Bay and Dundas Bay with the exception of designated and temporary whale waters and those areas closed to motorized vessels. Under alternative 4, 5, and 6 all tour, charter, and private vessels would be able to travel at unlimited speeds in the same areas. The ability to travel at unlimited speeds could increase the potential for a vessel accident in the areas mentioned above. By reducing cruise ships to 13 knots or less under alternatives 4, 5, and 6 the potential for a vessel accident or grounding could be reduced.

One vessel accident involving a tour vessel has already occurred within the wilderness waters of Dundas Bay. Eliminating cruise ships and tour vessels from the wilderness waters of Dundas Bay under alternatives 4, 5, and 6 would reduce the risk of a vessel accident in this area to extremely low.

.

4.4.4 Wilderness Resources

4.4.4 Wilderness Resources

This section evaluates the effects of each alternative on wilderness as a resource. The focus is on how the purposes, values, and characteristics of the wilderness contained within the park as defined in the Wilderness Act of 1964 and managed under the Alaska National Interest Lands Conservation Act (ANILCA) of 1980 would be affected by the proposed actions. Wilderness is a distinct park resource, separate from visitor experience; therefore, other aspects of visitor experience within the wilderness of Glacier Bay and Dundas Bay are evaluated in subsection 4.4.2, "Visitor Experience."

Issues of Concern Raised during Scoping. The primary issues of concern raised during public scoping with regard to wilderness resources include:

- An increase in vessel quotas could allow more people to experience a wilderness area intimately. In addition, wilderness would be more accessible.
- An increase in vessel quotas could diminish the value of wilderness by increasing the sense of crowdedness.
- The presence of large vessels could diminish the wilderness values.
- Increases in off-vessel activity could result in more trash and degradation of the terrestrial environment.

Regulatory Framework. The Wilderness Act of 1964 (Section 2c), the NPS Act of 1916 (Organic Act, Section 1), and the Alaska National Interest Lands Conservation Act (Section 101) call for providing recreational opportunities that emphasize viewing scenery or solitude, or that are primitive and unconfined. The concept of wilderness is defined in the Wilderness Act of 1964 (Public Law 88-577) as:

> *"an area of underdeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value."*

The 1916 Organic Act of the Park Service states that the purpose of the national parks is to "conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (16 USC 1).

Public lands in Alaska designated as wilderness under the provisions of the Alaska National Interest Lands Conservation Act (ANILCA) of 1980 differ from those designated outside of Alaska (see appendix I). Section 1110 of the act permits, " . . . the use of snow machines, motorboats, airplanes, and non-motorized surface methods for traditional activities . . . such use shall be subject to reasonable regulations by the Secretary to protect the natural and other values of the conservation system unit." This makes administration of wilderness in Alaska's national parks different than the administration in non-Alaskan national parks because some modes of transportation that are considered incompatible with the wilderness concept in other locations are allowed to occur in Alaskan wilderness. Those motorized uses, however, can only be permitted if they are for traditional activities.

Methodology and Assumptions. This section addresses effects on wilderness as a resource, with a focus on two major elements of wilderness: freedom (an open, untrammeled landscape), and naturalness (encompassing opportunities for solitude, or a primitive and remote experience). These qualities of wilderness are established in the literature (e.g., Aplet 2000). The freedom dimension incorporates primarily the character of the landscape and ecosystem (i.e., the notion of a place not under the control of human beings). The naturalness dimension of wilderness is directly affected by changes to the natural environment brought on by disturbance because of human activity, such as auditory and visual pollution, and water pollution due to fuel or other vessel spills. Motorized vessel traffic is more likely to affect characteristics of naturalness than freedom, and thus is given greater weight in this analysis.

Because wilderness consists of functioning ecosystems and natural processes, effects on wilderness are based largely on the effects analyses of the other topics addressed in this EIS. To qualitatively assess changes that would occur to existing wilderness resources through the implementation of each alternative, projections of future wilderness resource conditions were estimated. For the freedom dimension of wilderness, the characteristics used in this analysis are:

- the degree to which land provides opportunities for solitude.
- the remoteness of the land from human activities and development.
- the degree to which ecological processes remain uncontrolled by human agency.

For the naturalness dimension of wilderness, the characteristics used in this analysis are:

- the degree to which the area can provide opportunity for solitude.
- the degree to which the wilderness maintains natural composition.
- the degree to which it remains unaltered by artificial human structure.
- the degree to which it is unpolluted.

Each of these characteristics need not exist at an absolute maximum in wilderness, but collectively they define the qualities of freedom and naturalness and, therefore, facilitate the measurement of wildness in wilderness.

Based on these characteristics just described, the threshold criteria shown in table 4-27 were developed to measure and describe the intensity of effects on wilderness.

TABLE 4-27: THRESHOLD CRITERIA FOR WILDERNESS RESOURCES EFFECTS ANALYSIS

Negligible	Human activity and products of that activity (e.g., air, water, noise pollution) would be present, but would be localized and last less than one day. Overall wilderness values would remain unchanged.
Minor	Human activity and products of that activity (e.g., air, water, noise pollution) would be present, but would be localized and last less than one week.
Moderate	Human activity and products of that activity (e.g., air, water, noise pollution) would be present, occur over a relatively large area or "place," such as an inlet, and last longer than one week or occur so frequently as to be essentially continuous.
Major	Human activity and products of that activity (e.g., air, water, noise pollution) would substantially reduce both the naturalness and freedom dimensions of the wilderness resource at the scale of the entire park. Also, any major effect, within the wilderness area, on another resource, as identified in this EIS, would be considered a major effect on wilderness.

Alternative 1 (No Action) - Effects on Wilderness Resources.

Direct and indirect effects on wilderness resources — alternative 1 — Throughout most of the Glacier Bay Wilderness, including the expansive glaciers and rugged mountains, vessel traffic is not noticeable, since these areas are remote and isolated from traffic. Because most wilderness use is shoreline based, and motorized vessels are the primary modes of transportation in the park, human activity affects wilderness mainly along the shoreline in both Glacier and Dundas Bays. Under alternative 1, some currently motorized waters in designated wilderness, upper Dundas Bay and the Beardslee Entrance, would be retained as such.

Under the current vessel management framework, vessel traffic affects wilderness as a resource. The presence of motorized craft creates noise (from engine operation, horns, and public address systems) and contributes pollutants to the air and water. Other effects of vessel traffic include disturbances in feeding and breeding of both marine mammals and birds in Glacier Bay, the intrusion of vessel exhaust into wilderness, and the visual presence of vessels. These effects become greater where and when vessels concentrate, such as near the tidewater glaciers. Most of the area remains remote with fully functional ecosystems and opportunities for solitude, so the freedom dimension of the landscape would be maintained.

Vessel traffic affects natural conditions in wilderness by emitting air pollutants, particularly where vessel traffic comes near designated wilderness, including the entire terrestrial shoreline of the Bay. Depending upon air currents, operating systems, and the amount of ship traffic, particulates from cruise ship emissions may drift over the park's designated wilderness areas; however, emissions would affect only a small fraction of designated wilderness because air emissions disperse, and would be short-lived. Noise can intrude upon the naturalness of the shoreline wilderness. Engine noise can be heard from many places within designated wilderness, particularly where vessels travel close to shore (e.g., South Marble Island). The public address systems of tour and cruise ships also can be heard within wilderness areas.

As a result, motorized vessels do and would continue to decrease the naturalness present in nearby wilderness sections of the park, and would also decrease the freedom dimension. Reductions in naturalness would be localized and would not change the overall structure of wilderness in Glacier Bay or Dundas Bay. Seasonal closures to motorized vessels in wilderness waters reduce, but do not completely eliminate the potential for changes to naturalness. Wilderness waters that would remain open to motorized use (Dundas Bay and Beardslee Entrance) would continue to experience decreased naturalness.

Current operating requirements for motorized craft are designed to minimize wildlife disturbance and collisions with whales, and to reduce liquid waste discharges; however, within the narrow inlets/fjords vessel traffic would be concentrated, especially on peak use days. In particular, Tarr and Johns Hopkins inlets, both of which contain spectacular tidewater glaciers, are susceptible to congested conditions and, as described in section 4.2.2, “Air Quality,” inversions can sometimes trap vessel emissions, creating a temporary yet noticeable layer of haze that would detract from the natural character of the wilderness shorelines and slopes.

Another area subject to motorized vessels is the Beardslee Entrance. This area is the opening between Young and Strawberry Islands, which is within designated wilderness. This is the only place where cruise ships enter designated wilderness; however, in 2002, only one cruise ship out of 139 entered this area.

Under alternative 1, tour vessels would continue to visit Dundas Bay and the East Arm of Glacier Bay, except during the 6-week periods when Muir and Wachusett Inlets are closed. The shorelines of these areas, like almost all shorelines of the park outside of Bartlett Cove, would be exposed to these vessels, along with private and charter vessels. Some tour vessels are quite large and, within the relatively small Dundas Bay, may be imposing. In addition, tour vessels drop off kayakers who travel in relatively large groups that create noise and visual intrusions into the naturalness of wilderness shorelines of the East Arm and Dundas Bay.

Tour vessels have a relatively high risk factor for grounding and, due to their size, carry significant amounts of fuel, so the presence of tour vessels within Dundas Bay and the East Arm introduces greater potential risk of effects on the wilderness resource from fuel spills. Cruise ships occasionally travel up the East Arm, but since the retreat of the major glaciers in that area, such use would be infrequent, as would the resulting effects of seeing and hearing these vessels.

Dundas Bay, the northern portion of which is designated wilderness, also would remain open without daily limits. Use would be expected to increase for charter vessels, because Dundas Bay provides opportunities for fishing; wildlife viewing; and off-vessel activities, such as kayaking and shore walking — activities ideal for charter operations. In addition, Dundas Bay is one of the few places that remains usable when strong westerly winds (westerlies) blow through Icy Strait. Charter use within Dundas Bay, therefore, could peak on certain days so that 12 or more vessels could be present. Due to the small size of the Bay, this would create a strong human presence and detract from natural conditions, as perceived from the shoreline and from the wilderness waters located in the upper Bay. Peak off-boat activities also would detract from the naturalness of the Bay. This level of activity is expected to disturb wildlife use of the shoreline as well, further reducing the naturalness of the shoreline.

The overall direct effects to wilderness resources would be moderate due to the fact that human activity would occur frequently and create a strong human presence in the more enclosed waterways of the park, such as Dundas Bay, the East Arm, and the popular inlets of the West Arm.

Cumulative effects on wilderness resources – alternative 1 — The presence of motorized vessels, and the associated effects on wilderness, would be additive to other effects currently detracting from the character of wilderness in the park. Most notable are the effects of other backcountry users within the wilderness. While relatively dispersed, these uses create trails, campsites, and other signs of human use that can detract from the character of the wilderness not only on land but also as viewed from the water; so, too, would continued overflights of floatplanes, helicopters, and other aircraft. The Park Service is considering granting mountaineering permits for Mt. Fairweather that would involve aircraft overflights, dropoffs, and landings. These flights, and the noise from other flightseeing and recreational drop-off operations, would detract from natural conditions. The Park Service itself makes numerous motorized administrative and research trips into the Bay.

Collectively, the effects of these human activities are and would continue to remain moderate; however since the overall character and functioning of the wilderness would remain intact. Many of these effects have been occurring within the Glacier Bay Wilderness for decades, and the wilderness has remained a wild place, with a functioning natural ecosystem and plentiful opportunities for solitude in the rugged and beautiful landscape.

Impairment analysis for wilderness resources — alternative 1 — Because effects are expected to be moderate, the wilderness resource would not be impaired by continued management under the existing regulations.

Conclusion, wilderness resources — alternative 1 — Throughout most of Glacier Bay's remote and rugged interior wilderness, vessel traffic would not affect the wilderness character of the park. However, within Johns Hopkins and Tarr Inlets the effects of vessel noise and air pollution could be heightened (compared to other parts of the Bay) due to the concentrated use in these areas. The effects to the naturalness of upper Dundas Bay and Beardslee Entrance would be moderate because these bodies of water would remain open to motorized vessel use. Overall, the effect to wilderness resources of alternative 1 would be moderate because the effects occur over a relatively large area (entire bays and inlets) and are frequent. Cumulative effects from other activities would not substantially contribute to direct effects from alternative 1. Wilderness resources would not be impaired under this alternative.

Alternative 2 - Effects on Wilderness Resources.

Direct and indirect effects on wilderness resources — alternative 2 — Overall, alternative 2 would affect wilderness in a manner similar to that described under alternative 1, with moderate effects due to the visual presence of vessels, and vessel noise and emissions into the air and water. The vast majority of the Glacier Bay Wilderness would be unaffected by motorized vessel traffic, except for upper Dundas Bay and Beardslee Entrance. Shoreline areas would be most affected due to their proximity to vessel traffic.

Under alternative 2, fewer cruise ships, charter vessels, and private vessels would be allowed within Glacier Bay during the summer season than are currently allowed. This would result in a slight proportional reduction in associated effects, including, as described in other sections of this EIS, noise disturbances in feeding, nesting, and migration of marine mammals and birds in Glacier Bay, the intrusion of air emissions into wilderness, and the visual presence of vessels. Overall, effects would remain about the same as alternative 1, including the introduction of noise, water, and air emissions to the wilderness shoreline.

As with all alternatives, the motorized vessel-related effects would be localized in concentrated use areas, including Tarr and Johns Hopkins Inlets. Even with fewer vessels allowed over the season, the overall level of effect would be the same as alternative 1 because the effect would occur during peak use, daily entry limits would be the same as under the current situation.

As with alternative 1, Dundas Bay would remain open to tour vessels and would not have restrictions on entries for any vessel category, resulting in peak use days of charter vessels where up to 12 vessels may be present. The direct effects of alternative 2 on wilderness resources of Dundas Bay would be localized and short term.

Cumulative effects on wilderness resources – alternative 2 — Since alternative 2 would affect wilderness in the same manner as alternative 1, the cumulative effect also would be similar and would remain moderate for the shoreline of Glacier Bay. Collectively, the effects of backcountry users, aircraft, administrative vessels, and other human activities would remain moderate, since the overall character and functioning of the wilderness would remain intact.

Impairment analysis for wilderness resources — alternative 2 — Since the overall character and functioning of the wilderness would remain intact, even when considering cumulative effects, alternative 2 would not impair the Glacier Bay Wilderness resource.

Conclusion, wilderness resources — alternative 2 — Overall effects on wilderness would be similar to the existing situation, with no changes to most of Glacier Bay's wilderness and some reduction of naturalness due to the effects of noise and releases of air and water pollution. Most effects would occur in wilderness waters and along the shorelines. Private vessel numbers under alternative 2 would be the lowest allowed over the summer among all the alternatives, and the number of cruise ships would be reduced, but since peak numbers allowed would remain the same, the overall effect would be essentially the same. While alternative 2 would reduce overall vessel traffic within Johns Hopkins and Tarr Inlets, the effects of vessel noise and air pollution (i.e., reducing "naturalness" along the shorelines and slopes) could be heightened due to the concentrated vessel use in these areas. Overall, the effects to wilderness would be moderate because the effects occur over a relatively large area and are frequent. Cumulative effects from other activities would not substantially contribute to direct effects from alternative 2.Wilderness resources would not be impaired under this alternative.

Alternative 3 - Effects on Wilderness Resources.

Direct and indirect effects on wilderness resources — alternative 3 — Like alternative 2, the overall effects on wilderness from alternative 3 would be similar to those described under alternative 1. As described in other sections of this EIS, these consequences include noise disturbances in feeding, nesting, and migration to marine mammals and birds in Glacier Bay, the intrusion of air emissions into wilderness, and the visual presence of vessels.

The primary factor that would change from current conditions is that cruise ship numbers could increase to 184 cruise ships from June through August, allowing two cruise ships a day, every day, throughout the summer season. This number of cruise ships would increase the number of events during which congestion would occur in inlets, along with the associated reduction in naturalness. Using the increased percentage of cruise ships (32.4%) under this alternative, the frequency of congestion events when wilderness would be affected would increase by about one-third. The absolute effects of each congestion event would not change, since peak limits (daily entry quotas) would remain the same as under the current management scheme. As with all alternatives, shoreline areas would be most affected due to their proximity to vessel traffic.

As with alternative 1, overall effects would remain moderate, but would occur more frequently and for a longer seasonal duration, including the introduction of noise, water, and air emissions to the wilderness shoreline. These effects would remain localized. As with alternative 1, Dundas Bay would remain open to tour vessels and would not have restrictions on entries for any vessel category, resulting in peak use days of charter vessels where up to 12 vessels may be present.

Cumulative effects on wilderness resources — alternative 3 — Since alternative 3 would result in similar effects on wilderness as alternative 1, cumulative effects would be similar and would remain moderate. Collectively, the effects of backcountry users, aircraft, administrative vessels, and other human activities would continue to remain moderate, since the overall character and functioning of the wilderness would remain intact.

Impairment analysis for wilderness resources — alternative 3 — Since the overall character and functioning of the wilderness would remain intact, even when considering cumulative effects, alternative 3 would not impair the Glacier Bay Wilderness resource.

Conclusion, wilderness resources – alternative 3 — Overall effects on wilderness would be similar to alternative 1, and would be moderate, although there would be minimal effects throughout most of the Glacier Bay Wilderness. Some reduction of naturalness would occur due to the effects of noise and releases of air and water pollution. Most effects would occur in wilderness waters and along the shorelines. Since alternative 3 allows for up to two cruise ships a day, every day, throughout the summer, crowding events where within Johns Hopkins and Tarr Inlets would occur more frequently. Cumulative effects to wilderness resources from other activities in the park would not significantly contribute to the direct effects of this alternative. Wilderness resources would not be impaired under alternative 3.

Alternative 4 - Effects on Wilderness Resources.

Direct and indirect effects on wilderness resources – alternative 4 — Several major changes would occur under alternative 4 that would reduce effects to wilderness from those occurring under alternative 1:

- the East Arm, Beardslee Entrance, and Dundas Bay would be closed to cruise ships and tour vessels.
- daily vessel quotas would be reduced across all vessel categories.
- daily and seasonal vessel quotas would be set for charter use in Dundas Bay.
- cruise ships would be required to follow designated travel lanes.
- seasonal limits would be extended to May and September (currently they only apply from June through August).

Closing the East Arm and Dundas Bay to cruise ships and tour vessels would eliminate effects on naturalness within wilderness that occur from these vessels. These include emissions into the air and water, visual and noise intrusions, and shoreline disturbance and noise resulting from off-vessel activities.

Reducing vessel quotas also would reduce the congestion anticipated in alternatives 1, 2, and 3 that occur at the concentration points of Tarr and Johns Hopkins Inlets (and potentially Reid Inlet). The reduction in daily quotas could reduce peak use in these areas, but the daily limit of two cruise ships would remain; however, by keeping the daily limit open to two cruise ships, use could be staggered so that on some days, two cruise ships would enter Glacier Bay, and on other days, none would enter.

By requiring cruise ships to follow a central route up and down Glacier Bay, the distance to wilderness areas would be maximized, thereby providing more of a buffer and lower potential for effects on wilderness. In particular, Beardslee Entrance would be closed to cruise ships under this alternative, thereby eliminating the one place where cruise ships can enter designated wilderness. Finally, by extending the period for seasonal restrictions into May and September, the number of days where maximum vessel use occurs would be reduced.

Other effects of vessel traffic, while somewhat reduced, would remain similar to those that would occur under alternatives 1, 2, and 3. As described in other sections of this EIS, these consequences include disturbances in feeding, nesting, and migration to both sensitive marine mammals and birds in Glacier Bay, the intrusion of vessel exhaust into wilderness, and the visual presence of vessels. The direct effects of alternative 4 on wilderness resources would be moderate because noise, air emissions, and congestion would be frequent and occur over a large area.

Cumulative effects on wilderness resources — alternative 4 — As described under the previously addressed alternatives, the presence of motorized vessels and the associated effects on wilderness would add to other effects. Most notable are the effects of other backcountry users within the wilderness and overflights of floatplanes, helicopters, and other aircraft. Collectively, the effects of these human activities would be moderate, and the overall character and functioning of the wilderness would remain intact.

Impairment analysis for wilderness resources — alternative 4 — Because effects of this alternative would be expected to be moderate, the wilderness resource would not be impaired.

Conclusion, wilderness resources — alternative 4 — Overall effects on wilderness would be similar to the existing situation and would be moderate throughout most of Glacier Bay's wilderness. Some reduction of naturalness would occur due to the effects of noise and releases of air and water pollution. Most effects would occur in wilderness waters and along the shorelines. Since alternative 4 provides for the fewest cruise ships among the alternatives, effects related to crowding and air emissions within narrow fjords would be the lowest compared to the other alternatives, including the existing situation. Cumulative effects on wilderness resources from other activities in the park would not significantly contribute to direct effects. Wilderness resources would not be impaired by alternative 4.

Alternative 5 - Effects on Wilderness Resources.

Direct and indirect effects on wilderness resources — alternative 5 — Most of the same changes that would occur under alternative 4 would also be implemented under alternative 5. The objective of alternative 5 includes, in addition to protecting park resources and values, to increase a variety of use levels and opportunities for park visitors. Therefore, vessel levels would remain at current levels, as would most of the effects on wilderness, which are mostly minor. Vessel congestion would continue to occur at two major inlets of the West Arm; however, alternative 5 would contain protective actions, including:

- closing the entrance to Adams Inlet and Beardslee Entrance to cruise ships and tour vessels.
- closing Dundas Bay to cruise ships and upper Dundas Bay to tour vessels.
- setting seasonal vessel quotas for charter use (but no daily limit) in Dundas Bay.
- extending seasonal limits to May and September for cruise ships (currently they only apply from June through August).

Closing Dundas Bay to cruise ships would cause a negligible reduction in effects since cruise ships rarely, if ever, travel there. Effects of tour vessels would continue in lower Dundas Bay, including noise and air pollution at minor levels (i.e., affecting localized areas and effects lasting no more than a few hours).

Contrasted with alternative 4, alternative 5 would not require cruise ships to follow a central route up and down Glacier Bay; however, Beardslee Entrance would be closed to cruise ships under this alternative, thereby eliminating cruise ships' entryway into designated wilderness.

As opposed to the other alternatives, vessel speed restrictions under alternative 5 would be based on ground speed, rather than speed over water (see chapter 2 for a detailed discussion). As a result, vessel noise could increase at times when vessels move against the current, because the current speed would be added to the ground speed and the vessel would move through the water at a faster rate, thereby requiring more engine power and associated noise. Overall, this effect would be minor and would probably represent a negligible change over the existing situation, because most vessels already navigate based on ground speed, even though, technically, they should be using in-water speed. The overall direct effects to wilderness resources under this alternative would be moderate since they would be frequent and occur over a relatively large area.

Cumulative effects on wilderness resources — alternative 5 — As described under the previously addressed alternatives, the presence of motorized vessels, and the associated effects on wilderness, would be additive to other effects. Most notable are the effects of hikers and non-motorized boaters within the wilderness and overflights of floatplanes, helicopters, and other aircraft. Collectively, the effects of these human activities are and would continue to remain moderate, since the overall character and functioning of the wilderness would remain intact.

Impairment analysis for wilderness resources — alternative 5 — Because effects are expected to be moderate, the wilderness resource would not be impaired by continued management as described under this alternative.

Conclusion, wilderness resources — alternative 5 — The overall effect to wilderness resources would be moderate, although the closure of wilderness waters in Dundas Bay to both tour vessels and cruise ships indicates alternative 5 would have marginally lower effect levels than the current situation. Protective operating requirements would reduce overall effects on the wilderness resource from those currently occurring for cruise ships, and tour and charter vessels. Vessel activity would remain at current levels, as would most of the effects on wilderness, and would, therefore, be moderate. As with all alternatives, effects would be greatest near the most popular areas, including Tarr and Johns Hopkins Inlets. Cumulative effects from other activities in the park would not significantly contribute to direct effects. Wilderness resources would not be impaired under this alternative.

Alternative 6 – Effects on Wilderness Resources.

Direct and indirect effects on wilderness resources — alternative 6 – Most of the same changes that would occur under alternative 5 would also be implemented under alternative 6. The primary factor that would change from alternative 5 is that cruise ship numbers could increase to 184 from June through August and 122 during May and September, allowing two cruise ships a day, every day. This number of cruise ships would increase the number of events during which congestion (e.g., one or more vessels in the same vicinity at the same time) could occur at two major inlets of the West Arm. Using the increased percentage of cruise ships (32.4%) under this alternative, the frequency of congestion events when wilderness would be affected would increase proportionally by about one-third. The absolute effects of each congestion event would not change, since peak limits (daily entry quotas) would remain the same as under the current management scheme. As with all alternatives, shoreline areas would be most affected due to their proximity to vessel traffic; however, effects from increased vessel entries would occur along the entire length of vessels' routes through Glacier Bay. The vessels would affect wilderness resources by disrupting natural quiet and potentially degrading the natural environment through air emissions. As with alternative 5, alternative 6 would contain protective actions, including:

- Closing the entrance to Adams Inlet and Beardslee Entrance to cruise ships and tour vessels.
- Closing Dundas Bay to cruise ships and upper Dundas Bay to tour vessels.
- Setting seasonal vessel quotas for charter use (but no daily limit) in Dundas Bay.
- Extending seasonal limits to May and September for cruise ships (currently they only apply June through August).

Closing Dundas Bay to cruise ships would cause a negligible reduction in effects since cruise ships rarely, if ever, currently travel there. Effects of tour vessels would continue in lower Dundas Bay, including impacts from other users at moderate levels since they would affect the entire Bay and be a frequent occurrence.

As with alternative 5, alternative 6 would not require cruise ships to follow a central route up and down Glacier Bay; however Beardslee Entrance would be closed to cruise ships, thereby eliminating cruise ships' entryway into designated wilderness.

Cumulative effects on wilderness resources — alternative 6 — As described under the previously addressed alternatives, the presence of motorized vessels, and the associated effects on wilderness would be additive to other effects. Most notable are the effects of hikers and non-motorized boaters within the wilderness and overflights of floatplanes, helicopters, and other aircraft. Collectively, the effects of these human activities are and would continue to remain moderate, since the overall character and functioning of the wilderness would remain intact.

Impairment analysis for wilderness resources — alternative 6 — Because effects are expected to be moderate, the wilderness resource would not be impaired by continued management as described under this alternative.

Conclusion, wilderness resources — alternative 6 — The overall effect to wilderness resources would be moderate, although closure of wilderness waters in Dundas Bay to both cruise ships and tour vessels indicates alternative 6 would have marginally lower effect levels than the current situation. Even with increased seasonal-use days for cruise ships, protective operating requirements would reduce overall effects on the wilderness resource from those currently occurring for cruise ships, and tour and charter vessels. Vessel activity would remain at current levels, as could most of the effects on wilderness. As with all alternatives, effects would be greatest near the most popular areas, including Tarr and Johns Hopkins Inlets. Cumulative effects from other activities in the park would not significantly contribute to direct effects. Wilderness resources would not be impaired under this alternative.

Summary, Wilderness Resources. Under all alternatives, vessel traffic would reduce wilderness values along the terrestrial shoreline of Glacier Bay and Dundas Bay. Alternative 4 would have the lowest effect on wilderness values because of the lower vessel numbers and the elimination of cruise ships and tour vessels in all of Dundas Bay, East Arm of Glacier Bay, Beardslee Entrance, and Fingers and Berg Bays. Alternative 5 and 6 would eliminate cruise ships and tour vessels from the entrance to Adams inlet, Beardslee Entrance, and the wilderness waters of Dundas Bay, improving wilderness conditions there. Alternatives 3 and 6 would increase the potential for visible haze, noise, and naturalness in wilderness due to the increase in cruise ships.

4.4.5 Local and Regional Socioeconomics

4.4.5 Local and Regional Socioeconomics

This section evaluates the potential effects of implementing the proposed alternatives on local and regional socioeconomics.

Issues of Concern Raised during Scoping. The issues related to local and regional socioeconomics that were raised during scoping are:

- Increasing the vessel quota for private and charter vessels and providing access to Dundas and Taylor Bays could improve local economies and lifestyles. Revenues generated from local wildlife viewing and sightseeing charter and tour vessels could replace loss of livelihood resulting from the Glacier Bay commercial fishing phase-out.
- Increasing the number of permits allocated to local owners and operators could benefit the local economy, but the number of vessel entries should not increase.
- Increasing the vessel quota for tour vessels could benefit the economy of local communities by providing additional entries to local operators. Increased restrictions on local resident access could have detrimental effects to local economies.
- Increasing the vessel quota for private, locally based vessels would benefit inn and lodge operators by increasing their access to Glacier, Dundas, and Taylor Bays for their guests.

Issues raised during scoping related to the cumulative effect on the environment from the incremental effect of other actions include the following:

- Commercial fishing is being phased out of Glacier Bay and Dundas Bay wilderness waters, but will continue until all current permit holders cease to fish. (The waters outside Glacier Bay are open to commercial fishermen.)
- Some commenters have the perception that tourism in Southeast Alaska is leveling out and fewer independent travelers are coming to the park. These conditions may alter demand and the type of visitor experience preferred.
- The number of charter vessel operators is increasing, which could result in increased demand for permits.

Methodology and Assumptions. The analysis of effects on local and regional socioeconomics is focused on businesses and the local economies within which they operate. It identifies businesses that currently receive revenues, either directly or indirectly, from cruise ship and tour, charter, and/or private vessel access to Glacier Bay. Several research tools were used to assess business response to changing vessel quotas, including an analysis of cruise line and other business reactions (i.e., itinerary changes, pricing adjustments, etc.) to past changes in Glacier Bay permits, interviews with cruise line marketing managers, public meetings, and open houses held at local communities.

Economic impacts were evaluated and described in terms of whether each alternative would increase, decrease, or not change tourism revenues in local economies. It is assumed that tourism revenues will continue to increase in each of the communities evaluated regardless of which alternative is selected, due to the strong and steady trend of increased tourism to Southeast Alaska. Therefore, predicted declines for some alternatives are actually declines in the rate of increased revenues, rather than an actual decline.

Baseline community and regional data is drawn from secondary data sources, including the 2000 U.S. Census, Alaska Department of Labor and Workforce Development, Bureau of Economic Analysis, and others. The intensities of effects on communities are described in table 4-28.

TABLE 4-28: THRESHOLD CRITERIA FOR LOCAL AND REGIONAL SOCIOECONOMICS EFFECTS ANALYSIS

Negligible	The effect would not be detectable and would not change the socioeconomic environment, including individuals, businesses, and communities with economic linkages to the park.
Minor	A community-level economic effect would be measurable, but small relative to the size of overall economies. In the smaller communities (Gustavus, Hoonah, Pelican, Skagway, or Elfin Cove) effects would be considered minor if there could be an overall (economy-wide) change in employment and personal income of less than 5%. In larger communities (Juneau, Sitka, and Haines) effects would be considered minor if there could be an overall (economy-wide) change in employment and personal income less than 1%.
Moderate	The effect would be clearly detectable and could reduce the socioeconomic environment. In the smaller communities (Gustavus, Hoonah, Pelican, Haines, Skagway, or Elfin Cove) effects would be considered moderate if there could be an overall (economy-wide) change in employment and personal income of greater than 5%, but less than 10%. In larger communities (Juneau, Sitka, or Ketchikan) effects would be considered moderate if there could be an overall (economy-wide) change in employment and personal income greater than 1%, but less than 3%.
Major	The effect would have a substantial, highly noticeable, potentially permanent influence on the socioeconomic environment. More than one-quarter of people and businesses with economic linkages to the park would be affected. In the smaller communities effects would be considered major if there could be an overall (economy-wide) change in employment and personal income of greater than 10%. In larger communities effects would be considered major if there could be an overall (economy-wide) change in employment and personal income of greater than 3%.

Overview of how changes in vessel quotas and operating requirements may effect visitation patterns and associated revenues — The analysis of economic benefits and costs of changes in vessel quotas and operating requirements in Glacier Bay National Park and Preserve involves two primary questions:

1. How would changes in vessel quotas and/or operating requirements change visitation patterns in Glacier Bay, the Icy Strait area, and throughout Southeast Alaska?
2. How would the change in visitation patterns change revenues/economies and where?

The ultimate change in visitation patterns and associated revenues would be the result of the cumulative responses of many individual commercial operators and thousands of individual visitors (as consumer choices) to changes in availability and cost of visits to Glacier Bay.

A reduction in cruise ship quotas to Glacier Bay would not necessarily cause a proportional reduction in Southeast Alaska cruise ship visits. In one case during temporary, restrictions in Glacier Bay, cruise ships rerouted their destinations to include alternate ports of call. It is likely that operators would change their pricing, marketing, and destination packages in response to changes in availability of Glacier Bay visits. With fewer entries allowed into Glacier Bay, visits to other glacier destinations would increase, such as the Endicott Arm, a 30-mile (43-kilometer) long fjord 66 miles (106 kilometers) from Juneau, with Dawes and North Dawes glaciers, or the Hubbard Glacier of Disenchantment Bay. This is because of the high demand for glacier viewing by cruise ship passengers. Conversely, more entries allowed into Glacier Bay may reduce visits to other glacier sites.

In general, quotas and operating requirements for cruise ships and tour vessels have the most economic effects at the "tourism industry level," while those for charter and private vessels have the most economic effects at the local level. Cruise ship companies, and, to a somewhat lesser extent, tour vessel companies, that operate in Southeast Alaska employ thousands of people, most of whom are not from Alaska. The majority of their revenues also come from outside Alaska. Much of the money generated from the cruise ships that remain in Alaska benefits the economies of ports of call, including the tax base for local governments and general revenues and personal incomes related to tourist and cruise ship employee spending. Other revenues go outside of Alaska, including purchases for goods and services, including items such as food, flowers, and paper products.

Charter and private vessels have a much more direct effect on the local economies of non-port of call communities, such as Elfin Cove, Pelican, and Gustavus. Many charter operations are based in these communities and private vessel operators very often visit these communities.

Alternative 1 (No Action) – Effects on Local and Regional Socioeconomics.

Direct and indirect effects on local and regional socioeconomics — alternative 1 — The economic linkages between visitation in the park and local and regional economies are widespread and complex. The economies of cruise line ports of call such as Haines, Skagway, Juneau, Sitka, and Ketchikan benefit from cruise ship passenger spending, cruise line spending (moorage fees, etc.), and the tax revenues stemming from that spending. Cruise passengers spent just under $200 million in Southeast Alaska communities in 1999, the latest available data (McDowell 2000d). Cruise ship passengers spend an average of $120 each in Juneau, approximately $100 in Ketchikan and Skagway, and lesser amounts in Sitka and Haines. Cruise lines spent another $22 million on maritime services and other goods in services in direct support of their Southeast Alaska operations (McDowell 2000d). Access to Glacier Bay is linked to the economic well being of these ports of call because the inclusion of Glacier Bay in a cruise itinerary can determine which communities are also included in the itinerary, and whether or not the ship travels elsewhere.

The actual economic impact of the loss of cruise ship fees to the National Park Service cannot be fully predicted. Some seasonal jobs would be lost, but the overall spending and personal income within the community may not change substantially.

Alternative 1 would have negligible direct effects on Glacier Bay-dependent businesses, charter boat operators, lodging establishments, cruise lines, and tour boat operators. As the no-action alternative, no increase or decrease in business sales would be associated with alternative 1.

Businesses in the smaller communities with linkages to Glacier Bay, such as Elfin Cove sportfishing lodge operators, would not experience a change in sales or employment as a result of alternative 1. Some operators would, however, continue to experience difficulty in obtaining permits for Dundas Bay, as expressed in public hearings held during the scoping phase of this project.

Alternative 1 would not directly affect local and regional economies in Southeast Alaska. Alternative 1 would maintain personal income and employment for businesses and local economies that are dependent on Glacier Bay at current levels.

Cumulative effects on local and regional socioeconomics — alternative 1 — A broad range of factors influence the local and regional economies of Southeast Alaska. Some smaller communities, such as Pelican, will continue to struggle with changing conditions in the seafood industry, declining fish markets, and recent changes in fisheries management. Some residents of Pelican, Hoonah, and Gustavus hold the opinion that changes in vessel management in Glacier Bay, such as setting more permits for local charter operators, could benefit their local economies.

These communities and local residents have received monetary compensation from the federal government for lost income due to the Glacier Bay commercial fishing closures. The Glacier Bay Compensation Plan Economic Assessment calculated potential economic losses to fishermen, processors, communities and others between $23 million and $59 million. The federal government has made available a total of $31 million for the compensation program (McDowell 2000a). Assuming that changes in personal income and employment would increase in proportion to the percent employed in visitor-affected businesses and the 5 or 6% annual growth of the visitor industry, this effect would be minor to communities such as Hoonah, Pelican, Juneau, and Sitka and moderate in Gustavus, Elfin Cove, Haines, and Yakutat.

As alternative 1 will not produce changes in local and regional economies, the cumulative economic effects are negligible.

Impairment analysis for local and regional socioeconomics — alternative 1 — Socioeconomics is not a park resource or value, and so is not subject to the non-impairment standard defined in section 1.3.1 and further defined in NPS policy 1.4.6.

Conclusion, local and regional socioeconomics — alternative 1 — The direct and indirect adverse effects of the implementation of alternative 1 are minor. The cumulative considerations would not produce any independent changes to local and regional economies. No mitigation measures would be necessary and impairment does not apply to this resource; therefore, the overall effects of this alternative are minor adverse effects.

Alternative 2 – Effects on Local and Regional Socioeconomics.

Direct and indirect effects on local and regional socioeconomics — alternative 2 — Communities whose economies benefit from cruise, charter, and private boat tourism in Glacier Bay would experience lower business sales and lower employment, causing a minor to moderate effect on local personal income. The actual distribution of adverse economic effects among communities would depend on the specifics of the quotas, i.e., how the reductions would be implemented, which has not been determined. Personal income for local residents of the neighboring communities of Gustavus, Hoonah, Pelican, and Elfin Cove could decline due to reduced business activity for charter operators that rely on access to Glacier Bay for sales, stemming from a 13% reduction in charter permits and reduced local spending associated with private vessel traffic (also 13%).

Cruise line traffic could increase or decrease to any given community because, with Glacier Bay not available (or less available) cruise lines would look for other glacier experiences to offer their passengers, such as Tracy Arm. Some communities could see an increase in the number of port calls, while others might experience some decline. It is not possible to predict which communities would experience reductions or increases in cruise ship traffic.

In summary, the economies of communities with economic linkages to Glacier Bay would experience minor to moderate adverse income and employment effects from alternative 2. The overall direct and indirect effects of alternative 2 would be moderate.

Cumulative effects on local and regional socioeconomics — alternative 2 — Moderate cumulative adverse effects would be associated with alternative 2. Personal income in Gustavus, Pelican, Hoonah, and Elfin Cove have been and will remain depressed due to commercial fishing closures and restrictions in Glacier Bay, and other management and market issues facing the fishing industry as a whole. These effects may be partially offset by positive short-term effects from the monetary compensation to commercial fishers by the federal government. The effects of commercial fishing restrictions, coupled with the reduction in the number of vessel entry permits for the Bay, would result in moderate employment and income losses in the smaller communities in the Glacier Bay area. Effects to the larger communities would be moderate, although potentially major in communities if cruise ships would cease to call.

Impairment analysis for local and regional socioeconomics — alternative 2 — Socioeconomics is not a park resource and so is not subject to the non-impairment standard.

Conclusion, local and regional socioeconomics — alternative 2 — The overall direct and indirect effects would be moderate. Including cumulative effects, all of the park's smaller neighboring communities could experience moderate adverse economic effects, which could be mitigated to some extent by using preferred operator criteria. The overall effect on local and regional socioeconomics of implementing alternative 2 would be moderate.

Alternative 3 – Effects on Local and Regional Socioeconomics.

Direct and indirect effects on local and regional socioeconomics — alternative 3. Alternative 3 would have moderate positive effects on local economies dependent on cruise ship traffic in Southeast Alaska. It is possible that more ships could operate as Inside Passage cruises, rather than as cross-Gulf cruises, and as a result there could be more passenger spending in ports of call, as well as more tax and ship fee revenue collected by local governments and private dock owners. More local spending associated with an increase in traffic could increase employment and payroll in Southeast Alaska ports of call.

In summary, alternative 3 would have moderate positive effects on Southeast Alaska ports of call. Effects on other communities would be negligible.

Cumulative effects on local and regional socioeconomics — alternative 3 — There are no cumulative effects considerations under alternative 3 that would result in effects measurably different from those identified for alternative 3 alone.

Impairment analysis for local and regional socioeconomics — alternative 3 — Socioeconomics is not a park resource and so is not subject to the non-impairment standard.

Conclusion, local and regional socioeconomics — alternative 3 — Implementation of alternative 3 would result in moderate positive direct and indirect effects.

Alternative 4 – Effects on Local and Regional Socioeconomics.

Direct and indirect effects on local and regional socioeconomics — alternative 4 — Moderate adverse local and regional economic effects would be associated with alternative 4. Personal income for local residents within Gustavus, Hoonah, Pelican, and Elfin Cove could decline as a result of a potential 17% reduction in business activity for charter operators. Gustavus's economy would be adversely affected by a 34% reduction in June-to-August cruise ship passenger fees paid to the Park Service. The actual economic impact of the loss of cruise ship fees to the National Park Service cannot be fully predicted. Some seasonal jobs would be lost, but the overall spending and personal income within the community may not change substantially. The community's economy also would be affected by the 33% reduction in tour vessel-use days during the June through August period.

The communities of Hoonah, Elfin Cove, and Pelican, which are not economically dependent on Glacier Bay cruise or tour vessel activity, would experience minor adverse effects, associated with a decline in charter vessel permits.

Losses of personal income in local communities due to reduced private vessels cannot be fully predicted because of potential offsetting factors. Reducing private vessel entries into Glacier Bay may cause some private vessels to not go to the Icy Strait area, thereby reducing visitation to local communities. However, limited entry into Glacier Bay could cause private vessels to come to the Icy Strait area and "wait" for a permitted entry. During this waiting time, private vessel operators may travel to local communities to visit, purchase gas and supplies, and perhaps eat at a local restaurant or even spend the night in harbor. The availability of short-notice permits under alternative 4 could offset this "waiting" period and associated visits to local communities. Overall, a reduction in private vessels is considered to have a negative, yet minor, effect on local communities.

The cruise line port of call communities of Skagway, Haines, Juneau, and Sitka could experience adverse economic effects from alternative 4. In the short term, these communities could experience some change in cruise line traffic as a result of rerouting of cruise itineraries. With fewer Glacier Bay entry opportunities, cruise lines would look for other glacier experiences to offer their passengers, such as Tracy Arm or Hubbard Glacier. This may or may not result in a decline in traffic to a particular community.

Overall economic effects of alternative 4 would be in the moderate range, with loss of potential personal incomes to local communities due to lost charter and private vessel traffic in the area.

Reducing speed limits for large vessels to 13 knots throughout Glacier Bay would add about three hours of travel time to cruise ships itineraries. This could result in the loss of one port of call, or reduced time spent at a port of call, thereby reducing revenues for that community and also for the cruise ship operator, which makes considerable money from off-ship activities at ports of call. Cruise ship operators may choose to increase speeds outside of Glacier Bay to make up for some of the lost time. This would increase fuel costs but would eliminate the need of skipping a port of call.

Cumulative effects on local and regional socioeconomics — alternative 4 — The cumulative economic effects associated with alternative 4 would be similar, but more adverse, than those described under alternative 2. The economies of Gustavus, Pelican, Hoonah, and Elfin Cove are reduced due to the combination of commercial fishing closures and restrictions in Glacier Bay and restricted visitor vessel entry permits for the Bay. This effect of alternative 4 would be small in relation to these other effects, but would reduce potential future employment and income in the smaller communities in the Glacier Bay area.

Impairment analysis for local and regional socioeconomics — alternative 4 — Socioeconomics is not a park resource and so is not subject to the non-impairment standard.

Conclusion, local and regional socioeconomics — alternative 4 — Reducing cruise ship numbers may shift cruise ship use to other ports of call and potentially to cross Gulf locations, rather than Southeast Alaska. Some ports of call may receive increased use, while others receive lower use. Reducing charter and private vessels would have minor to moderate negative economic effects in small, local communities, including Gustavus, Hoonah, Elfin Cove, and Pelican.

Alternative 5 — Effects on Local and Regional Socioeconomics.

Direct and indirect effects on local and regional socioeconomics — alternative 5 — The economic effects of alternative 5 generally would be similar to those described under alternative 1. That is, there would be negligible effects on local economies and businesses. Regarding effects on cruise lines, the reduced number of May and September cruise ship entries exceeds the actual number of cruise ship entries during those two months in 2001; therefore, the economic effects would be negligible.

The changes in Dundas Bay management included in alternative 5 could have minor positive economic effects on commercial users of Dundas Bay. Dundas Bay is typically a secondary attraction or destination for charter boat visitors, many of whom are in the area primarily to saltwater sport fish from lodges in Elfin Cove. Primary saltwater sportfishing areas are in the Cross Sound area; however, Dundas Bay is an important alternative destination when bad weather pushes the charter boats off the prime fishing grounds, and for wildlife viewing, crab fishing, and other activities. In alternative 5, charter vessels frequenting Dundas Bay will have no daily vessel quota and separate charter vessel quotas will be established for Glacier Bay. The seasonal-use day limits under alternative 5 are the same as current use-day limits for charters. This should provide more flexibility for charter operators and may allow for slightly more visitation than occurs now.

Reducing speed limits for large vessels to 13 knots throughout Glacier Bay would add about three hours of travel time to cruise ships' itineraries. This could result in the loss of one port of call, or reduced time spent at a port of call, thereby reducing revenues for that community and also for the cruise ship operator, which makes considerable money from off-ship activities at ports of call. Cruise ship operators may choose to increase speeds outside of Glacier Bay to make up for some of the lost time. This would increase fuel costs, but would eliminate the need of skipping a port of call.

In summary, the overall direct and indirect effects of this alternative on local and regional socioeconomics would be minor positive effects.

Cumulative effects on local and regional socioeconomics — alternative 5 — Cumulative economic effects would be similar to those described under alternative 1, including reductions of traditional economies, such as fishing and seafood processing. Alternative 5 will not produce measurable direct or indirect adverse changes in local and regional economies, therefore the contribution to cumulative economic effects are considered negligible.

Impairment analysis for local and regional socioeconomics — alternative 5 — Socioeconomics is not a park resource and so is not subject to the non-impairment standard.

Conclusion, local and regional socioeconomics — alternative 5 — Implementation of alternative 5 would result in negligible adverse and minor positive direct and indirect effects to local and regional economies.

Alternative 6 – Effects on Local and Regional Economics

Direct and indirect effects on local and regional socioeconomics — alternative 6 **—** Overall effects would be similar to those described under alternative 3, with the exception that reduced speed limits might interfere with cruise ship itineraries and associated spending in ports of call.

By allowing for potential increases in Glacier Bay visits via cruise ships, then the corresponding potential exists for increased revenues of cruise ship ports of call. Use of some ports of call, including those related to Tracy Arm or Hubbard Glacier might be reduced over what would otherwise occur, since those areas are used as alternatives to Glacier Bay.

Cumulative effects on local and regional socioeconomics — alternative 6 — Cumulative economic effects would be similar to those described under alternative 1. Alternative 6 will not produce measurable direct or indirect adverse changes in local and regional economies; therefore the contribution to cumulative economic effects would be negligible.

Impairment analysis for local and regional socioeconomics — alternative 6 — Socioeconomics is not a park resource and so is not subject to the non-impairment standard.

Potential mitigation measures for local and regional socioeconomics — alternative 6 — No mitigation measures are necessary for alternative 6.

Conclusion, local and regional socioeconomics — alternative 6 — Implementation of alternative 6 would result in negligible adverse and minor positive direct and indirect effects to local and regional economies. Cumulative considerations would not produce any independent changes to local and regional economies. Mitigation measures would not be necessary if this alternative is implemented. Impairment does not apply to this topic. Alternative 6 would result in negligible effects on local and regional economies in Southeast Alaska.

Summary, Local and Regional Socioeconomics. In general, effects from changes in cruise ship and tour vessel quotas could occur at the tourism-industry level, while changes in charter and private vessels could occur at the local level, including the many small communities in the Icy Strait area.

4.5 MANDATORY TOPICS RELATED TO THE EFFECTS ANALYSIS

Director's Order 12 (NPS 2001a) requires that the following topics be addressed in an EIS. This section describes the topics either by reference to where they are addressed or by describing them as irrelevant to the EIS, and thus excluded from the analysis.

4.5.1 Possible Conflicts Between the Proposal and Land Use Plans, Policies, or Controls for the Area Concerned

Establishing vessel quotas and operating requirements are consistent with existing plans. As described in chapter 1, subsections 1.1.1 and 1.1.2 (purpose and need, respectively) the proposed action is prompted and required by numerous plans, policies, and laws.

4.5.2 Energy Requirements and Conservation Potential

While vessel fuel is the primary energy requirement related to vessel management, this EIS is not addressing that use or fuel conservation potential, since both topics are outside the scope of this EIS. In addition, most vessels are designed for relatively good fuel efficiency, since fuel is often one of the greatest operating expenses for vessels.

4.5.3 Natural or Depletable Resource Requirements and Conservation Potential

All alternatives strive to protect natural resources, since such protection is one of the fundamental missions of the National Park Service and one of the three major goals the Park Service intends to achieve by implementing the proposed action. Potential effects on natural resources are described under each resource topic in chapter 4.

4.5.4 Urban Quality, Historic and Cultural Resources, and Design of the Built Environment

The proposed action involves no urban areas and is a plan that would involve actions outside of the built environment. Historic and cultural resources are addressed in chapters 3 and 4.

4.5.5 Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (Executive Order 12898)

Presidential Executive Order 12898, "Environmental Justice," states:

> *To the greatest extent practicable and permitted by law, agencies must make achieving EJ part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands.*

Environmental justice concerns the disproportionate burden of cost, or denial of benefits, to a particular minority social, economic, or ethnic group, stemming from changes in vessel management in Glacier Bay. With respect to the communities around Glacier Bay, this could include disproportionate adverse economic effects resulting from a particular management alternative, or the disproportionate denial of future economic opportunity related to motorized vessel access to Glacier Bay.

Environmental Justice — Alternative 1. As the no-action alternative, the only potential environmental justice issues would stem from the denial of economic opportunity to a particular minority group. This denial could stem from the loss of future economic opportunity that could result from increased motorized vehicle access to the Bay. The economic opportunity costs associated with alternative 1 are potentially most pronounced for the residents of Hoonah, a community with a population that is 61% Alaska Native, and with a per capita income of $16,097 in 2000, which is 25% below the U.S. average of $21,587 and 29% below the Alaska average of $22,660. While Hoonah currently has little economic dependence on Glacier Bay visitor traffic, the community is looking to the visitor industry for future local economic development, including the Point Sophia project. Increased motorized vessel access to the Bay could facilitate those economic development efforts, or conversely, more limited access could constrain those efforts.

Environmental justice is also a concern with respect to cumulative effects. Hoonah seafood processors and fishermen are among those who have had some degree of economic dependence on commercial fishing in Glacier Bay. Commercial fishing in Glacier Bay is being phased-out, with some areas of the Bay entirely closed to commercial fishing, and other areas open only to lifetime-access permit holders.

Environmental Justice — Alternatives 2, 4, and 5. The environment justice issues concerning alternatives 2, 4, and 5 are the same as those described under alternative 1. The concerns relate to reduced opportunity for the people of Hoonah to expand their local economy through visitor industry development. Hoonah does not currently have strong tourism-related linkages to Glacier Bay; however, changes in motorized vessel permits could change the community's ability to build such linkages. Concerns around cumulative effects also are the same as described for alternative 1.

Environmental Justice — Alternatives 3 and 6. There are no environmental justice concerns associated with alternatives 3 and 6. Alternatives 3 and 6 would provide for increased motorized vessel access to Glacier Bay. Depending on specifically how the alternative was implemented, it could afford equal opportunity for neighboring communities to benefit economically from that increased access.

4.5.6 Wetlands and Floodplains

As described in "Subsection 4.3.6. Coastal/Shoreline Environment and Biological Communities," none of the actions being considered would be anticipated to have a major adverse affect to shoreline communities. The planning area contains coastal wetlands, but none are anticipated to be adversely affected by any of the alternatives. There is no known data on floodplains in the planning area.

4.5.7 Prime and Unique Farmlands

No prime or unique farmlands are present within the park.

4.5.8 Endangered or Threatened Plants and Animals and Their Habitats

No endangered or threatened plants are present in the park. The endangered humpback whale and threatened Steller sea lion are discussed in depth in chapters 3 and 4.

4.5.9 Important Scientific, Archeological, or Other Cultural Resources

One of the primary purposes of Glacier Bay National Park and Preserve is to support scientific research related to glaciating and other natural processes. Vessel traffic can and occasionally does interfere with research activities. No specific conflict or interference was identified during scoping, so no actions were considered to reduce such conflicts. Archeological and cultural resources are addressed in detail in chapters 3 and 4.

4.5.10 Ecologically Critical Areas, Wild and Scenic Rivers, or Other Unique Natural Resources

No wild and scenic rivers are present within the marine areas that are being evaluated. The planning area contains many ecologically critical areas, and, in fact, the entire park can be considered an ecologically critical area. Adverse effects are presented in chapter 4 under the various resource topics.

4.5.11 Public Health and Safety

Public health and safety are addressed in "Subsection 4.4.3. Vessel Use and Safety."

4.5.12 Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) of 1972 (16 USC 1451, as amended) provides assistance to states, in cooperation with federal and local agencies, for developing land and water use programs in coastal zones. Section 307 of the Coastal Zone Management Act stipulates that federal projects that affect coastal resources or uses in a state's coastal zone must be consistent to the maximum extent practicable with the relevant enforceable policies of that state's federally-approved coastal zone management plan. As "lands the use of which is by law subject solely to the discretion of…the Federal Government, its officers, or agents," the Glacier Bay National Park and Preserve is statutorily excluded from the Coastal Zone Management Act's definition of Alaska's "coastal zone" (16 USC § 1453[1]). Based on the assessment of potential effects documented in this EIS, the Park Service has determined that implementation of the proposed vessel management plan would only affect coastal resources and uses within the boundaries of federally controlled property and would have no effects outside these boundaries. Consequently, the CZMA Section 307 federal consistency requirement does not apply and coordination with the State of Alaska is not required.

4.5.13 Sacred Sites

Sacred sites are described in "Subsection 4.4.1. Cultural Resources."

4.5.14 Indian Trust Resources

No known Indian trust resources are present within the planning area.

4.6 UNAVOIDABLE ADVERSE EFFECTS

Under all alternatives, vessel traffic would emit pollutants into the air and water, disturb marine birds and mammals (including the endangered humpback whale and the threatened Steller sea lion), and reduce visitor opportunities and enjoyment for some visitors. Collisions between vessels and marine mammals and birds could occur.

4.6.1 Physical Environment

Soundscape. Under all alternatives, vessel noise would regularly intrude into the natural soundscape, both on the surface and underwater. Cruise ship and tour vessel public address systems would be audible from many locations, including wilderness areas. Under alternatives 4, 5, and 6, reducing speed for cruise ships to 13 knots or less throughout Glacier Bay would greatly reduce human-caused sound in the underwater soundscape. Alternative 4 would cause the lowest level of human-caused sounds because it would allow the fewest vessels, restrict cruise ship speeds to 13 knots, and close Dundas Bay and much of the East Arm of Glacier Bay to tour vessels.

Air Quality. All alternatives would result in moderate effects, but implementation of alternative 4 would result in the lowest level of effects of all the alternatives. The emissions of nitrogen oxides in Glacier Bay under all alternatives would be above the 250 tons per year thresholds; however, based on the size of the area, the fact that all the sources are mobile and dispersed, and using Juneau's air quality for comparison, it is unlikely that these emissions would exceed air quality standards. Stack emissions from cruise ships and tour vessels occasionally cause visible haze, especially in narrow inlets. The frequency, magnitude, and duration of such events in not known. Proposed speed restrictions and quota changes under alternatives 4, 5, and 6 could reduce visibility problems, although increases to private vessel quotas under these alternatives would offset some of this improvement.

Water Quality. A potential major effect to water quality would occur in the unlikely event of a large oil discharge or fuel spill. While the analysis determined that such a spill is very unlikely, the addition or reduction in vessels entering Glacier Bay may incrementally increase or decrease, respectively, the likelihood of the event over the long term. Eliminating cruise ships and tour vessels from Dundas Bay would reduce the risk of accidents for these vessels in that area, which includes several areas of shallow waters and other navigational hazards.

4.6.2 Biological Environment

Threatened and Endangered Species. All alternatives would cause some individual whales and sea lions to move away from passing vessels in Glacier Bay or Dundas Bay. However, humpback whales are not expected to leave Glacier Bay or Dundas Bay due to vessel noise, however, because whale distribution has been shown to be more a factor of prey abundance than of avoidance of vessels. Overall effects are expected to be at the individual level, and, therefore, minor to moderate. Collisions with ships would be rare, but cannot be ruled out under any of the alternatives and, over time, are probably inevitable. The risk and potential frequency of such collisions increases with vessel traffic increases, so alternative 3 would have the highest potential level of risk for whale deaths due to vessel strikes. Alternatives 4, 5, and 6 include speed restrictions to 13 knots for cruise ships, a speed that has been shown to reduce the likelihood of whale collisions.

Marine Mammals. Under all alternatives, marine mammals would be disturbed by vessel traffic. Vessel traffic would cause individuals to avoid areas of high vessel use and would reduce energy intake and/or increase energy expenditures. Most marine mammals are highly mobile and able to avoid vessels, but individuals may be struck and injured or killed by vessels. The context of effects are expected to be at the individual level, including harbor seals, whose numbers in Southeast Alaska are declining.

Marine Birds and Raptors. Vessel traffic would disturb concentration areas of brood-rearing harlequin ducks, molting waterfowl, and foraging marbled murrelets. These species are particularly sensitive to vessel traffic and are expected to experience potential local population declines. Alternatives 5 and 6, which have the highest level of private vessel-use days, would also have the greatest potential for disturbing shore birds and colonial nesting birds, since these vessels can travel closer to shore than larger vessels.

Marine Fishes. Some fish may avoid areas near vessels, but no major effects are expected.

Coastal/Shoreline Environmental and Biological Communities. Implementation of any of the alternatives would have a minor effect on coastal/shoreline communities.

4.6.3 Human Environment

Cultural Resources. From the perspective of the Huna Tlingit (scoping), vessel traffic affects ethnographic resources in Glacier Bay by polluting or otherwise degrading the natural environment and, thus, degradation of the Huna Tlingit ancestral homeland.

Visitor Experience. Disturbance to visitors by other visitors would be unavoidable. Backcountry visitors are most sensitive to disturbance by motorized vessels. Visitor opportunity would change among the alternatives in three primary ways. First, since more than 85% of visitors to Glacier Bay experience the park on a cruise ship, changes in the numbers of cruise ships allowed would greatly affect opportunities and costs for the most common method of viewing the Bay. Second, providing opportunity in the form of cruise ship entry also removes opportunities and reduces the quality of visits for people who wish to experience the Bay without cruise ships. Third, alternative 4 would increase opportunities for solitude and quiet in Dundas Bay and the East Arm of Glacier Bay north of Sebree Island by not allowing cruise ships to enter these areas on a year-round basis. Additionally, tour vessels would not be allowed to enter Dundas Bay or the East Arm of Glacier Bay north of Muir Point. Alternative 4 would limit charter vessels to five and three per day in Glacier Bay and Dundas Bay, respectively. Although alternatives 5 and 6 would have seasonal-use day limits, with no daily limit, charter operators and thus visitors on charter vessels would be afforded greater flexibility in use in Dundas Bay.

Vessel Use and Safety. Risks of major vessel accidents resulting in large fuel spills and major loss of life are not expected. Occasional groundings with associated small fuel leaks would be expected under any of the alternatives.

Wilderness Resources. The sights and sounds of vessel traffic would change the naturalness of some wilderness areas (which include essentially all terrestrial shoreline areas above the mean high-tide line of Glacier and Dundas Bays). Alternative 4 would eliminate cruise ships from Dundas Bay, Beardslee Entrance, and the East Arm north of Sebree Island. Tour vessels would not be allowed within Dundas Bay, Beardslee Entrance, Fingers Bay, Berg Bay, and the East Arm north of Muir Point under this alternative. This would provide more wilderness experience for visitors wishing to spend time in these areas without the presence of large motorized vessels.

Local and Regional Socioeconomics. Alternative 2 would reduce direct and indirect spending by cruise lines and passengers, and the associated fees and taxes paid by cruise ship companies. Alternatives 3 and 6 would benefit local communities and cruise ship ports of call by increasing cruise ship entries. Alternatives 2 and 4 could result in lost employment and local incomes due to the loss of cruise ship revenues and related employment. Alternative 4 would reduce charter and tour vessel entries, as well as associated employment.

4.7 SUSTAINABILITY AND LONG-TERM MANAGEMENT

Director's Order 12 requires that Park Service managers consider the long-term impacts and the effect of foreclosing future options from actions being considered. These are defined in two ways, as presented in the following two sections.

4.7.1 The Relationship between Local Short-Term Uses of the Environment and the Maintenance and Enhancement of Long-Term Productivity

This required consideration addresses the question of whether the proposed action would be providing short-term benefits at the cost of future generations.

Based on the analyses presented under the physical, biological, and human environments, no long-term loss of productivity is expected. Should vessels be banned from Glacier and Dundas Bays, most effects would immediately cease and most others would soon pass with time. Glacier Bay and Dundas Bay areas show the remarkable ability of ecosystems to recover from major changes, considering most of these areas were under a vast ice sheet just 200 years ago. Even damages from a major fuel spill, while determined to be unlikely, would eventually diminish.

In addition, the primary goals of the project, as specified in chapter 1 of this EIS, are to protect the park resources from vessel traffic, to provide high-quality opportunities to park visitors, and to simplify vessel management. All of these goals are meant to protect the park's values and resources over the long term.

4.7.2 Irreversible and Irretrievable Commitments of Resources

Irreversible effects are those that cannot be reversed except in the extreme long term. An example of irreversible effects is the cutting of old growth trees. Irretrievable effects are those that are lost for a period of time. An example of irretrievable effects is loss of use of resources, such as recreational use, as a result of prohibiting access to an area to protect a sensitive wildlife species.

As stated above, most effects of vessel traffic would be eliminated immediately or soon after removal of vessels from Glacier Bay, should such an action be taken; therefore, none of the effects described in this chapter are considered irreversible.

Allowing cruise ships and other vessels access to most of the central portions of Glacier Bay represents an irretrievable loss to experience these areas in the absence of vessels. The proposed action, which is to set vessel quotas and operating requirements, would cause irretrievable loss of recreational opportunities, including loss for non-motorized experiences in much of Glacier and Dundas Bays, as well as loss of opportunities for people to enter the area either via cruise ship, tour vessel, charter vessel, or private vessel. Rather than recite the alternatives here, it is sufficient to note that proposed limits and closure of areas to all or some vessel types represents an irretrievable loss of access to those areas.

CONSULTATION AND COORDINATION

GLACIER BAY

NATIONAL PARK AND PRESERVE, ALASKA

VESSEL QUOTAS AND OPERATING REQUIREMENTS • FINAL ENVIRONMENTAL IMPACT STATEMENT

CHAPTER 5. CONSULTATION AND COORDINATION

This chapter describes the history of public involvement leading up to and during development of the FEIS. Public participation in the planning process helps to ensure that the Park Service fully understands and considers the public's interest. Through public involvement, the Park Service shared information about the planning process, issues, and proposed actions. In turn, the planning teams were informed of the concerns and values of those groups and individuals who participated in the process. Also as part of public involvement and in compliance with laws and regulations, management agencies and other public constituencies were consulted. With the help of the public's involvement, the Park Service is able to make informed decisions and improved plans.

5.1 HISTORY OF PUBLIC INVOLVEMENT

5.1.1 Scoping Meetings

The scoping period began on February 22, 2002, with publication of the Notice of Intent to Prepare an EIS in the *Federal Register* (67 *Federal Register* 8313, February 22, 2002) and ended on June 7, 2002. During the scoping period, the Park Service published a scoping newsletter in May 2002 and conducted seven public meetings in:

- Hoonah, Alaska (May 20, 2002).
- Gustavus, Alaska (May 21, 2002).
- Pelican, Alaska (May 23, 2002).
- Elfin Cove, Alaska (May 23, 2002).
- Anchorage, Alaska (May 28, 2002).
- Juneau, Alaska (May 29, 2002).
- Seattle, Washington (May 30, 2002).

A total of 83 persons attended the scoping meetings in Hoonah, Gustavus, Pelican, Elfin Cove, Anchorage, Juneau, and Seattle. The Park Service received comments during these scoping meetings and more than 5,000 electronic-mail messages, postcards, and comment letters from organizations and private citizens.

Other scoping activities included:

- conducting an internal scoping meeting with park staff on April 18 and 19, and May 8, 2002.
- conducting a meeting with the U.S. Biological Research Division at park headquarters on May 9, 2002, and with the National Marine Fisheries Service on May 29, 2002, in Juneau.
- conducting a meeting with representatives of the Alaska Land Act Coordinating Committee (ALACC) on June 12, 2002.
- mailing 755 brochures with scoping questionnaires (July 2002).
- publishing meeting notice advertisements in major newspapers.
- distributing flyers to all the communities where scoping meetings were conducted and mailing flyers to the harbormasters or port directors of the city or borough offices of Hoonah, Pelican, Juneau, Sitka, Petersburg, Ketchikan, Haines, and Yakutat, Alaska, as well as to the Alaska Women's Environmental Network for their electronic announcement page.

- distributing public service announcements and press releases via facsimile and electronic mail to the following newspapers and radio stations: *Alaska Business Monthly*; *Alaska Journal of Commerce*; *Alaska Magazine*; *Alaska Star*; *Anchorage Daily News*; *Anchorage Press*; *Anchorage Times*; Alaska Public Radio Network; Alaska Rural Communication Service; Associated Press; *Capital City Weekly*; *Chilkat Valley News*; Coast Alaska, Inc.; *Daily Sitka Sentinel*; *Eagle Eye News*; *Island News*; Jeanie Green Productions; *Juneau Empire*; KCAW-FM; *Ketchikan Daily News*; KINY-AM; KNBA-FM; KRBD-FM; KRSA-AM; KSKA-FM; KTKN-AM; KTOO-FM; Native Voice Communications; Reuters America; *The Alaskan Southeaster*; and *The Chamber*.
- posting the brochure and the comment form on the park's website.
- receiving comments via the website.

The Park Service established an internal team to assist in identifying significant issues and the range of alternatives for the EIS. The team consists of representatives from the park and preserve and the NPS Alaska Support Office.

5.1.2 Public Hearings

The public comment period began with the issuance of the DEIS and publication of the Notice of Availability in the *Federal Register* (*Federal Register, volume 68, number 55,* March 21, 2003) and ended on May 14, 2003. During the comment period, the Park Service conducted seven open house/public hearings to receive verbal comments on the DEIS in:

- Hoonah, Alaska (April 14, 2003).
- Gustavus, Alaska (April 15, 2003).
- Pelican, Alaska (April 16, 2003).
- Elfin Cove, Alaska (April 17, 2003).
- Juneau, Alaska (April 23, 2003).
- Anchorage, Alaska (April 24, 2003).
- Seattle, Washington (April 29, 2003).

A total of 79 persons attended the open house/public hearings in Hoonah, Gustavus, Pelican, Elfin Cove, Juneau, Anchorage, and Seattle. The Park Service received comments during these public hearings and more than 1,000 electronic-mail messages, postcards, comment letters, and web-based comments from organizations and private citizens.

Advertisement of the open house/public hearings was conducted in accordance with DO-12. Paid advertisements were placed in the *Juneau Empire*, *Anchorage Daily News*, *Seattle Times*, and *Seattle Post-Intelligencer*. Press releases were issued in these publications as well as in the *Seattle Daily Journal of Commerce*, *Alaska Journal of Commerce*, *The Anchorage Press*, *Anchorage Chronicle*, *Anchorage Times*, *Associated Press*, *Alaska Star*, and *Juneau Capital City Weekly*. Press releases and public service announcements were issued to APRN, Statewide Radio Network, KCAW-FM Sitka, KSKA-FM Anchorage, KFQD-AM Anchorage, KNBA-FM Anchorage, KMXS-FM Anchorage, KENI-AM Anchorage, KINY-AM Juneau, KSUP-FM Juneau, KTOO-FM Juneau, and KJNO-FM Juneau. Additionally, flyers were mailed to the respective town halls for posting.

Table 5-1 lists specific people and agencies contacted in the preparation of this EIS and the resources that were addressed.

TABLE 5-1: AGENCIES CONSULTED

Contact	Organization	Resource
Carolyn Morehouse	Alaska Department of Environmental Conservation	Air, Water
Bill Borrie, Ph.D.	University of Montana	Wilderness, Visitor Experience
Prof. Matt Carroll	Washington State University	Wilderness, Visitor Experience
Prof. Ed Krumpe	University of Idaho	Wilderness, Visitor Experience
Gary Drew	U.S. Geological Survey, BRD	Marine Birds
James Bodkin	U.S. Geological Survey, BRD	Marine Birds
Eric Knudsen	U.S. Geological Survey, Alaska Field Office, Biological Resource Division	Chief, Marine and Freshwater Resources
Steve Brockman	U.S. Fish and Wildlife Service, Ecological Services	Marine Birds
Richard Gordon	Concerned Citizen	Marine Birds
Gus van Vliet	Concerned Citizen	Marine Birds
Dan Esler	Canadian Wildlife Service	Marine Birds
Kathy Kuletz	U.S. Fish and Wildlife Service	Marine Birds
Dan Gibson	University of Alaska Museum	Marine Birds
Robert Ritchie	ABR, Inc.	Marine Birds
Michael Payne	NOAA, National Marine Fisheries Service	Endangered Species
Kaja Brix	NOAA, National Marine Fisheries Service	Endangered Species

5.2 MAJOR ISSUES RAISED DURING SCOPING

Many comments were received from the public during the scoping period. Major issues raised during scoping are described below.

5.2.1 Collisions with Marine Mammals

The public expressed concerns about humpback whale mortality or injury risk resulting from collisions with vessels. Many people pointed out that a pregnant humpback whale was killed by a cruise ship collision. Concern was also expressed in regards to the lower portion of Glacier Bay and its importance to humpback whales and other marine wildlife. The public expressed a desire to see the vessel quotas and speed limits continue in this area.

5.2.2 Effect of Noise on Whales

The public expressed concern about the impact of vessels and underwater noise on humpback whale behavior.

5.2.3 Pollution Generated from Cruise Ships

Many public comments addressed the topic of the pollution generated by cruise ships, including air and water pollutants, and the potential of an oil spill in ice-filled waters. They were concerned about the effects of air pollutants from stack emissions and the effects of air pollution on visitor experience. In addition, they pointed out that an increase in vessel numbers might have a detrimental effect on the park’s air and water quality, and could adversely affect many wildlife species. Public comments suggested that the EIS should consider the potential for ice damage to vessels traveling in the upper Bay and that protocol for vessel operations in ice-filled waters should be developed. In conjunction with the vessel hazards in ice-filled waters, if there were an oil spill in these areas, the public expressed concern that there are no mechanisms to clean and contain the oil. In addition, comments questioned the quality and capability of oil spill response equipment available in the park.

5.3 AGENCY CONSULTATIONS

The Park Service is not formally designating any cooperating agencies for this EIS. The final decision and its implementation are the sole responsibility of the Park Service. However, other agencies have jurisdiction under other laws that the Park Service must adhere to, and/or have special expertise or knowledge that is required for complete analysis and coordination of the alternatives. These agencies include the NOAA Fisheries (formerly known as the National Marine Fisheries Service), the U.S. Fish and Wildlife Service (USFWS), and the U.S. Coast Guard. State, local, and tribal agencies that were consulted include the State of Alaska Office of History and Archaeology / State Historic Preservation Officer, the Alaska Department of Fish and Game, the Alaska Department of Environmental Conservation, and the Hoonah Indian Association.

5.3.1 U.S. Fish and Wildlife Service and National Marine Fisheries Service

The Endangered Species Act of 1973, as amended, (16 USC 1531 et seq.) requires all federal agencies to consult with the U.S. Fish and Wildlife Service to ensure that any action authorized, funded, or carried out by the agency does not jeopardize the continued existence of listed species or critical habitat. Because the threatened and endangered species of concern for this EIS — the Pacific Northwest humpback whale and Steller sea lion — are marine mammals, the Park Service also is consulting with NOAA Fisheries (formerly the National Marine Fisheries Service) under section 7 of the Endangered Species Act. NOAA Fisheries will issue a biological opinion that determines whether the proposed action will affect the Pacific Northwest humpback whale and Steller sea lion populations. This biological opinion will update the biological opinion issued by the National Marine Fisheries Service in 1993. This EIS is intended to fulfill the information requirements for a biological assessment for section 7 consultation.

Based on the consultation with the U.S. Fish and Wildlife Service, no threatened or endangered species under their jurisdiction are present in Glacier Bay and Dundas Bay; therefore, the proposed action would have no effect on any of the threatened and endangered species under their jurisdiction (USFWS case number 02-14V).

5.3.2 State of Alaska Office of History and Archaeology / State Historic Preservation Officer

To comply with section 106 of the 1966 National Historic Preservation Act (NHPA), as amended in 1992, and the Alaska Historic Preservation Act (1970), the Park Service is consulting with the state historic preservation officer (SHPO) regarding undertakings that may affect historic properties. The state historic preservation officer must concur that cultural resources would not be adversely affected as a result of the proposed action. This concurrence must be received before promulgation of new vessel management regulations.

On January 29, 2003, the Park Service met with the state historic preservation officer. During the meeting, it was determined that the section 106 requirements will be integrated into the EIS for this project. The Park Service sent a letter per a request by the state historic preservation officer on February 21, 2003 (see appendix J). As stated in the letter, the Park Service is consulting with the

Hoonah Indian Association. The Park Service has prepared a report that documents surveys and inventories for cultural resources in the area of potential affect (APE), and is seeking concurrence with the finding of “no historic properties affected.”

5.3.3 Alaska Department of Fish and Game

The Alaska Department of Fish and Game has participated in management decisions within Glacier Bay for many years, including the establishment of NPS regulations. In addition, the Park Service and the Alaska Department of Fish and Game maintain a Master Memorandum of Understanding related to wildlife management in National Parks. Currently, the State of Alaska and the U.S. are litigating the title to tide and submerged lands within the National Park, and the case is before the U.S. Supreme Court (*Alaska v. United States*, No. 128, Original).

The Alaska Department of Fish and Game does not issue permits or exercise regulatory authority related to any actions resulting from this EIS.

5.3.4 Alaska Department of Environmental Conservation

The Park Service is consulting with the Alaska Department of Environmental Conservation, Division of Air and Water Quality, to obtain data concerning motorized vessel compliance with opacity (opaqueness), water quality, and commercial passenger vessel environmental compliance regulations in the park and Southeast Alaska. The Alaska Department of Environmental Conservation supplied recently generated reports concerning cruise ship compliance with opacity and commercial passenger vessel environmental compliance regulations and data concerning air quality in the city of Juneau.

5.3.5 Hoonah Indian Association

During the past several years, the National Park Service has developed an effective working relationship with the Hoonah Indian Association and other regional Native organizations with interests in matters pertaining to Glacier Bay National Park and Preserve. All parties consulted concur that Glacier Bay and Dundas Bay lie within the traditional homelands of the Hoonah Tlingits, and that the Hoonah Indian Association, a federally recognized tribal government, is the representative government for Hoonah Tlingits. During this extended consultation the full range of issues relating to vessel quotas, operating requirements, and cultural resources has been identified and discussed at length. Prior to this EIS, extensive ethnographic research had been conducted to gather detailed information about cultural resources important to Hoonah Tlingits. In conjunction with this EIS, meetings were held with the tribal government a full year prior to scoping to advise them that the process would be happening and to begin to identify issues of concern. Scoping meetings were later held with the tribal government and with community and tribal members, and follow-up meetings resulted in a new agreement regarding access to Glacier Bay by members of the Hoonah Indian Association.

The Park Service is consulting with the Hoonah Indian Association regarding Glacier Bay’s harbor seals and their role in Hoonah culture, including discussions about access to this important traditional food and the population trend of seals in the park. Other issues discussed include effects on air and water quality and overall ecosystem health.

5.4 RECIPIENTS OF THE DRAFT AND/OR FINAL ENVIRONMENTAL IMPACT STATEMENTS

This list includes all agencies, organizations, and people who are receiving copies of this EIS.

Alaska congressional delegation:
- Congressman Don Young
- Senator Lisa Murkowski
- Senator Ted Stevens

Federal agencies:
- U.S. Coast Guard
- U.S. Department of Agriculture
  - U.S. Forest Service, Tongass National Forest
- U.S. Department of Interior
  - Fish and Wildlife Service
  - National Park Service, Alaska Region
  - National Park Service, Washington Office
  - Special Assistant to the Secretary for Alaska
- U.S. Environmental Protection Agency
- Marine Mammal Commission
- National Oceanic and Atmospheric Administration Fisheries
- U.S. Navy, Naval Surface Warfare Center

Native corporations and organizations:
- Alaska Federation of Natives
- Aukquan Traditional Council
- Central Council, Tlingit and Haida Indian Tribes of Alaska
- Goldbelt, Inc.
- Huna Totem
- Hoonah Indian Association
- Indian Tribes of Alaska
- Klukwan, Inc.
- Kootznoowoo, Inc.
- Sealaska Corporation
- Shee Atiká, Inc.
- Sitka Tribe of Alaska
- Thirteenth Regional Corporation
- Yak-tat Kwaan, Inc.
- Yakutat Tlingit Tribe

State of Alaska:
- Alaska Department of Fish and Game
- Alaska Department of Law
- Alaska Department of Natural Resources
- Alaska Department of Public Safety
- Alaska Department of Transportation and Public Facilities
- Alaska Marine Highway
- Alaska Public Lands Information Center
- Alaska State Historic Preservation Officer
- Alaska State Parks
- Division of Government Coordination
- Governor Frank Murkowski

Other government agencies:

- British Columbia Parks
- City and Borough of Juneau
- City and Borough of Yakutat
- Hoonah Indian Association
- Mayor, City of Hoonah
- Mayor, City of Pelican
- Pelican City Council
- Parks Canada, Kluane National Park
- Yukon Parks and Historic Sites

Organizations:

- Alaska Center for the Environment
- Alaska Conservation Alliance
- Alaska Conservation Foundation
- Alaska Convention and Visitor Bureau
- Alaska Environmental Lobby
- Alaska Mental Health Trust Land Office
- Alaska Natural Heritage Program
- Alaska Natural History Association
- Alaska Outdoor Council
- Alaska Public Interest Research Group
- Alaska Quiet Rights Coalition
- Alaska State Chamber of Commerce
- Alaska Tourism Industry Association
- Alaska Travel Industry Association
- Alaska Trollers Association
- Alaska Wilderness Recreation and Tourism Association
- Alaska Wildlife Alliance
- Alaska Wildlife Federation
- Alaska Women of Wilderness
- Allied Fisherman of Southeast
- Anchorage Audubon Society
- Angoon Community Association
- Anchorage Convention and Visitors Bureau
- AWRTA
- Chamber of Commerce
- Coastwise Pilots
- Convention and Visitors Bureau
- Cruise Line Agencies of Alaska
- Earth Justice Legal Defense Fund
- Elfin Cove Community Council
- Friends of Glacier Bay
- Gustavus Community Association
- Gustavus Visitors Association
- National Audubon Society
- National Outdoor Leadership School
- National Park Foundation
- National Parks Conservation Association, Anchorage
- National Parks Conservation Association, Washington, D.C.
- National Wildlife Federation
- Northwest Cruise Ship Association

Resource Development Council for Alaska, Inc.
Sealaska Heritage Foundation
Seaplane Pilots Association
Sierra Club, Alaska Field Office
Skagway Convention and Visitors Bureau
Southeast Alaska Conservation Council
Southeast Alaska Pilots Association
Southeast Alaska Tourism Council
Southeast Conference
The Conservation Fund
The Nature Conservancy of Alaska
The Thirteenth Regional Corporation
The Wilderness Society
Trustees of Alaska
Wilderness Watch
Wildlife Federation of Alaska

Businesses:

The EIS will be sent to businesses that fall into the following categories:
Accommodations/lodges
Charter vessel companies
Cruise ship companies
Fishing services
Flying services
Hiking services
Leisure services
Mountaineering services
Raft and kayak services
Tour vessel companies
Transportation services
Wilderness schools

Educational institutions:

Alaska Pacific University
Alaska Resource Library/Information Services
Alaska State Historical Library, Juneau
Juneau Library
University of Alaska-Anchorage
Gustavus Public Library
Z.J. Loussac Public Library

Media:

Alaska Journal of Commerce
Alaska Magazine
Alaska Welcomes You
Anchorage Daily News
Anchorage Press
Anchorage Times
APRN
Associated Press
Daily Sitka Sentinal
Jeanie Greene Productions
Juneau Empire

KCAW-FM
Ketchikan Daily News
KFQD-AM
KIMO-TV
KINY-AM
KNBA-FM
KOAHNIC Broadcast Corporation
KRBD-FM
KTKN-AM
KTOO-FM
Native Voice Communications
Reuters America

5.5 PREPARERS

Tables 5-2 and 5-3 list the people from Glacier Bay National Park and Preserve and the U.S. Department of the Interior (DOI) solicitor's office who participated in the development of this document.

TABLE 5-2: NPS/DOI CONTRIBUTORS

Name	Organization	Position
Tomie Lee	Glacier Bay National Park and Preserve	Superintendent
Jed Davis	Glacier Bay National Park and Preserve	Deputy Superintendent
Nancy Swanton	Glacier Bay National Park and Preserve	EIS Project Manager
Mary Kralovec	Glacier Bay National Park and Preserve	Assistant Chief of Resource Management
Mary Beth Moss	Glacier Bay National Park and Preserve	Former Chief of Resource Management
David Nemeth	Glacier Bay National Park and Preserve	Chief of Concessions
Kris Nemeth	Glacier Bay National Park and Preserve	Chief of Interpretation
Chuck Young	Glacier Bay National Park and Preserve	Chief Ranger
Allison Banks	Glacier Bay National Park and Preserve	Recreation Planner
Janet Doherty	Glacier Bay National Park and Preserve	Biological Science Technician (Wildlife)
Bill Eichenlaub	Glacier Bay National Park and Preserve	Database Manager
Chris Gabriele	Glacier Bay National Park and Preserve	Wildlife Biologist
Denise Healy	Glacier Bay National Park and Preserve	Administrative Assistant
Wayne Howell	Glacier Bay National Park and Preserve	Cultural Resource Specialist
Lewis Sharman	Glacier Bay National Park and Preserve	Coastal Ecologist
Chad Soiseth	Glacier Bay National Park and Preserve	Fisheries Biologist
Rusty Yerxa	Glacier Bay National Park and Preserve	Writer/Editor
Joan Darnell	National Park Service, Alaska Support Office	Environmental Resources Team Manager
Bruce Greenwood	National Park Service, Alaska Support Office	Environmental Protection Specialist
Bud Rice	National Park Service, Alaska Support Office	Environmental Protection Specialist
Heather Rice	National Park Service, Alaska Support Office	Environmental Protection Specialist
Glen Yankus	National Park Service, Alaska Support Office	Environmental Protection Specialist
Chris Bockmon	U.S. Department of the Interior	Office of the Solicitor

TABLE 5-3: CONSULTANTS

Name	Project Role	Years Exp.	Highest Degree/Discipline	Affiliation
Steve Hall	Project Manager, Soundscape, Biological Resources (chapter 4; lead), Visitor Experience	15	B.S., Wildlife and Wildland Recreation Management	E & E
Louise Flynn	Assistant Project Manager	13	M.E.S./Environmental Studies	E & E
Bill Richards	Project Director	15	B.S., Environmental Science	E & E
Bruce Wattle	Air Quality	22	B.S., Atmospheric Science	E & E
Laurie Kutina	Air Quality	9	M.A., Architecture	E & E
William Daughdrill	Vessel Use and Safety	24	M.A., Public Administration	E & E
Patti Murphy	Water Quality	14	B.A., Environmental Studies / Natural History	E & E
Dawn Roderique	Quality Assurance Officer	20	M.S., Urban and Environmental Studies	E & E
Cheryl Karpowicz	Principal-in-Charge	29	B.A., Interdepartmental Studies	E & E
Elke Rank	Water Quality	3	M.S., Environmental Planning	E & E
Aarti Joshi	Alternatives	3	M.S., Urban and Environmental Planning	E & E
Jennifer Rouda	Purpose and Need / Alternatives	6	M.S., Environmental Science	E & E
Amy Liddicoat	Purpose and Need	7	B.S., Landscape Architecture	E & E
Gina Edwards	Editor	18	B.S., Communications	E & E
Hilary Hoffman	Publications	3	B.A., English	E & E
Renee Nordeen	Publications	5	B.S. (expected 2004), Publications	E & E
Ben Martich	Effects Analysis	6	B.S., Mathematics	E & E
Bob Hardy	Editor	10	B.S., Journalism	E & E
Liza Sanden	GIS	3	B.A., Biology	E & E
John Pickering	Fjord Dynamics and Oceanic Processes / Wave Dynamics	25	M.S., Environmental Quality Engineering (thesis pending); MBA, Management and Finance; B.S., Forest Engineering; B.A., Mathematics and Physics	PND
Jennifer Wilson	Fjord Dynamics and Oceanic Processes / Wave Dynamics	8	M.S., Environmental Studies	PND
Alan Christopherson	Fjord Dynamics and Oceanic Processes / Wave Dynamics	27	M.S., Civil Engineering; B.S., Civil Engineering	PND
Orson Smith, Ph.D.	Fjord Dynamics and Oceanic Processes / Wave Dynamics	29	Ph.D., Physical Oceanography; M.S., Civil Engineering	Univ. of Alaska Anchorage
Sandra Donohue	Fjord Dynamics and Oceanic Processes / Wave Dynamics	2	B.S., Civil Engineering; M.S., Mathematics	PND

TABLE 5-3: CONSULTANTS

Name	Project Role	Years Exp.	Highest Degree/Discipline	Affiliation
Stephen R. Braund	Cultural Resources	21	M.A., Anthropology	SRBA
Roger K. Harritt*	Cultural Resources	23	Ph.D., Anthropology	SRBA
Elizabeth D. Grover	Cultural Resources	7	M.A., Anthropology	SRBA
Charles Malme*	Acoustics	43	E.E., Acoustics	LGL
Mike Williams*	Marine Mammals, T&E Species	15	M.S., Zoology	LGL
Steve Maclean*	Marine Mammals	10	M.S., Wildlife and Fisheries	LGL
Howard Teas*	Marine Fish and Benthic Invertebrates	20	M.A., Marine Sciences	LGL
Bob Day	Marine Birds	25	Ph.D., Oceanography	ABR
Steve McCool*	Wilderness	32	Ph.D., Recreation Management	University of Montana
Charles Besacon*	Wilderness	11	Ph.D., In Progress	Independent Consultant
Susan Bell	Socioeconomics	20	N.D., Public Relations	McDowell
Jim Calvin	Socioeconomic Analysis	15	M.S., Mineral Economics	McDowell

* contributor

Affiliations Key:

ABR = Alaska Biological Resources, Inc.
E & E = Ecology and Environment, Inc.
LGL = LGL, Inc., Alaska Research Associates.
McDowell = McDowell Group.
PND = Peratrovich, Nottingham, & Drage, Inc.
SRBA = Stephen R. Braund and Associates.

REFERENCES

GLACIER BAY

NATIONAL PARK AND PRESERVE, ALASKA

VESSEL QUOTAS AND OPERATING REQUIREMENTS • FINAL ENVIRONMENTAL IMPACT STATEMENT

6.1 BIBLIOGRAPHY

Ackerman, R. E.

1968 *Archeology of the Glacier Bay Region, Southern Alaska.* Report of Investigations. Washington State University, Laboratory of Anthropology.

Act to Prevent Pollution from Ships.

1980 33 U.S.Code, 1901-1912. October 21, 1980, as amended 1987, 1989, 1990, 1991, 1993 and 1996.

Agler, B.A., S.J. Kendall, P.E. Seiser, and J.R. Lindell

1995 "Estimates of Marine Bird and Sea Otter Abundance in Southeast Alaska During Summer 1994." Anchorage, AK: U.S. Fish and Wildlife Service.

Åhlund, M., and F. Götmark

1989 "Gull Predation on Eider Ducklings *Somateria mollissima*: Effects of Human Disturbance." *Biological Conservation* 48:115–127.

Alaska Commercial Fisheries Entry Commission (ACFEC)

2002 Commercial Fisheries Entry Commission Permit and Permit Holders Reports [online database]. Available on the Internet @ http://www.dced.state.ak.us/cbd/commdb/CF_CIS.htm.

Alaska Department of Community and Economic Development (ADCED)

2002 Alaska Community Database, Community Information Summaries [online database]. Available on the Internet @ http://www.dced.state.ak.us/cbd/commdb/CF_CIS.htm.

Alaska Department of Environmental Conservation (ADEC)

2001 "Interim Cruise Ship Sampling Data Summary," Alaska Department of Environmental Conservation, September 6, 2001.

2002a "Mid season Cruise Ship and Ferry Report of 2002." Available on the Internet @ www.state.ak.us/local/akpages/ENV.CONSERV/ press/2002/cruisemsrpt02.pdf

2002b "Science Advisory Panel, Commercial Passenger Vessel Environmental Compliance Program. The Impact of Cruise Ship Wastewater Discharge on Alaska Waters." November 2002. Available on the Internet @ http://www.state.ak.us/local/akpages/ENV.CONSERV/press/cruise/documents/impactcruise.htm

2002c Electronic Mail Correspondence Regarding Vessel Opacity Data for 2002 from C. Morehouse, Alaska Department of Environmental Conservation, to L. Kutina, Ecology and Environment, Inc., July 25, 2002.

Alaska Department of Fish and Game (ADFG)

1990 *Report to the Board of Fisheries: 1989/90 Region 1 Shellfish Fisheries.* Regulatory Information Report No. 1J90-03. Alaska Department of Fish and Game, Division of Commercial Fisheries.

Alaska Department of Fish and Game (ADFG)

1994 *Wildlife Notebook Series*. Alaska Department of Fish and Game, Publishing Section.

1995 *Report to the Board of Fisheries: 1994/95 Region 1 Shellfish Fisheries.* Regulatory Information Report No. 1J95-25. Alaska Department of Fish and Game, Division of Commercial Fisheries.

1997 *Report to the Board of Fisheries: 1995/96 Region 1 Shellfish Fisheries.* Regulatory Information Report No. 1J96-31. Alaska Department of Fish and Game, Division of Commission Fisheries.

2002a "Anadromous Waters Catalog and Atlas:" Database. Available on Internet @ http://www.habitat.adfg.state.ak.us/geninfo/anadcat/anadcat.shtml

2002b "Invasive Species in Alaska." Alaska Department of Fish and Game Aquatic Nuisance Species Management Plan. Alaska Department of Fish and Game Technical Report. V. Fay primary author. Available on the Internet @ http://www.state.ak.us/adfg/geninfo/special/invasive/invasive.htm

2003 Electronic mail from S. Johnson, Juneau, AK to S. Hargy, Ecology and Environment, Inc., Anchorage, AK, February 25, regarding 2002 participation in salmon trolling fishery.

2003 Electronic mail from J. Rumble to S. Hargy, Ecology and Environment, Inc., Anchorage, AK, February 27, regarding tanner crab fishery in Glacier Bay.

Alaska Department of Labor and Workforce Development (ADLWD)

2000 Demographic Data from 2000 US Census [database online]. Available on the Internet @ http://almis.labor.state.ak.us/default.asp?PAGEID=135.

2002 2000 Employment and Earnings Summary File [database online]. Available on the Internet @ http://www.cfec.state.ak.us/menus/mnus_pmt.htm.

Alaska Department of Natural Resources (ADNR)

2002 *Alaska Heritage Resource Survey*. Anchorage, AK: Alaska Department of Natural Resources, Division of Parks and Outdoor Recreation, Office of History and Archaeology.

Alaska National Interest Lands Conservation Act of 1980 (ANILCA)

1980 16 U.S. Code, Chapter 51, Public Law 96-487, 94 Statute 2371. December 2, 1980.

American Ornithologists' Union (AOU)

1998 *Check-list of North American Birds*. Seventh edition. Washington, DC: American Ornithologists' Union.

2000 "Forty-Second Supplement to the American Ornithologists' Union Check-list of North American Birds." *Auk* 117:847–858.

Anderson, D.E., O.J. Rongstad and W.R. Mytton
1989 "Response of Nesting Red-Tailed Hawks to Helicopter Overflights." *Condor* 91:296-299.

Anderson, D.W.
1988 "Dose–Response Relationship Between Human Disturbance and Brown Pelican Breeding Success." *Wildlife Society Bulletin* 16:339–345.

Anderson, D.W., and J.O. Keith
1980 "The Human Influence on Seabird Nesting Success: Conservation Implications." *Biological Conservation* 18:65–80.

Anderson, S.H.
1995 "Recreational Disturbance and Wildlife Populations." In *Wildlife and Recreationists: Coexistence through Management and Research*, edited by R.L. Knight and K.J. Gutzwiller, 157–168. Washington, DC: Island Press.

Angliss, R.P., D.P. DeMaster, and A.L. Lopez
2001a *Alaskan Marine Mammal Stock Assessments, 2001*. Technical Memorandum NMFS-AFSC 124. U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

2001b *Final 2000 Pacific Stock Assessment Report*. Silver Spring, MD: National Marine Fisheries Service.

Anthony, R.G., R J. Steidl, and K. McGarigal
1995 "Recreation and Bald Eagles in the Pacific Northwest." In *Wildlife and Recreationists: Coexistence through Management and Research*, edited by R.L. Knight and K.J. Gutzwiller, 223–241. Washington, DC: Island Press.

Aplet, G., J. Thomson, and M. Wilbert
2000 "Indicators of Wildness: Using Attributes of the Land to Assess the Context of Wilderness." In *Wilderness Science in a Time of Change Conference, Missoula, MT*. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Aroyan, J. L.
2001 "Three-Dimensional Modeling of Hearing in *Delphinus delphis*." *Journal of the Acoustical Society of America* 110(6): 1-14.

Au, W.W.L., and P.W.B. Moore
1984 "Receiving Beam Patterns and Directivity Indices of the Atlantic Bottlenose Dolphin *Tursiops truncates*." *Journal of Acoustical Society of America* 75 (1): 255-262.

Babcock, E., and L. Sharman
1983 "Observations of Molting Canada Geese in Adams Inlet." Gustavus, AK: Glacier Bay National Park and Preserve.

Babushina, E.S.
1999 "Sound Reception in Marine Mammals: Effects of Stimulus Parameters and Transmission Pathways." *Biophysics* 44(6): 1064-1071.

Babushina, E.S.
2000 “Sound Reception in Marine Mammals: Effects of Stimulus Parameters and Transmission Pathways (Part 2).” *Biophysics* 45(5): 901-908.

Baird, R.W.
1999 “Status of Killer Whales in Canada- Limiting Factors.” Contact report to the Committee on the Status of Endangered Wildlife in Canada. Available on the Internet @ http://is.dal.ca/~whitelab/rwb/kwstat2.htm.

Baird, R.W., R. Otis, and R.W. Osborne
1998 “Killer Whales and Boats in the Haro Strait Area: Biology, Politics, Esthetics and Human Attitudes.” An abstract of a presentation to the Workshop on Whale Watching Research, Monaco, January 19, 1998. Available on the Internet @ http://is.dal.ca/~whitelab/rwb/kwharo.htm.

Baker, C.S.
1985a “Humpback Whales of Glacier Bay and Adjacent Waters, Summer 1985.” Gustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

1985b “The Population Structure and Social Organization of Humpback Whales (*Megaptera novaeangliae*) in the Central and Eastern North Pacific.” Ph.D. Thesis, University of Hawaii, Honolulu, HI.

1986 “Population Characteristics of Humpback Whales in Glacier Bay and Adjacent waters, Summer 1986” Gustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

Baker, C.S., A. Perry, J.L. Bannister, M.T. Weinrich, R.B. Abernethy, J. Calambokidis, J. Lien, R.H. Lambertsen, J. Urban Ramirez, O. Vasquez, P.J. Clapham, A. Alling, S.J. O’Brien, and S.R. Palumbi
1993 “Abundant Mitochondrial DNA Variation and World-Wide Population Structure in Humpback Whales.” *Proceedings of the National Academy of Sciences* 90:8239-8243.

Baker, C.S., and L.M. Herman
1987 “Alternative Population Estimates of Humpback Whales (*Megaptera novaeangliae*) in Hawaiian Waters.” *Canadian Journal of Zoology* 65:2818-2821.

1989 “Behavioral Responses of Summering Humpback Whales to Vessel Traffic: Experimental and Opportunistic Observations.” Final Report Number NPS-NR-TRS-89-01 Prepared for the National Park Service, Alaska Regional Office, Anchorage, AK.

Baker, C.S., S.T. Palumbi, R.H. Lambertsen, M.T. Weinrich, J. Calambokidis, and S. J. O’Brien
1990 “Influence of Seasonal Migration on Geographic Distribution of Mitochondrial DNA Haplotypes in Humpback whales.” *Nature* 344: 238-240.

Baker, M.

2000a "Transfer and Storage Facility, Oil Spill Prevention Control, and Countermeasure (SPCC) Plan, Glacier Bay National Park and Preserve, Gustavus, Alaska." Prepared for the U.S. Department of Interior, National Park Service, by Michael Baker, Jr., Inc.

2000b "Facility Response Plan – Bartlett Cove Fuel Transfer and Storage Facility, Alaska." Prepared for the U.S. Department of Interior, National Park Service, by Michael Baker, Jr., Inc.

Bamford, A.R., S.J.J.F. Davies, and R. van Delft

1990 "The Effects of Model Power Boats on Waterbirds at Herdsman Lake, Perth, Western Australia." *Emu* 90:260–265.

Barr, N.

1983 *Under Alaskan Seas: The Shallow Water Marine Invertebrates*. Anchorage, AK: Alaska Northwest Publishing Company.

Batten, L.A.

1977 "Sailing on Reservoirs and its Effects on Water Birds." *Biological Conservation* 11:49–58.

Bauer, G.B., J.R. Mobley, and L.M. Herman

1993 "Responses of Wintering Humpback Whales to Vessel Traffic." *Journal of Acoustical Society of America* 94(3, Pt. 2): 1848.

Beamish, P.

1979 "Behavior and Significance of Entrapped Baleen Whales." In *Behavior of Marine Animals, Volume 3: Cetaceans*, edited by H.E. Winn and B.L. Olla. New York: Plenum.

Beamish, P. and E. Mitchell

1973 "Short Pulse Length Audio Frequency Sounds Recorded in the Presence of a Minke Whale (*Balaenoptera acutorostrata*)." *Deep-Sea Research* 20(4): 375-386.

Bélanger, L., and J. Bédard

1990 "Energetic Cost of Man-Induced Disturbance to Staging Snow Geese." *Journal of Wildlife Management* 54:36–41.

Bell, D.V., and L.W. Austin

1985 "The Game-Fishing Season and Its Effects on Overwintering Waterfowl." *Biological Conservation* 33:65–80.

Bellrose, F.C.

1976 *Ducks, Geese, and Swans of North America.* Second edition. Harrisburg, PA: Stackpole Books.

Benson, Carl S., G. Wendler and R. March

1978 *On the Climate and Air Pollution Potential In Glacier Bay National Monument, Alaska*. Fairbanks, AK: Geophysical Institute of the University of Alaska, Fairbanks.

Bermello, Ajamil & Partners

2003 "Ketchikan Waterfront Development Plan." Prepared for the City of Ketchikan.

Bernatowicz, J.A., P.F. Schempf, and T.D. Bowman

1996 "Bald Eagle Productivity in South-central Alaska in 1989 and 1990 after the Exxon Valdez Oil Spill." In *Proceedings of the Exxon Valdez Oil Spill Symposium*, edited by S.D. Rice, R.B. Spies, D.A. Wolfe, and B.A. Wright, 785–797. Bethesda, MD: American Fisheries Society Symposium 18.

Best, P.

1982 "Season Abundance, Feeding, Reproduction, Age, and Growth in Minke Whales off Durban (With Incidental Observations from the Antarctic)." *Report of the International Whaling Commission* 32:759-786.

1987 "Estimates of the Landed Catch of Right (and Other Whalebone) Whales in the American Fishery, 1805-1909." *Fishery Bulletin* 85(3):403-418.

Bickham, J.W., J.C. Patton, and T.R. Loughlin

1996 "High Variability for Control-Region Sequences in a Marine Mammal: Implications for Conservation and Biogeography of Steller Sea Lions (*Eumetopias jubatus*)." *Journal of Mammalogy* 77(1):95-108.

Bigg, M.A.

1969 "The Harbour Seal in British Columbia." *Fisheries Research Board of Canada Bulletin*. Volume 172.

1981a "Harbour Seal, *Phoca vitulina*, Linnaeus, 1758 and *Phoca largha*, Pallas, 1811." In *Handbook of Marine Mammals, Volume 2: Seals*, edited by S.H. Ridgway and R.J. Harrison, 1-27. New York: Academic Press.

1981b "Effects of Human Disturbance on Colonial Species, Particularly Gulls." *Colonial Waterbirds* 4:28–36.

1986 "The Effect of Human Activity on Shorebirds in Two Coastal Bays in Northeastern United States." *Environmental Conservation* 13:123–130.

1995 "Beach Recreation and Nesting Birds." In *Wildlife and Recreationists: Coexistence through Management and Research*, edited by R.L. Knight and K.J. Gutzwiller, 281–295. Washington, DC: Island Press.

1998 "Effects of Motorboats and Personal Watercraft on Flight Behavior over a Colony of Common Terns." *Condor* 100:528–534.

Bigg, M.A., P.F. Olesiuk, G.M. Ellis, J.K.B. Ford, and K.C. Balcomb III

1990 "Social Organization and Genealogy of Resident Killer Whales (*Orcinus orca*) in the Coastal Waters of British Columbia and Washington State." *Report of the International Whaling Commission* (Special Issue 12):386-406.

Bishop, G.H., P.N. Hoogie, and S. Taggart
1995 "Habitat Correlates of Pacific Halibut and Other Groundfish Species in Glacier Bay National Park." In *Proceedings of the Third Glacier Bay Science Symposium, 1993*, edited by D.R. Engstrom, 215-219. Anchorage, AK: National Park Service.

Bishop, R. J.
1967 "Reproduction, age determination and behavior of the harbor seal, *Phoca vitulina* L. in the Gulf of Alaska." Master's Thesis, Cooperative Wildlife Research Unit, University of Alaska, Fairbanks.

Black, N.A., A. Shulman-Janiger, R.L. Ternullo, and M. Guerrero-Ruiz
1997 "Killer Whales of California and Western Mexico: A Catalog of Photo-Identified Individuals." NOAA Technical Memorandum NMFS-SWFSC-247. U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

Blanco, G., P. Yorio, and M. Bertellotti
1999 "Effects of Research Activity on Hatching Success in a Colony of South American Terns." *Waterbirds* 22:148–150.

Bluewater Network
2001 "American Watercraft Association (AWA) Position Paper Full of Holes." Available on the Internet @ http://www.bluewaternetwork.org/reports/rep_pl_pwc_awaposition.pdf

Bodkin, J.L. and K.A. Kloecker
1999 *Intertidal Clam Diversity, Size, Abundance and Biomass in Glacier Bay National Park and Preserve: 1999 Annual Report*. Anchorage, AK: U.S. Geological Survey, Biological Resources Division, Alaska Biological Science Center.

Bodkin, J.L., K.A. Kloecker, G.G. Esslinger, D.H. Monson, and J.D. DeGroot
2001 *Sea Otter Studies in Glacier Bay National Park and Preserve: Aerial Surveys, Foraging Observations, and Intertidal Clam Sampling. Annual Report.* Anchorage, AK: United States Geological Survey, Alaska Biological Science Center.

Borggaard, D., J. Lien, and P. Stevick
1999 "Assessing the Effects of Industrial Activity on Large Cetaceans in Trinity Bay, Newfoundland (1992-1995)." *Aquatic Mammals* 25(3):149-161.

Borrie, W.T., and R.M. Birzell
2001 "Approaches to Measuring Quality of the Wilderness Experience." In *Visitor Use Density and Wilderness Experience: Proceedings*, Volume RMRS-P-20, edited by W.A. Freimund and D.N. Cole, 29-38. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station.

Bortolloti, G.R.
1985 "Factors Influencing the Growth of Bald Eagles in North Central Saskatchewan." *Canadian Journal of Zoology* 67:606–611.

Bourne, N.
1991 Fisheries and Aquaculture: West Coast of North America. In *Scallops: Biology, Ecology, and Aquacultur*e, edited by S.E. Shumway. Elsevier, N.Y.

Bowles, A.E.
1995 "Responses of Wildlife to Noise." In *Wildlife and Recreationists: Coexistence through Management and Research*, edited by R.L. Knight and K.J. Gutzwiller, 109–156. Washington, DC: Island Press.

Braham, H.W.
1984 "The Status of Endangered Whales: An Overview." *Marine Fisheries Review* 46(4)2-6.

Bratton, S.P.
1990 "Boat Disturbance of Ciconiiformes in Georgia Estuaries" *Colonial Waterbirds* 13:124–128.

Brown, K.M., and R.D. Morris
1994 "The Influence of Investigator Disturbance on the Breeding Success of Ring-Billed Gulls (*Larus delawarensis*)." *Colonial Waterbirds* 17:7–17.

Brown, P.J., and G. Haas
1980 "Wilderness Recreation Experiences: The Rawah Case." *Journal of Leisure Research* 12:229-41.

Brown, P.L. Jr., N.L. Christensen, H.J. Cortner, T.C. Kiernan, W.H. Meadows, W. Reffalt, J.L. Sax, G. Siehl, S. Udall, and D.L. Williams
2001 *Ensuring the Stewardship of the National Wilderness Preservation System: A Report to the USDA Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, and US Geological Survey*. Washington, D.C.: Pinchot Institute for Conservation.

Browning, R.
1974 *Fisheries of the North Pacific*. Alaska Northwest Publishing Company, Anchorage, AK: 408 pp.

Buckley, P.A, and F.G. Buckley
1978 "Guidelines for the Protection and Management of Colonially Nesting Waterbirds." Boston, MA: National Park Service.

Buehler, D.A., T.J. Mersmann, J.D. Fraser, and J.K.D. Seegar
1991 "Non-breeding Bald Eagle Communal and Solitary Roosting Behavior and Roost Habitat on the Northern Chesapeake Bay." *Journal of Wildlife Management* 55:273–281.

Bunnell, F.L., D. Dunbar, L. Koza, and G. Ryder
1981 "Effects of Disturbance on the Productivity and Numbers of White Pelicans in British Columbia—Observations and Models." *Colonial Waterbirds* 4:2–11.

Burger, A.E., and D.M. Fry

1993 "Effects of Oil Pollution on Seabirds in the Northeast Pacific." In *The Status, Ecology, and Conservation of Marine Birds of the North Pacific*, edited by K. Vermeer, K.T. Briggs, K.H. Morgan, and D. Siegel-Causey, 254–263. Ottawa, Ontario: Canadian Wildlife Service, Special Publication.

Burger, J.

1981 "Effects of Human Disturbance on Colonial Species, Particularly Gulls." *Colonial Waterbirds* 4:28–36.

1986 "The Effect of Human Activity on Shorebirds in Two Coastal Bays in Northeastern United States." *Environmental Conservation* 13:123–130.

1995 "Beach Recreation and Nesting Birds." In *Wildlife and Recreationists: Coexistence through Management and Research*, edited by R.L. Knight and K.J. Gutzwiller, 281–295. Washington, DC: Island Press.

1998 "Effects of Motorboats and Personal Watercraft on Flight Behavior over a Colony of Common Terns." *Condor* 100:528–534.

Burger, J., and M. Gochfeld

1983 "Behavioural Responses to Human Intruders of Herring Gulls (*Larus argentatus*) and Great Black-Backed Gulls (*L. marinus*) with Varying Exposure to Human Disturbance." *Behavioural Processes* 8:327–344.

1991 "Human Activity Influence and Diurnal and Nocturnal Foraging of Sanderlings (*Calidris alba*)." *Condor* 93:259–265.

1993 "Tourism and Short-Term Behavioural Responses of Nesting Masked, Red-Footed, and Blue-Footed Boobies in the Galápagos." *Environmental Conservation* 20:255–259.

Burger, J., M. Gochfeld, and L.J. Niles

1995 "Ecotourism and Birds in Coastal New Jersey: Contrasting Responses of Birds, Tourists, and Managers." *Environmental Conservation* 22:56–65.

Cairns, D.

1980 "Nesting Density, Habitat Structure, and Human Disturbance as Factors in Black Guillemot Reproduction." *Wilson Bulletin* 92:352–361.

Calambokidis, J., G. H. Steiger, and L. E. Healey

1983a "Behavior of Harbor Seals andTheir Reaction to Vessels in Glacier Bay, Alaska." In *Abstracts of the Fifth Biennial Conference on the Biology of Marine Mammals, 1983, Boston, MA.*

Calambokidis, J., G.H. Steiger, and R.A. Butler

1983b "Biology and Behavior of Molting Canada Geese in Glacier Bay, Alaska." Olympia, WA: Cascadia Research Collective.

Calambokidis, J., G.H. Steiger, J.M Straley, L.M. Herman, S. Cerchio, D.R. Salden, J. Urbán , J.K. Jacobsen, O. Von Zeigesar, K.C. Balcomb, C.M. Gabriele, M.E. Dahlheim, S. Uchida, G. Ellis, Y. Miyamura, P.L. de Guevara, M. Yamaguchi, F. Sato, S.A. Mizroch, L. Schlender, K. Rasmussen, J. Barlow, T.J. Quinn II

2001 "Movements and Population Structure of Humpback Whales in the North Pacific." *Marine Mammal Science* 17(4):769-794.

Calambokidis, J., G.H. Steiger, J.M Straley, T.J. Quinn II, L.M. Herman, S. Cerchio, D.R. Salden, M. Yamaguchi, F. Sato, J. Urban R., J. Jacbosen, O. von Ziegesar, K.C. Bacomb, C.M. Gabriele, M.E. Dahlheim, N. Higashi, S. Uchida, J.K.B. Ford, Y. Miyamura, P.L. de Guevara , S.A. Mizroch, L. Schlender, and K. Rasmussen

1997 "Abundance and Population Structure of Humpback Whales in the North Pacific Basin." Final Report submitted to Southwest Fisheries Science Center, La Jolla, CA.

Calkins, D., and P.C. Lent

1975 "Territoriality and Mating Behavior in Prince William Sound Sea Otters." *Journal of Mammalogy* 56(2): 528-529.

Calkins, D.G., and K.W. Pitcher

1982 "Population Assessment, Ecology and TrophicRelationships of Steller Sea Lions in the Gulf of Alaska." In *Final Report to the Outer Continental Shelf Environmental Assessment Program*, 445-546. U.S. Department of Commerce, National Oceanographic and Atmospheric Administration.

Calkins, D.G., D.C. McAllister, K.W. Pitcher, and G.W. Pendleton

1999 Steller Sea Lion Status and Trend in Southeast Alaska: 1979-1997. *Marine Mammal Science* 15(2): 462-477.

Carney, K.M., and W.J. Sydeman

1999 "A Review of Human Disturbance Effects on Nesting Colonial Waterbirds." *Waterbirds* 22:68–79.

Catton, T.

1995 *Land Reborn: A History of Administration and Visitor Use in Glacier Bay National Park and Preserve*, Chapter XII Protecting the Humpback Whales. Prepared for the National Park Service under. Seattle, WA: Government Printing Office. Also available on Internet @ http://www.nps.gov/glba/adhi/adhit.htm.

Cerchio, S., and M. Dahlheim

2001 "Variation in Feeding Vocalizations of Humpback Whales (*Megaptera novaeangliae*) from Southeast Alaska." *Bioacoustics* 11:277-295.

Clapham, P.J.

1996 "The Social and Reproductive Biology of Humpback Whales: An Ecological Perspective." *Mammal Review* 26(1):27-49.

Clean Water Act

1972 33 U.S. Code, Chapter 26.

Clemens, W.A., and G.V. Wilby

1961 "Fishes of the Pacific Coast of Canada." *Fisheries Research Board of Canada*, Bulletin 68 (second edition).

Climo, L., and T. Duncan

1991 "The Status of Molting Canada Geese in Adams Inlet, Glacier Bay National Park and Preserve, Alaska, in 1991." Gustavus, AK: Glacier Bay National Park and Preserve.

Cole, D.N.

1996 "Ecological Manipulation in Wilderness: An Emerging Management Dilemma." *International Journal of Wilderness* 2(1): 15-19. Ojai, CA: WILD Foundation.

2001 "Management Dilemmas That Will Shape Wilderness in the 21st Century." *Journal of Forestry* 99(1):4-8.

Conant, B., J.G. King, J.L. Trapp, and J.I. Hodges

1988 "Estimating Populations of Ducks Wintering in Southeast Alaska." In *Waterfowl in Winter*, edited by M.W. Weller, 541–551. Minneapolis, MN: University of Minnesota Press.

Conomy, J.T., J.A. Dubovsky, J.A. Collazo, and W.J. Fleming

1998 "Do Black Ducks and Wood Ducks Habituate to Aircraft Disturbance." *Journal of Wildlife Management* 63: 373-381.

Conover, M.R., and D.E. Miller

1978 "Reaction of Ring-Billed Gulls to Predators and Human Disturbances at Their Breeding Colonies." *Proceedings of the Colonial Waterbird Group* 2:41–47.

Cordell, K.H.

2000 "Wilderness in the Contemporary American Mind." Presentation to the Wilderness Summit, 2000. Washington, DC. May 16-17.

Cordell, K.H., J. Teasley, and G. Super

1997 "Outdoor Recreation in the United States: Results from a National Survey on Recreation and the Environment." Prepared for the Outdoor Recreation and Wilderness Assessment Group, USDA Forest Service, Athens GA, and the Department of Agriculture and Applied Economics, University of Georgia.

Corr, P.O.

1973 "Bald Eagle (*Haliaeetus leucocephalus alaskanus*) Nesting Related to Forestry in Southeastern Alaska." M.S. Thesis. Fairbanks, AK: University of Alaska.

Craig, P., and L.Haldorson

1986 "Pacific salmon in the North American Arctic." *Arctic* 39(1): 2-7.

Crowell, A.

1995 "Archaeology in a Mythical Landscape: Glacier Bay National Park." Informal narrative.

Cruise Line International Association (CLIA)
2002 "Over 2 Million Cruisers Sail in 3rd Quarter." Cruise News December 6, 2002. Available on the Internet @ http://www.cruising.com.

Cruise Lines Agencies of Alaska (CLAA)
2002 Unpublished data, Miscellaneous Years, 1990-2002. Date collected by Cruise Lines Agencies of Alaska, Ketchikan, Alaska.

Cruz-Aguero, J. de la
1999 "A first Mexican Record of the Chinook Salmon, *Oncorhynchus tshawytscha*." *California Fish and Game* 85(2): 77-78.

Cryer, M., N.W. Linley, R.M. Ward, J.O. Stratford, and P.F. Randerson
1987 "Disturbance of Overwintering Waterfowl by Anglers at Two Reservoir Sites in South Wales." *Bird Study* 34:191–199.

Dahlheim, M., A. York, R. Towell, J. Waite, and J. Briewick
2000 "Harbor Porpoise (*Phocoena phocoena*) Abundance in Alaska: Bristol Bay to Southeast Alaska, 1991 – 1993." *Marine Mammal Science* 16(1)28-45.

Dahlheim, M.E., D.K. Ellifrit, and J.D. Swenson
1997 *Killer Whales of Southeast Alaska a Catalogue of Photo-Identified Individuals*. Seattle, WA: National Marine Mammal Laboratory.

Dauenhauer, N.M. and R. Dauenhauer
1987 *Haa Shuka, Our Ancestors: Tlingit Oral Narratives*. Juneau, AK: Sealaska Heritage Foundation and Seattle, Washington: University of Washington Press.

Day, R.H., A.K. Prichard, and D.A. Nigro
In review "Ecological Specialization and Overlap of Brachyramphus Murrelets in Glaciated Fjords of Prince William Sound, Alaska." *Auk*.

Day, R.H., and D.A. Nigro
1999 "Status and Ecology of Kittlitz's Murrelet in Prince William Sound, 1996–1998, Exxon Valdez Oil Spill Restoration Project Final Report." (Restoration Project 98142), Fairbanks, AK: ABR, Inc.

2000 "Feeding Ecology of Kittlitz's and Marbled Murrelets in Prince William Sound, Alaska." *Waterbirds* 23:1–14.

Day, R.H., K.J. Kuletz, and D.A. Nigro
1999 "Kittlitz's Murrelet (*Brachyramphus brevirostris*)." In *The Birds of North America*, No. 435, edited by A. Poole and F. Gill. Philadelphia, PA: The Birds of North America, Inc.

Day, R.H., S.M. Murphy, J.A. Wiens, G.D. Hayward, E.J. Harner, and B.E. Lawhead
1997a "Effects of the Exxon Valdez Oil Spill on Habitat Use by Birds Along the Kenai Peninsula, Alaska." *Condor* 99:728–742.

Day, R.H., S.M. Murphy, J.A. Wiens, G.D. Hayward, E.J. Harner, and L.N. Smith
1997b "Effects of the Exxon Valdez Oil Spill on Habitat Use by Birds in Prince William Sound, Alaska." *Ecological Applications* 7:593–613.

De Laguna, F.

1990 “Tlingit.” In: *Handbook of North American Indians*, edited by W. Suttles, 203-228. Washington, D.C: Smithsonian Institution.

DesGranges, J.L., and A. Reed

1981 “Disturbance and Control of Selected Colonies of Double-Crested Cormorants in Quebec.” *Colonial Waterbirds* 4:12–19.

Doherty, J.L., and C.M. Gabriele

2001 “Population Characteristics of Humpback Whales in Glacier Bay and Adjacent Waters: 2001.” Gustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

2002 “Population Characteristics of Humpback Whales in Glacier Bay and Adjacent Waters: 2002.” Annual Report. Gustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

Driver, B., R. Nash, and G. Haas

1987 “Wilderness Benefits: A State-of-Knowledge Review.” In *Proceedings--National Wilderness Research Conference: Issues, State-of-Knowledge, Future Directions*, edited by R. Lucas, 294-319. Ft.Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, GTR-220.

Duncan, T., and L. Climo

1991 “Scoter Census in the Hugh Miller Area, 1991.” Gustavus, AK: Glacier Bay National Park and Preserve.

Dunnet, G.M.

1977 “Observations on the Effects of Low-Flying Aircraft at Seabird Colonies on the Coast of Aberdeenshire, Scotland.” *Biological Conservation* 12:55-63.

Dzinbal, K.A., and R.L. Jarvis

1984 “Coastal Feeding Ecology of Harlequin Ducks in Prince William Sound, Alaska, During Summer.” In *Marine Birds: Their Feeding Ecology and Commercial Fisheries Relationships*, edited by D.N. Nettleship, G.A. Sanger, and P.F. Springer, 6–10. Ottawa, Ontario: Canadian Wildlife Service, Special Publication.

Eadie, J.M., J.P.L. Savard, and M.L. Mallory

2000 “Barrow’s Goldeneye (*Bucephala islandica*).” In The Birds of North America, No. 548, edited by A. Poole and F. Gill. Philadelphia, PA: The Birds of North America, Inc.

Egret Communications/ARA Consulting

2002 Juneau Tourism Management Plan. Prepared for the City and Borough of Juneau. Seattle, WA: Egret Communications/ARA Consulting.

Eichenlaub, B.

1998 Electronic mail from B. Eichenlaub, Glacier Bay National Park, National Park Service to all Glacier Bay Resource Management Employees, regarding Keystone Beaches in Glacier Bay National Park, August 31, 1998.

Eldridge, P.

1972a “Tanner Crab Fishery in the Gulf of Alaska.” In *A Review of the Oceanography and Renewable Resources of the Northern Gulf of Alaska, Section 12*. Institute Marine Science Report R72-23, Sea Grant Report 73-3, edited by D.H. Rosenberg, 267-286. Fairbanks, AK: University of Alaska.

1972b “The King Crab Fisheries in the Gulf of Alaska.” In *A Review of the Oceanography and Renewable Resources of the Northern Gulf of Alaska, Section 12*. Institute Marine Science Report R72-23, Sea Grant Report 73-3, edited by D.H. Rosenberg, 211-266. Fairbanks, AK: University of Alaska.

Eley, D.

2000 “Needs Assessment for a Major Fuel Oil Spill, Glacier National Park and Preserve.”

Ellison, L.N., and L. Cleary

1978 “Effects of Human Disturbance on Breeding of Double-Crested Cormorants.” *Auk* 95:510–517.

Energy and Environmental Analysis, Inc. (EEA, Inc.)

2000 “Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data”- EPA420-R-00-002 . Washington D.C.: U. S. Environmental Protection Agency, Office of Mobile Resources: February 2000.

Enger, P.E. and R. Andersen

1967 “An Electrophysiological Field Survey of Hearing in Fish.” *Comparative Biochemistry and Physiology* 22: 517-525.

Erbe, C.

2002 “Underwater Noise of Whale-Watching Boats and Potential Effects on Killer Whales (*Orcinus orca*), Based on an Acoustic Impact Model.” *Marine Mammal Science* 18(2):394-418.

2003 Assessment of bioacoustic impact of ships on humpback whales in Glacier Bay, Alaska. Prepared for Glacier Bay National Park and Preserve, Gustavus, Alaska. Moggill, Australia.

Erwin, R.M.

1980 “Breeding Habitat Use by Colonially Nesting Waterbirds in Two Mid-Atlantic U.S. Regions Under Different Regimes of Human Disturbance.” *Biological Conservation* 18:39–51.

Feder, H.M., and S.C. Jewett

1986 “The Subtidal Benthos.” In *The Gulf of Alaska: Physical Environment and Biological Resources*, edited by D. W. Hood and S. T. Zimmerman, 347-396. Anchorage, AK: National Oceanic and Atmospheric Administration, Ocean Assessments Division, Alaska Office.

Ferrero, R.C., and W.A. Walker
1999 "Age, Growth, and Reproductive Patterns of Dall's Porpoise (*Phocoenoides dalli*) in the Central North Pacific Ocean." *Marine Mammal Science* 15(2):273-313.

Fetterolf, P.M.
1983 "Effects of Investigator Activity on Ring-Billed Gull Behavior and Reproductive Performance." *Wilson Bulletin* 95:23–41.

Fevolden, S.E.
1989 "Genetic Differentiation of the Iceland Scallop *Chlamys islandica* (*Pectinidae*) in the Northern Atlantic Ocean." *Marine Ecology Progress Series*, 51: 75-77.

FishBase
2003 Fishbase Global Information System on Fishes website. Available on the Internet @ http://www.fishbase.org/home.htm.

Fisher, H.D.
1952 "The Status of the Harbour Seal in British Columbia, With Particular Reference to the Skeena River." *Fisheries Research Board of Canada Bulletin*, Volume 93.

Fitzpatrick, S., and B. Bouchez
1998 "Effects of Recreational Disturbance on the Foraging Behaviour of Waders on a Rocky Beach." *Bird Study* 45:157–171.

Flemming, S.P., R.D. Chiasson, and P.C. Smith
1988 "Piping Plover Status in Nova Scotia Related to its Reproductive and Behavioral Responses to Human Disturbance." *Journal of Field Ornithology* 59:321–330.

Ford, J.K.B., G.M. Ellis, and K.C. Balcomb
1994 Killer Whales- The Natural History and Genealogy of *Orcinus orca* in British Columbia and Washington State. Vancouver, Canada: UBC Press.

Foster, N.R.
1991 Intertidal Bivalves: A Guide to the Common Marine Bivalves of Alaska. Fairbanks, AK: University of Alaska Press.

Frankel, A.S., J.R. Mobley, Jr., and L.M. Herman
1995 "Estimation of Auditory Response Thresholds in Humpback Whales Using Biologically Meaningful Sounds." In *Sensory Systems of Aquatic Mammals*, edited by R.A. Kastelein, J.A. Thomas, and P.E. Nachtigall. Woerden, Netherlands: De Spil Publishers.

Frankel, S.A., and C.W. Clark
1998 "Results of Low-Frequency Playback of M-Sequence Noise to Humpback Whales, *Megaptera novaeangliae*, in Hawai'i." *Canadian Journal of Zoology* 76: 521-535.

2000 "Behavioral Responses of Humpback Whales (*Megaptera novaeangliae*) to Full-Scale ATOC Signals." *Journal of the Acoustical Society of America* 108(4):1930-1937.

Frost, K.J., and L.F. Lowry
1981 “Foods and Trophic Relationships of Cetaceans in the Bering Sea.” In *The Eastern Bering Sea Shelf: Oceanography and Resources*, Volume 2, edited by D.W. Hood and J.A. Calder, 825-836. Seattle, WA: University of Washington Press.

Gabriele, C., A. Frankel, and T. Lewis
2001 “Frequent Humpback Whale Songs Recorded in Glacier Bay, Alaska in Fall 2000.” In *Abstracts 14th Biennial Conference on the Biology of Marine Mammals, Vancouver, Canada, 2001*.

Gabriele, C.M.
1995 “Population Characteristics of Humpback Whales in Glacier Bay and Adjacent Waters: 1995.” Gustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

1997 “Comparison of Humpback Whales Group Dynamics between Hawaii and Alaska.” In *Report of the Workshop to Assess Research and Other Needs and Opportunities Related to Humpback Whale Management in the Hawaiian Waters*, edited by P.M. Payne, B. Phillips, and E. Nita. NOAA Technical Memorandum NMFS-OPR-11.

Gabriele, C.M., and T.M. Lewis
2000 “Summary of Opportunistic Marine Mammal Sightings in Glacier Bay and Icy Strait 1994-1999.” Gustavus, AK: Glacier Bay National Park and Preserve.

Gabriele, C.M., J.M. Straley, S.A. Mizroch, C.S. Baker, A.S. Craig, L.M. Herman, D.
2001 “Estimating the Calf Mortality Rate of Central North Pacific Humpback Whales.” *Canadian Journal of Zoology* 79(4):589-600.

Geiselman, J., J. Dunlap, P. Hooge, and D. Albert (Eds.)
1997 “Glacier Bay Ecosystem GIS CD-ROM Set.” Anchorage, AK and Juneau AK: U.S. Geological Survey and Interrain Pacific. Available on the Internet @ http://www.inforain.org/alaska/glabaycd/.

Gende, S.M., M.F. Willson, B.H. Marston, M. Jacobson, and W.P. Smith
1998 “Bald Eagle Nesting Density and Success in Relation to Distance from Clearcut Logging in Southeast Alaska.” *Biological Conservation* 83:121–126.

Gentry, R.L., and J.H. Johnson
1981 “Predation by Sea Lions on Northern Fur Seal Neonates.” *Mammalia* 45:423-430.

Giese, M., and M. Riddle
1999 “Disturbance of Emperor Penguin *Aptenodytes forsteri* Chicks by Helicopters.” *Polar Biology* 22: 366-371.

Gillett, W.H., J.L. Hayward, Jr., and J.F. Stout
1975 “Effects of Human Activity on Egg and Chick Mortality in a Glaucous-Winged Gull Colony.” *Condor* 77:492–495.

Glba_webmaster@nps.gov

2001 “Glacier Bay National Park and Preserve; A Human History Timeline.” National Park Service . Available on the Internet @ http://www.nps.gov/glba/learn/about/history/timeline.htm.

2001 “Glacier Bay National Park and Preserve; Geography.” National Park Service . Available on the Internet @ http://www.nps.gov/glba/learn/about/nature/geology/geography.htm.

2001 “Glacier Bay National Park and Preserve; Geology.” National Park Service. Available on the Internet @ http://www.nps.gov/glba/learn/about/nature/geology.

2001 “Glacier Bay National Park and Preserve; Glaciers.” National Park Service. Available on the Internet @ http://www.nps.gov/glba/learn/about/nature/geology/glaciers.htm.

Glockner-Ferrari, D.A., and M.J. Ferrari

1990 “Reproduction in the Humpback Whale, *Megaptera novaeangliae,* in Hawaiian Waters, 1975-1988: The Life History, Reproductive Rates and Behavior of Known Individuals Identified Through Surface and Underwater Photography.” *Reports of the International Whaling Commission* (Special Issue 12):161-169.

Glockner-Ferrari, M.J. Ferrari, S. Cerchio, O. von Ziegesar, J.M. Darling, D. McSweeney, T.J. Quinn II, and J.K. Jacobsen

2001 “Estimating the Calf Mortality Rate of Central North Pacific Humpback Whales.” *Canadian Journal of Zoology* 79(4):589-600.

GMA Research Corporation

2001 *Images of Alaska 2000*. Prepared for Alaska Travel Industry Association. Anchorage, AK: GMA Research Corporation.

Goldschmidt, W.R. and T.H. Haas

1998 *Haa Aani – Our Land: Tlingit and Haida Land Rights and Use*. Edited with an Introduction by Thomas F. Thornton. Juneau, AK: Sealaska Heritage Foundation and Seattle, Washington: University of Washington Press.

Götmark, F.

1992 “The Effects of Investigator Disturbance on Nesting Birds.” In *Current Ornithology*, Volume 9, edited by D.M. Power, 63–104. New York, NY: Plenum Press.

Gotshall, D.W.

1978 “Northern California Dungeness crab, Cancer magister, Movements as Shown by Tagging.” *California Fish and Game* 64:234-254.

Graefe, A.R., and J. Holland

1997 “Establishing Boating Capacities at Lake Mead National Recreation Area.”

Greater Yakutat Chamber of Commerce

2002 Yakutat’s Chamber of Commerce website. Available on the Internet @ http://www.ptialaska.net/~gycc/.

Green, M.L.
1990 “The Impact of Parasail Boats on the Hawaiian Humpback Whale (*Megaptera novaeangliae*).” Marine Mammal Commission Hearings, March, 1990 Honolulu, Hawaii. Paper presented at annual meeting of the Animal Behavior Society, June, 1991, Wilmington, NC.

Grinnell, J.
1909 “Birds and Mammals of the 1907 Alexander Expedition to Southeastern Alaska.” *University of California Publications in Zoology* 5:171–264.

Groot, C. and L. Margolis, eds.
1991 *Pacific Salmon Life Histories*. Vancouver, BC: University of British Columbia Press.

Grubb, T.G., and W.W. Bowerman
1997 “Variations in Breeding Bald Eagle Responses to Jets, Light Planes and Helicopters.” *Journal of Raptor Research* 31: 213-222.

Gulliksen, B., and J.P. Taasen
1982 “Effect of an Oil Spill in Spitzbergen in 1978.” *Marine Pollution Bulletin* 13 (3): 96-98.

Gustuvus Internet Group
2002 “A Complete Guide to Gustavus, Alaska and Glacier Bay.” Available on the Internet @ http://www.gustavus.com.

Haines Convention and Visitors Bureau
2002 Haines Convention and Visitors Bureau Website. Available on Internet @ http://www.haines.ak.us/.

Hanggi, E.B., and R.J. Schusterman
1994 “Underwater Acoustic Displays and Individual Variation in Male Harbour Seals, *Phoca vitulina*.” *Animal Behaviour* 48(6): 1275-1283.

Havera, S.P., L.R. Boens, M.M. Georgi, and R.T. Shealy
1992 “Human Disturbance of Waterfowl on Keokuk Pool, Mississippi River.” *Wildlife Society Bulletin* 20:290–298.

HaySmith, L., and J.D. Hunt
1995 “Nature Tourism: Impacts and Management.” In *Wildlife and Recreationists: Coexistence through Management and Research*, edited by R.L. Knight and K.J. Gutzwiller, 203–219. Washington, DC: Island Press.

Hendee, J.C., G.H. Stankey, and R.C. Lucas
1990 *Wilderness Management*. Golden, CO: North American Press.

Hennick, D.P.
1970 “Reproductive Cycle, Size at Maturity, and Sexual Composition of Commercial Harvested Weathervane Scallops (*Patinopecten caurinus*) in Alaska.” *Journal of the Fisheries Research Board of Canada* 27:2112-2119.

Hennick, D.P.
1973 *Sea Scallop, Patinopecten caurinus, Investigations in Alaska*. Juneau, AK: Alaska Department of Fish and Game, Commercial Fisheries Division, Completion Report 5-23-R.

Henny, C.J., L.J. Blus, S.P. Thompson, and U.W. Wilson
1989 "Environmental Contaminants, Human Disturbance, and Nesting of Double-Crested Cormorants in Northwestern Washington." *Colonial Waterbirds* 12:198–206.

Henry, E. and M.O. Hammill
2001 "Impact of Small Boats on the Haulout Activity of Harbour Seals (*Phoca vitulina*) in Metis Bay, Sant Lawrence Estuary, Quebec, Canada." *Aquatic Mammals* 27(2):140-148.

Herman, L.M., and W.N. Tavolga
1980 "The Communication Systems of Cetaceans." In *Cetacean Behavior: Mechanisms and Functions*, edited by L.M. Herman. New York: Wiley-Interscience.

Herz, M., and J. Davis
2002 *Cruise Control: A Report on How Cruise Ships Affect the Marine Environment*. Prepared for the Ocean Conservancy, San Francisco, CA.

Hill, K.M.
1999 "After the Accident: Lessons Learned from the Grounding of the M/V Wilderness Adventurer, June 12, 1999, Dundas Bay, Alaska." Seattle, WA: Glacier Bay Park Concessions, Inc.

Hines, A.H., and G.M. Ruiz
2000 "Biological Invasions of Cold-Water Coastal Ecosystems: Ballast-mediated Introduction in Port Valdez/Prince William Sound, Alaska." Prepared for Prince William Sound Regional Citizens' Advisory Council. Available on the Internet @ http://www.pwsrcac.org/oldsite/NIS/Smithsonian%202000/AK99_0ReptCover.pdf

Hockey, P.A.R.
1987 "The Influence of Coastal Utilisation by Man on the Presumed Extinction of the Canarian Black Oystercatcher *Haematopus meadewaldoi* Bannerman." *Biological Conservation* 39:49–62.

Hoelzel, A.R., M.E. Dahlheim, and S.J. Stern
1998 "Low Genetic Variation Among Killer Whales (*Orcinus orca*) in the Eastern North Pacific, and Genetic Differentiation Between Foraging Specialists." *Journal of Heredity* 89:121-128.

Hohn, A.A., R.L. Brownell, Jr.
1990 "Harbor Porpoise in Central Californian Waters: Life History and Incidental Catches." Paper SC/42/SM47 presented at the 42nd Meeting of the Scientific Committee, International Whaling Commission, Nordwijik, Holland.

Holland America Line
1997 "Pollution Minimization Plan." Holland America Line, Marine Operations Department.

Hooge, P.N. and E.R. Hooge
2002 *Fjord Oceanographic Processes in Glacier Bay, Alaska*. Gustavus, AK: U.S. Geological Survey, Alaska Science Center, Glacier Bay Field Station.

Hooge, P.N., and S.J. Taggart
1996 "Pacific Halibut in Glacier Bay National Park, Alaska: Draft." Gustavus, AK: Glacier Bay National Park and Preserve, Research and Resource Management.

1998 "Pacific Halibut in Glacier Bay National Park, Alaska." In *Status and Trends of the Nation's Biological Resource*s, Volume 2, edited by M.J. Mac, P.A. Opler, C.E. Puckett Haecker, and P.D. Dorn, 712-714. Reston, VA: U.S. Department of the Interior, U.S. Geological Survey.

Hooge, P.N., S. J. Taggart, and E.R. Hooge
In Prep. "Home Range and Movement Patterns of Pacific Halibut in Glacier Bay, Alaska: Site Fidelity Within and Between Years." Unpublished Manuscript. Gustavus, AK: USGS Alaska Science Center, Glacier Bay Field Station.

Hoonah Indian Association (HIA)
2002 Letter from the Hoonah Indian Association, Hoonah, AK, outlining comments for the proposed Vessel Management Plan, July 11, 2002.

Horwood, J.
1990 *Biology and Exploitation of the Minke Whale*. Boca Raton, FL: CRC Press, Inc.

Howell, W.
2002 "Hoonah Tlingit Access into Glacier Bay National Park." Draft Issue Briefing Statement. National Park Service.

Hubb-Sea World
2002 Electronic mail from A. Bowles, Hubb-Sea World, San Diego, CA to R.H. Day, ABR Inc., Fairbanks, AK, September 29.

Hulbert, I.A.R.
1990 "The Response of Ruddy Shelduck *Tadorna ferruginea* to Tourist Activity in the Royal Chitwan National Park of Nepal." *Biological Conservation* 52:113–123.

Hume, R.A.
1976 "Reactions of Goldeneyes to Boating." *British Birds* 69:178–179.

Hunt, G.L., Jr.
1972 "Influence of Food Distribution and Human Disturbance on the Reproductive Success of Herring Gulls." *Ecology* 53:1051–1061.

Hunt, W.A.
1998 "The Ecology of Harlequin ducks (*Histrionicus histrionicus*) Breeding in Jasper National Park, Canada." M.S. Thesis. Burnaby, BC, Canada: Simon Fraser University.

Hunter, L.E.
1997 "Tidewater Terminus Dynamics in Glacier Bay, Alaska." In *Calving Glaciers: Report of a Workshop, February 28-March 2, 1997, Byrd Polar Research Center* Report No. 15., edited by C.J.Van der Veen. Columbus, OH: Byrd Polar Research Center, Ohio State University.

Hunter, L.E. and R.D. Powell
1995 "Climatic Controls on Glacier Mass Balance in Glacier Bay National Park and Preserve, Alaska." In *Proceedings of the Third Glacier Bay Science Symposium, 1993,* edited by D.R. Enginstrom, 46-54. Anchorage, AK: National Park Service.

Ickes, S.K., J.H. Belant, and R.A. Dolbeer
1998 "Nest Disturbance Techniques to Control Nesting by Gulls." *Wildlife Society Bulletin* 26:269–273.

International Council of Cruise Lines (ICCL)
1999 "Cruise Industry Waste Management Practices and Procedures." November 29.

2002 International Council of Cruise Lines webpage. Available on the Internet @ http://www.iccl.org/.

International Maritime Organization (IMO)
1973 International Convention for the Prevention of Pollution of Ships, 1973, MARPOL 73/78. Available on the Internet @ http://www.londonconvention.org/marpol_73.htm.

International Pacific Halibut Commission
2003 Electronic mail from T.Kong, Seattle, WA, to S. Hargy, Ecology and Environment, Inc., Anchorage, AK, February 27, regarding 2001 commercial halibut landings.

Irvine, G.V. (Project Leader) et al.
2001 *Development of Coastal Monitoring Protocols and Process-Based Studies to Address landscape-Scale Variation in Coastal Communities of Glacier Bay National Park and Preserve: Phase II; Development and Testing of Monitoring Protocols for Selected Intertidal Habitats and Assemblages*. Draft, Final Annual Report, NRPP Project, February 2001. Anchorage, AK : U.S. Geological Survey, Biological Resources Division, Alaska Biological Science Center.

Jacobson, M.J., and J.I. Hodges
1999 "Population Trend of Bald Eagles in Southeast Alaska, 1967–97." *Journal of Raptor Research* 33:295–298.

Jameson, R.J. and A.M. Johnson
1993 "Reproductive Characteristics of Female Sea Otters." *Marine Mammal Science* 9 (2): 156-167.

Jefferson, T.A.
1989 "Calving Seasonality of Dall's Porpoise in the Eastern North Pacific." *Marine Mammal Science* 5(2):196-200.

Jemison, L.A.

2001 “Summary of Harbor Seal Diet Data Collected in Alaska from 1990-1999.” In *Harbor Seal Investigations in Alaska*, Annual Report, NOAA Grant NA87FX0300, edited by Adkison, M., and R. J. Small, Chapter 5. Anchorage, AK: Alaska Department of Fish and Game, Division of Wildlife Conservation.

Johnson, A.M.

1982 “Status of Alaska Sea Otter Populations and Developing Conflicts with Fisheries.” *Transactions, 47th North American Wildlife and Natural Resources Conference* 47: 293-299.

Johnson, C.S.

1971 “Auditory Masking of One Pure Tone by Another in the Bottlenosed Porpoise.” *Journal of the Acoustical Society of America* 49(4, Pt. 2): 1317-1318.

Johnson, D.R.

1979 “A Statistical Summary of Selected Data from the 1978 Backcountry Users Survey Glacier Bay National Park.” Seattle WA: University of Washington, Cooperative Research Park Studies Unit.

1990 “Glacier Bay National Park Tour Boat Passenger Survey, 1989.” Seattle WA: University of Washington, College of Forest Resources, Cooperative Research Park Studies Unit.

Johnson, D.R., P.G. Gonzalez, and G. Vequist

1990 “Social Science Perspectives on Visitor Use and Management of Glacier Bay National Park.” Seattle, WA: University of Washington, College of Forest Resources, Cooperative Park Studies Unit.

Johnson, R.A.

1938 “Predation of Gulls in Murre Colonies.” *Wilson Bulletin* 50:161–170.

Juneau Convention and Visitors Bureau (JCVB)

2002 “2002 Juneau Cruise Ship Calendar.” Juneau, AK: Juneau Convention and Visitors Bureau.

2003 Juneau Convention and Visitors Bureau website. Available on the Internet @ http://www.traveljuneau.com.

Jurasz, C.M., and V.P. Jurasz

1979 “Feeding Modes of the Humpback Whale, *Megaptera novaeangliae*, in Southeast Alaska.” *Scientific Report of the Whales Research Institute* 31: 69-83.

Kahl, R.

1991 “Boating Disturbance of Canvasbacks During Migration at Lake Poygan, Wisconsin.” *Wildlife Society Bulletin* 19:242–248.

Kastak, D., and R.J. Schusterman

1995 “Aerial and Underwater Hearing Thresholds for 100 Hz Pure Tones in Two Pinnipeds Species.” In: *Sensory Systems of Aquatic Mammals*, edited by R.A. Kastelein, J.A. Thomas and P.E. Nachtigall. Woerden, Netherlands: De Spil Publishers.

2002 “Changes in Auditory Sensitivity with Depth in a Free-Diving California Sea Lion (*Zalophus californianus*).” *Journal of the Acoustical Society of America* 112(1): 329-333.

Kastak, D.R. J. Schusterman, B.S. Southall, and C.J. Reichmuth

1999 “Underwater Temporary Threshold Shift Induced by Octave–Band Noise in Three Species of Pinniped*.” Journal of the Acoustical Society of America* 106(2):1142-1148.

Keiser, R., B.M. Lehman, P.K. Withler, and R.D. Stanley

1992 “W. E. Ricker and Eastward Ho Cruise to Study the Effects of Trawling on Rockfish Behavior, October 15-27, 1990.” Canadian Manuscript Report, *Fisheries and Aquatic Science*, Number 2161. (abstract only).

Keller, V.E.

1989 “Variations in the Response of Great Crested Grebes Podiceps cristatus to Human Disturbance—A Sign of Adaptation?” *Biological Conservation* 49:31–45.

Keller, V.E.

1991 “Effects of Human Disturbance on Eider Ducklings *Somateria mollissima* in an Estuarine Habitat in Scotland.” *Biological Conservation* 58:213–228.

Kennicutt II, M.C., and S.T. Sweet

1992 “Hydrocarbon Cantamination on the Antarctic Peninsula: III. The Bahia Paraiso-Two Years After the Spill.” *Marine Pollution Bulletin* 25: 303-306.

Kennicutt II, M.C., S.T. Sweet, W.R Fraser, W.L. Stockton, and M. Culver

1991 “Gounding of the Bahia Paraiso at Arthur Harbor, Antarctica. 1. Distribution and Fate of Oil Spill Related Hydrocarbons 1991.” *Environmental Science and Technology* 25 (3): 509-518

Kenyon, K.W.

1969 “The Sea Otter in the Eastern Pacific Ocean.” *North American Fauna* 68.

1981 “Sea otter *Enhydra lutris* (Linnaeus, 1758).” In *Handbook of Marine Mammals*, Volume 1, edited by S.H. Ridgway, and R.J. Harrison. London: Academic Press.

Ketten, D.R.

1998 “Marine Mammal Auditory Systems: A Summary of Audiometric and Anatomical Data and its Implications for Underwater Acoustic Impacts.” NOAA-TM-NMFS-SWFSC-256. National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

2000 “Cetacean Ears.” In *Hearing by Whales and Dolphin*, edited by W.W.L. Au, A.N. Popper, and R.R. Fay, page 43108. New York: Springer-Verlug.

Ketten, D.R., S. Ridgeway, and G. Early
1995 “Apocalyptic Hearing: Aging, Injury, Disease and Noise in Marine Mammal Ears.” In *Abstracts of the 11th Biennial Conference on the Biology of Marine Mammals*.

King, J.G., and G.A. Sanger
1979 “Oil Vulnerability Index for Marine Oriented Birds.” In *Conservation of Marine Birds of Northern North America, Wildlife Research Report No. 11*, edited by J.C. Bartonek and D.N. Nettleship, 227–239. Washington, DC: U.S. Fish and Wildlife Service.

King, J.G., F.C. Robards, and C.J. Lensink
1972 “Census of the Bald Eagle Breeding Population in Southeast Alaska.” *Journal of Wildlife Management* 36:1292–1295.

Kinze, C. C., T. B. Sorensen, and H. Kremer
1990 “The Growth and Reproduction of West-Greenlandic Harbour Porpoises (*Phocoena phocoena* (L.)) with Remarks on Sex and Age Distribution.” Paper SC/42/SM48 Presented at 42nd Meeting of the Scientific Committee, International Whaling Commission.

Knight, R.L., and S.K. Knight
1984 “Responses of Wintering Bald Eagles to Boating Activity.” *Journal of Wildlife Management* 48:999–1004.

Korschgen, C.E., L.S. George, and W.L. Green
1985 “Disturbance of Diving Ducks by Boaters on a Migrational Staging Area.” *Wildlife Society Bulletin* 13:290–296.

Kralovec, M.L.
1994a “Bald Eagle Nest Tree Locations and Productivity Protocols for Glacier Bay National Park, 1994.” Gustavus, AK: Glacier Bay National Park and Preserve.

1994b “Bald Eagle Movements in and from Glacier Bay National Park and Preserve, Alaska.” Prepared for National Park Service. Blackburg, VA: Virginia Polytechnic Institute and State University.

2001 “The Backcountry Distribution and Use Report.” Gustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

2002 Glacier Bay National Park and Preserve Backcountry Visitor and Vessel Distribution Study And Permit System Final Report, 1997-2000. Draft. Gustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

Krieger, K. J.
1990 “Relationship between Prey Abundance and Usage of Glacier Bay by Humpback Whales.” *In Second Glacier Bay Science Symposium, 1988*, edited by A.M. Milner, and J. D. Wood Jr., pages 90-95. Gustavus, AK: U.S. National Park Service, Glacier Bay National Park and Preserve

Krieger, K.J. and B.L. Wing

1984 *Hydroacoustic Surveys and Identification of Humpback Whale Forage in Glacier Bay, Stephens Passage, and Frederick Sound, Southeastern Alaska, Summer 1983*. NOAA Technical Memorandum NMFS F/NWC-66. Juneau, AK: U.S. National Marine Fisheries Service, Auke Bay Laboratory.

1986 *Hydroacoustic Monitoring of Prey to Determine Humpback Whale Movements*. NOAA Technical Memorandum NMFS F/NWC-98. Auke Bay, AK: U.S. National Marine Fisheries Service.

Kruse, G.J., M. Crow, E.E. Krygier, D.S. Lloyd, K.W. Pitcher, L.D. Rea, M. Ridgway, R.J. Small, J. Stinson, and K.M. Wynne

2001 "A Review of Proposed Fishery Management Actions and the Decline of Steller Sea Lions *Eumetopias jubatus* I Alaska: A Report by the Alaska Steller Sea Lion Restoration Team." Juneau, AK: Alaska Department of Fish and Game.

Kuletz, K.J.

1996 "Marbled Murrelet Abundance and Breeding Activity at Naked Island, Prince William Sound, and Kachemak Bay, Alaska, Before and After the Exxon Valdez oil spill." In *Proceedings of the Exxon Valdez Oil Spill Symposium*, edited by S.D. Rice, R.B. Spies, D.A. Wolfe, and B.A. Wright, 770–784. Bethesda, MD: American Fisheries Society Symposium 18.

Kurtz, R.S.

1995 "Glacier Bay National Park and Preserve Historic Resource Study." Anchorage, AK: United States Department of the Interior, National Park Service, Alaska System Support Office.

Kury, C.R., and M. Gochfeld

1975 "Human Interference and Gull Predation in Cormorant Colonies." *Biological Conservation* 8:23–34.

Laist, D.W., A.R. Knowlton, J.G. Mead, A.S. Collet, and M. Podesta

2001 "Collisions Between Ships and Whales." *Marine Mammal Science* 17(1):35-75.

Landres, P., M.W. Brunson, L. Merigliano, C. Sydoriak, and S. Morton

2000 "Naturalness and Wildness: The Dilemma and Irony of Managing Wilderness." In *Wilderness Science in a Time of Change Conference—Volume 5: Wilderness Ecosystems, Threats, and Management; 1999 May 23–27; Missoula, MT*, Proceedings RMRS-P-15-VOL-5, edited by D.N. Cole, S.F. McCool, W.T. Borrie, and J. O'Loughlin. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Lawson, S., and R.E. Manning

2001 "Crossing Experiential Boundaries: Visitor Preferences Regarding Tradeoffs Among Social, Resource, and Managerial Attributes of the Denali Wilderness Experience." *The George Wright Forum* 18(3):10-27.

Leatherwood, S., R.R. Reeves, W.F. Perrin, and W.E. Evans
1982 *Whales, Dolphins, and Porpoises of the Eastern North Pacific and Adjacent Arctic waters: A Guide to their Identification*. U.S. Department of Commerce, National Oceanic and Atmospheric Administration Technical Report. National Marine Fisheries Service circular 444.

Lelli, B. and D.E. Harris
2001 "Human Disturbances Affect Harbor Seal Haul-Out Behavior: Can the Law Protect These Seals from Boaters?" *Macalester Environmental Review*, October 23, 2001.

Lenz, J., T. Gotthardt, M. Kelly, and R. Lipikin
2001 "Vascular Plant and Vertebrate Species Lists from NPSpecies as of September 30, 2001 for Glacier Bay National Park and Preserve: Fish Species List." Prepared by the Alaska Natural Heritage Program for the National Park Service.

Lenz, J., T. Gotthardt, R. Lipikin, and M. Kelly
2002 *Compilation of Existing Species Data in Alaska's National Parks: Final Inventory and Monitoring Report to the National Park Service*. Anchorage, AK: Alaska Natural Heritage Program, University of Alaska.

Lesage, V., C. Barrette, M.C.S. Kingsley, and B. Sjare
1999 "The Effect of Vessel Noise on the Vocal Behavior of Belugas in the St. Lawrence River Estuary, Canada." *Marine Mammal Science* 15(1): 65-84.

Leseberg, A., P.A.R. Hockey, and D. Lowenthal
2000 "Human Disturbance and the Chick-Rearing Ability of African Black Oystercatchers (*Haematopus moquini*): A Geographical Perspective." *Biological Conservation* 96:379–385.

Lewis, T.M. and E.A. Matthews
2000 "Effects of Human Visitors on the Behavior of Harbor Seals (*Phoca vitulina* richardsi) at McBride Glacier Fjorid, Glacier Bay National Park." Final Report to Glacier Bay National Park. Gustavus, AK.

LGL, Inc.
2003 Unpublished literature research and analysis for the Glacier Bay National Park and Preserve Vessel Quotas and Operating Requirements Draft Environmental Impact Statement. Anchorage, AK.

Lien, J., S. Todd, and J. Guigne
1990 "Inferences About Perception in Large Cetaceans, Especially Humpback Whale, from Incidental Catches in Fixed Fishing Gear, Enhancement of Nets by 'Alarm' Devices, and the Acoustics of Fishing Gear." In *Sensory Abilities of Cetaceans: Laboratory and Field Evidence*, edited by J.A. Thomas, and R.A. Kastelein. New York: Plenum.

Lien, J., W. Barney, S. Todd, R. Seton, and J. Guzzwell
1992 "Effects of Adding Sounds to Cod Traps on the Probability of Collisions by Humpback Whales." In *Marine Mammal Sensory Systems*, edited by J.A. Thomas, R.A. Kastelein, and A.Ya. Supin. New York: Plenum.

Littlejohn, M.
2000 "Glacier Bay National Park Bartlett Cove Visitor Study, Summer 1999." University of Idaho, Cooperative Research Park Studies Unit.

Litzow, M. A., J. F. Piatt, and M. Arimitsu
2002 Inventory of Marine and Estuarine Fishes in Southeast Alaska National Parks During Summer, 2001. Anchorage, AK: U.S. Geological Survey, Alaska Science Center, Biological Science Office.

Lockyer, C., and M. Walton
1994 "Aspects of the Biology of Harbour Porpoise, *Phocoena phocoena*, in British Waters." Paper SC46/SM13 Presented at 46th Meeting of the Scientific Committee, International Whaling Commission.

Loughlin, T.R.
1997 "Using the Phylogeographic Method to Identify Steller Sea Lion Stocks." In *Molecular Genetics of Marine Mammals, Incorporating the Proceedings of a Workshop on the Analysis of Genetic Data to Address Problems of Stock Identity as Related to Management of Marine Mammals*, edited by A. Dizon, S.J. Chivers, and W. Perrin, 329-341. Society of Marine Mammals Special Report No. 3.

Loughlin, T.R., A.S. Perlov, and V.A. Vladimirov
1992 "Range-Wide Survey and Estimation of Total Number of Steller Sea Lions in 1989." *Marine Mammal Science* 8(3):220-239.

Loughlin, T.R., and R. Nelson, Jr.
1986 "Incidental Mortality of Northern Sea Lion in Shelikof Strait, Alaska." *Marine Mammal Science* 2:14-33.

Lowry, L.F.
1990 "Alaska's Seals and Sea Lions: Where Are They Going?" *Alaska's Wildlife* September-October 1990:14-21.

Lowry, L.F., K.J. Frost, D.G. Calkins, G.L. Swartzman, and S. Hills
1982 "Feeding Habits, Food Requirements, and Status of Bering Sea Marine Mammals." Document 19. Anchorage, AK: North Pacific Fishery Management Council.

Lowry, L.F., K.J. Frost, J.M. Ver Hoef, and R.A. DeLong
2001 "Movements of Satellite-Tagged Subadult and Adult Harbor Seals in Prince William Sound, Alaska." *Marine Mammal Science* 17(43):835-861.

Mallory, M., and K. Metz
1999 "Common Merganser (*Mergus merganser*)." In *The Birds of North America, No. 442*, edited by A. Poole and F. Gill. Philadelphia, PA: The Birds of North America, Inc.

Malme, C.I., P.R. Miles, and P.T. McElroy

1982 “The Acoustic Environment of Humpback Whales in Glacier Bay and Frederick Sound/Stephens Passage, Alaska.” Report Number 4848. Prepared for the National Marine Mammal Laboratory, Seattle, WA.

Malme, C.I., P.R. Miles, C.W. Clark, and J.E. Bird

1983 “Investigations of the Potential Effects of Underwater Noise from Petroleum Industry Activities on Migrating Gray Whale Behavior.” BBN Rep. 5366. Report from Bolt, Beranek & Newman Inc., Cambridge, MA prepared for U.S. Minerals Management Service, Anchorage, AK.

Mann, D.H. and G.P. Streveler

1997 “Final Report on Geological Investigations Associated with 1995 SAIP Survey in Glacier Bay National Park and Preserve, Alaska.” Manuscript on file, National Park Service, Alaska.

Manning, R.E., and D.W Lime

1996 “Crowding and Carrying Capacity in the National Park System: Toward a Social Science Research Agenda.” In *Congestion and Crowding in the National Park System*, edited by D.W. Lime, 27-65, Volume 86-1996. St. Paul, MN: Minnesota Agricultural Experiment Station.

Mantell, M.A., and P.C. Metzger

2002 “The Organic Act and the Stewardship of Resources within Park Boundaries.” December 12. National Park Service.

Marine Protection, Research, and Sanctuaries Act.

1974 33 U.S. Code, 1401-1445. October 23, 1974, as amended 1975-1977, 1980-1982, 1984, 1988, 1992 and 1996.

Mathews, E.A.

1993a “Opportunistic counts of Northern Sea Lions (*Eumetopias jubatus*) in Glacier Bay National Park and Preserve.” Gustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

1993b “Incident Report on an Abandoned Harbor Porpoise (*Phocoena phocoena*) Calf Off Willoughby Island, Glacier Bay National Park.” Report to Glacier Bay National Park and Preserve, Gustavus, AK.

1996 Distribution and Ecological Role of Marine Mammals (in Southeast Alaska). Supplemental Environmental Impact Statement, U.S. Environmental Protection Agency, Region 10.

Mathews, E.A., and G.W. Pendelton

1997 “Estimation of Trends in Abundance of Harbor Seals at Terrestrial and Glacial Ice Haulouts in Glacier Bay National Park, Southeast Alaska, 1975-1996.” In *Annual Report: Harbor Seal Investigations in Alaska*, 57-75. NOAA Grant NA57FX0367. Alaska Department of Fish and Game, Division of Wildlife Conservation. Anchorage, AK.

Matkin, C.O., and E.L. Saulitis

1994 "Killer Whale (*Orcinus orca*) Biology and Management in Alaska." Washington, D.C: Marine Mammal Commission.

Matkin, D.

1989 "Beardslee Islands Bird and Mammal Baseline Survey." Gustavus, AK: Glacier Bay National Park and Preserve.

Matsuura, S. and K. Takeshita

1990 "Longevity of Red King Crab, *Paralithodes camtschatica*, Revealed by Long-term Rearing Study." In *Proceedings of the International Symposium on King and Tanner Crabs.* University of Alaska, Alaska Sea Grant Report 90-04: 181-188.

Mattila, D.K., L.N. Guinee, and C.A. Mayo

1987 "Humpback Whale Songs on a North Atlantic Feeding Ground." *Journal of Mammalogy* 68(4): 880-883.

Maybaum, H.L.

1993 "Responses of Humpback Whales to Sonar Sounds." *Journal of the Acoustical Society of America* 94(3, Pt. 2): 1848-1849.

Mayer, D.L.

1972 "Synopsis of Biological Data on the Dungeness Crab (*Cancer magister*) (Dana, 1852) with Emphasis on the Gulf of Alaska." In *A Review of the Oceanography and Renewable Resources of the Northern Gulf of Alaska*, Section 14, Report R72-23, Sea Grant Report 73-3, edited by D.H. Rosenberg, 287-311. Fairbanks, AK: Institute of Marine Science, University of Alaska.

McDowell Group, Inc.

1996a "Juneau's Visitor Industry: An Economic Profile." Prepared for the Tourism Working Group, City and Borough of Juneau. Juneau, AK: McDowell Group, Inc.

1996b "Sitka's Visitor Industry: An Economic Impact Study." Prepared for the Sitka Convention and Visitors Bureau. Juneau, AK: McDowell Group, Inc.

1999 "Alaska Visitor Industry Economic Impact Study"

2000a "Economic Impact of the Cruise Industry in Southeast Alaska." Prepared for Southeast Conference. Juneau, AK: McDowell Group, Inc.

2000b "Glacier Bay Compensation Plan Economic Assessment." Prepared for National Park Service, Gustavus, AK.

2002a From unpublished survey research database of McDowell Group, Inc. Alaska Travelers Survey, 2001.

2002b "Haines Tourism Management Plan." Prepared for the City of Haines. Juneau, AK: McDowell Group, Inc.

McDowell Group, Inc.

2002c From unpublished cruise traffic database of McDowell Group, Inc.

2002d "Sitka Economic Profile 2000." Prepared for the City and Borough of Sitka. Juneau, AK: McDowell Group, Inc.

2002e The Capital Economy: An Assessment of the Local and Regional Impacts of a Capital Move. Juneau, AK: McDowell Group, Inc.

2003 Personal communication from Jim Calvin, McDowell Group, Inc., Juneau, AK to Steve Hall, Ecology & Environment, Inc., Seattle, WA, September 18.

McGarigal, K., R.G. Anthony, and F.B. Isaacs

1991 "Interactions of Humans and Bald Eagles on the Columbia River Estuary." *Wildlife Monographs* 115:1–47.

McSweeney, D.J., K.C. Chu, W.F. Dolphin, and L.N. Guinee

1989 "North Pacific Humpback Whale Songs: A Comparison of Southeast Alaskan Feeding Ground Songs with Hawaiian Wintering Ground Songs." *Marine Mammal Science* 5(2): 139-148.

Mecklenburg, C. W., T. A. Mecklenburg, and L. K. Thorsteinson

2002 Fishes of Alaska. Bethesda, MD: *American Fisheries Society*.

Merrick, R.L., T.R. Loughlin, and D.G. Calkins

1987 "Decline in Abundance of the Northern Sea Lion, *Eumetopias jubatus*, in Alaska, 1956-86." *Fishery Bulletin* 85(2):351-365.

Mikola, J., M. Miettinen, E. Lehikoinen, and K. Lehtilä

1994 "The Effects of Disturbance Caused by Boating on Survival and Behaviour of Velvet Scoter *Melanitta fusca* Ducklings." *Biological Conservation* 67:119–124.

Miles, P.R. and C.I. Malme

1983 "The Acoustic Environment and Noise Exposure of Humpback Whales in Glacier Bay, Alaska." Prepared for the National Marine Mammal Laboratory, Seattle, WA.

Miller, D.J., and R.N. Lea

1972 "Guide to the Coastal Marine Fishes of California." *California Department of Fish and Game, Fish Bulletin* 157.

Miller, P.J.O., N. Biassoni, A. Samuels, and P. Tyack

2000 "Whale Songs Lengthen in Response to Sonar." *Nature* 405:903.

Misund, O.A., J.T. Øvredal, and M.T. Halfsteinsson

1996 "Reactions of Herring Schools to the Sound Field of a Survey Vessel." *Aquatic Living Resources* 9:5–11.

Mitchell, C.T., E.K. Anderson, L.G. Jones, and W.J. North

1970 "What Oil Does to Ecology." *Journal, Water Pollution Control Federation* 42 (5): 812-818

Møhl, B.

1968b "Hearing in Seals." In *The Behavior and Physiology of Pinnipeds*, edited by R.J. Harrison, R.C. Hubbard, R.S. Peterson, C.E. Rice, and R.J. Schusterman. New York: Appleton-Century-Crofts.

1968a "Auditory Sensitivity of the Common Seal in Air and Water." *Journal of Auditory Research* 8(1): 27-38.

1967 "Frequency Discrimination in the Common Seal and a Discussion of the Concept of Upper Hearing Limit." In *Underwater Acoustics*, Volume 2, edited by V.M. Albers. New York: Plenum.

Moore, P.W.B., and R.J. Schusterman

1976 "Discrimination of Pure-Tone Intensities by the California Sea Lion." *Journal of the Acoustical Society of America* 69(6): 1405-1407.

1987 "Audiometric Assessment of Northern Fur Seals, Callorhinus ursinus." *Marine Mammal Science* 3(1): 31-53.

Moore, P.W.B., and W.W.L. Au

1975 "Underwater Localization of Pulsed Pure Tones by the California Sea Lion (*Zalophus californianus*)." *Journal of the Acoustical Society of America* 58(3): 721-727.

Morrow, J.E.

1980 *The Freshwater Fishes of Alaska*. Anchorage, AK: Alaska Northwest Publishing Company.

Motyka, R.J. and A. Post

1995 "Taku Glacier: Influence of Sedimentation, Accumulation to Total Area Ratio, and Channel Geometry on the Advance of a Fjord-type Glacier." In *Proceedings of the Third Glacier Bay Science Symposium, 1993*, edited by D.R. Enginstrom, 38-45. Anchorage, AK: National Park Service.

Mueller, A.J., and P.O. Glass

1988 "Disturbance Tolerance in a Texas Waterbird Colony." *Colonial Waterbirds* 11:119–122.

Mueller, G.L.

1973 "Preliminary Survey of Intertidal Fauna and Flora of Glacier Bay National Monument: A Final Report" (unpublished). Juneau, AK: U.S. Department of the Interior, National Park Service, Glacier Bay National Monument. Referenced in J.L. Bodkin, and K.A. Kloecker.1999. *Intertidal Clam Diversity, Size, Abundance and Biomass in Glacier Bay National Park and Preserve: 1999 Annual Report.* Anchorage, AK: U.S. Geological Survey, Biological Resources Division, Alaska Biological Science Center.

Muir, J.

1915 *Travels in Alaska*. Boston: Houghton Mifflin.

Murphy, S.M., and T.J. Mabee

2000 “Status of Black Oystercatchers in Prince William Sound, Alaska, Nine Years After the Exxon Valdez Oil Spill.” *Waterbirds* 23:204–213.

Myrberg, A.A.

1978 “Ocean Noise and the Behavior of Marine Animals.” *In Effects of Noise on Wildlife*, edited by J.L. Fletcher and R.G. Busnel, 169-208. New York, San Francisco, London: Academic Press.

1981 “Sound Communication and Interception in Fishes.” In *Hearing and Sound Communication in Fishes*, edited by W.N Tavolga, A.N. Popper, and R.R. Fay, Chapter 20. New York, Heidelberg, Berlin: Springer-Verlag.

National Academy of Sciences

2002 “Oil in the Sea III: Inputs, Fates and Effects.” National Academy Press, Washington DC. Available on the Internet @ http://search.nap.edu/books/0309084385/html/.

National Environmental Policy Act of 1969, as amended. (NEPA)

1969 42 U.S.Code 4321-4347, Public Law 91-190, January 1, 1970, as amended by Public Law 94-52, July 3, 1975; Public Law 94-83, August 9, 1975; and Public Law 97-258, § 4(b), Sept. 13, 1982.

National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries)

2002 “Acoustics Program. NOAA Fisheries Office of Protected Resources web site.” Available on the Internet @ http://www.nmfs.noaa.gov/prot_res/ PR2/ Acoustics_Program/acoustics.html.

National Park Service (NPS)

1983 “Glacier Bay: A Guide to Glacier Bay National Park and Preserve, Alaska.” Handbook 123. Washington, D.C.: U.S. Department of Interior, Division of Publications National Park Service.

1984 *General Management Plan: Glacier Bay National Park and Preserve, Alaska.* Gustavus, AK: Department of the Interior, National Park Service, Glacier Bay National Park and Preserve.

1989 *Wilderness Visitor Use Management Plan.* Gustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

1995a *Glacier Bay National Park and Preserve Vessel Management Plan and Environmental Assessment.* Anchorage, AK: Department of the Interior, National Park Service, Alaska Region.

1995b “Baseline Water Quality Data Inventory and Analysis Glacier Bay National Park and Preserve.” Technical Report NPS/NRWRD/NRTR-95/56. Fort Collins, CO: National Park Service Water Resources Division.

1995c “Up-Bay Operation Manual 1995: Fuel Barge Operating Guidelines.doc” Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service (NPS)

1996 *Glacier Bay National Park and Preserve Vessel Management Plan and Environmental Assessment Finding of No Significant Impact (FONSI) and Dear Reader Letters.* Anchorage, AK: Department of the Interior, National Park Service, Alaska Regional Office.

1997a "Cultural Resource Management Guideline, Release No. 5."

1997b "Commercial Visitor Services - 1997." Gustavus, AK, National Park Service, Glacier Bay National Park and Preserve.

1997c Glacier Bay National Park and Preserve Mission Statement. Available on the Internet @ http://www.nps.gov/akso/gpra/glba.htm.

1998a *Commercial Fishing Environmental Assessment, Glacier Bay National Park and Preserve.* Anchorage, AK: U.S. Department of the Interior, National Park Service, Alaska Region.

1998b "Director's Order 28: Cultural Resources Management."

1998 "Prospectus Under Which Concession Permits Will Be Open For Competition For The Operation Of Cruise Ship Services Within Glacier Bay National Park and Preserve: cs prespectus98.pdf." Gustavus, AK: National Park Service, Glacier Bay National Park.

1998 *General Management Plan, Glacier Bay National Park and Preserve, Alaska*.

1999a "Director's Order 41: Wilderness Preservation and Management." U.S. Department of the Interior, National Park Service.

1999b "List of Classified Structures." Department of the Interior, National Park Service, Alaska Regional Office.

1999c "FY 2000 Budget and Annual Performance Plan for Glacier Bay National Park and Preserve."

2000a "Glacier Bay National Park and Preserve: Strategic Plan. October 1, 2000 - September 30, 2005." Gustavus, AK: Glacier Bay National Park and Preserve.

2000b "Director's Order 55: Interpreting the National Park Service Organic Act."

2001a "Director's Order 12: Conservation Planning and Environmental Impact Analysis, and Decision-Making."

2001b "2001 NPS Management Policies." Available on the Internet @ http://www.nps.gov/refdesk/mp/.

2001c "Director's Order 47: Soundscape Preservation and Noise Management."

National Park Service (NPS)

2001d “Cultural Resources Management.” In 2001 National Park Service Management Policies, Chapter 5. Washington, D.C.: U.S. Department of Interior, National Park Service.

2001e “National Park Service Cultural Landscapes Inventory, 2001, Bartlett Cove, Glacier Bay National Park and Preserve.”

2001f “The National Park Service- Our Mission.” Available on the Internet @ http://www.nps.gov/legacy/mission.html.

2001g “Backcountry User Database: BackcountrySurvey.mdb” (6/5/2002) Gustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

2002a “Glacier Bay National Park and Preserve 2002 Compendium.” Available on the Internet @ http://data2.itc.nps.gov/parks/glba/ppdocuments/ACF63BB.pdf.

2002d “National Park Service Cultural Landscapes Inventory, 2002, Dundas Bay, Glacier Bay National Park and Preserve.”

2002e “Homebody” (National Park Service’s Public Use Database) [database online]. Available on the Internet @ http://www.aqd.nps.gov/stats/homebody.htm.

2002f “Glacier Bay National Park and Preserve Visitor Use Statistics.” Electronic database file “vqor use data 021022.xls.” Gustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

2002g “Wilderness Designations in Glacier Bay National Park and Preserve: Wilderness.shp (20020422).” Anchorage, AK: National Park Service, Alaska Support Office.

2002h Glacier Bay National Park and Preserve Commercial Visitor Services website [database online]. Available on the Internet @ http://www.nps.gov/glba/admin/commercial/index.htm.

2002i “Glacier Bay Coastal Inventory Segments: segsutm8.shp (20020527).” Gustavus, AK: National Park Service, Glacier Bay National Park.

2002j “2001 and 2002 Dundas Bay Vessel Traffic Documented During Outer Waters Vessel Activity Survey (OWVAS) Project Serial Surveys Database.” Dundas Bay vessels.xls. Gustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

2002k National Park Service, Glacier Bay National Park and Preserve website. Available on the Internet at http://www.nps.org/glba

2002 Personal communication from Mary Kralovec, National Park Service, Glacier Bay National Park and Preserve, Gustavus, AK to Robert Day, ABR, Inc., Fairbanks, AK, April 10.

National Park Service (NPS)

2002 Electronic mail from Mary Kralovec, National Park Service, Glacier Bay National Park and Preserve, Gustavus, AK to Robert Day, ABR, Inc., Fairbanks, AK, July 30.

2002 Electronic mail from Chuck Young, National Park Service, Glacier Bay National Park and Preserve, Gustavus, AK to Elke Rank, Ecology and Environment, Inc., San Francisco, CA on November 4.

2002 Electronic mail from Chuck Young, National Park Service, Glacier Bay National Park and Preserve, Gustavus, AK to Elke Rank, Ecology and Environment, Inc., San Francisco, CA on October 11.

2002 Electronic mail from David Nemeth, Glacier Bay National Park and Preserve, to Elke Rank, Ecology and Environment, Inc., San Francisco, CA, October 21.

2002 Electronic mail from David Nemeth, Glacier Bay National Park and Preserve, to Elke Rank, Ecology and Environment, Inc., San Francisco, CA, September 16-18, 2002.

2002 Personal Communication from Dave Nemeth, National Park Service, Glacier Bay National Park and Preserve Chief of Concessions to E. Rank, Ecology and Environment, Inc., July 2, 2002.

2002 Personal Communication from Allison Banks, National Park Service, Glacier Bay National Park and Preserve to Ecology and Environment, Inc.

2002 Personal Communication from Chad Soiseth, National Park Service, Glacier Bay National Park and Preserve to Ecology and Environment, Inc.

2002 Personal Communication from Christine Gabriele, National Park Service, Glacier Bay National Park and Preserve to LGL, Inc.

2003a “Glacier Bay National Park and Preserve Visitor Use Statistics: vqor use data.xls.” Gustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

2003b Park Ranger Office, Glacier Bay Air Quality Program, Visible Emission Observation Program Summary, July 6, 2002 to September 11, 2002.

2003c “Glacier Bay National Park and Preserve 2002 Visitor Survey Card Data Report.” Gustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

2003 Electronic mail from Maya Seraphin, National Park Service, Glacier Bay National Park and Preserve Chief of Concessions to E. Rank, Ecology and Environment, Inc., January 6.

National Park Service Organic Act.

1916 16 U.S. Code Sections 1 - 4, Public Law 235, 39 Statute 535. August 25, 1916. Amended 1978.

National Park Service, the Advisory Council on Historic Preservation and the National Conference of Historic Preservation Officers (NPS, ACHP, and NCHPO)

1995 "Programmatic Agreement Among the National Park Service, the Advisory Council on Historic Preservation and the National Conference of Historic Preservation Officers."

National Research Council

2000 Marine Mammals and Low-Frequency Sound: Progress Since 1994. Washington D.C.: National Academy Press.

National Resources Program Center (NRPC)

2002 "Draft Guidance on Assessing Impacts and Impairment to Natural Resources." October 8, 2002. National Parks Service, National Resources Program Center.

Naval Surface Warfare Center (NSWC)

2002 *Southeast Alaska Cruise Ship Underwater Noise.* Technical Report NSWCCD-71-TR-2002/S74. Author Blair Kipple. Prepared for Glacier Bay National Park and Preserve. Bremerton, WA: Naval Surface Warfare Center-Detachment Bremerton.

Nemeth, D.

2002 "2001 Vessel Statistics: vessel stats 2001.xls." Gustavus, AK: National Park Service, Glacier Bay Park and Preserve, Concession Office.

2003 "2002 Vessel Statistics: vessel stats 2002.xls." Gustavus, AK: National Park Service, Glacier Bay Park and Preserve, Concession Office.

Neproshin, A.Y.

1978 "Behavior of the Pacific Mackerel, *Pneumatophorus japonicus*, When Affected by Vessel Noise." *Journal of Ichthyology* 18:695–699.

Nisbet, I.C.T.

2000 "Disturbance, Habituation, and Management of Waterbird Colonies." *Waterbirds* 23:312–332.

Norris, K.S., and T.P. Dohl

1980 "Behavior of the Hawaiian Spinner Dolphin, *Stenella longirostris*." *Fishery Bulletin* 77(4): 821-849.

Norris, T.F.

1995 "Effects of Boat Noise on the Singing Behavior of Humpback Whales (*Megaptera novaeangliae*)." M.S. Thesis. San Jose State University.

1999 "Effects of Boat Nose on the Acoustic Behavior of Humpback Whales*." Journal of the Acoustical Society of America Abstracts.*

Northern Economics
2002 "Alaska Visitor Arrivals and Profile Summer 2001." Draft. Prepared for the Alaska Department of Community and Economic Development.

O'Clair, C.E., L. Freese, R.P. Stone, T.C. Shirley, E.H. Leder, S. Taggart, and G.H. Kruse
1995 "Nearshore Distribution and Abundance of Dungeness Crabs in Glacier Bay National Park, Alaska." In *Proceedings of the Third Glacier Bay Science Symposium, 1993* edited by D.R. Engstrom, 196-202. Anchorage, AK: National Park Service.

O'Clair, C.E., P. Stone, and J.L. Freese
1990 "Movements and Habitat Use of Dungeness Crabs and the Glacier Bay Fishery." In *Proceedings of the Second Glacier Bay Science Symposium*, edited by A.M. Milner and D. Wood, Jr., 74-77. Anchorage, AK: National Park Service.

O'Clair, R.M. and S.C. Lindstrom
2000 *North Pacific Seaweeds*. Auke Bay, AK: Plant Press..

O'Clair, R.M., and C.E. O'Clair
1998 *Southeast Alaska's Rocky Shores: Animals.* Auke Bay, AK: Plant Press.

O'Clair, C. E. and S. T. Zimmerman
1986 "Biogeography and Ecology of Intertidal and Shallow Subtidal Communities." In *The Gulf of Alaska: Physical Environment and Biological Resources*, edited by D.W. Hood and S.T. Zimmerman, 305-344. U.S. Department of the Interior, National Oceanic and Atmospheric Administration, Ocean Assessments Division.

Oil Pollution Act of 1990.
1990 33 U.S. Code, 2701-2760.

Olesiuk, P.F., M.A. Bigg, and G.M. Ellis
1990 "Life History and Population Dynamics of Resident Killer Whales (*Orcinus orca*) in the Coastal Waters of British Columbia and Washington State." *Report of the International Whaling Commission* (Special Issue 12):209-242.

Ollason, J.C., and G.M. Dunnett
1980 "Nest Failures in the Fulmar: The Effect of Observers." *Journal of Field Ornithology* 51:39–54.

Orensanz, J. M., A. M. Parma, and O. O. Iribarne
1991 "Population Dynamics and Management of Natural Stocks." In *Scallops: Biology, Ecology, and Aquaculture*, edited by S.E. Shumway, 625-713. Elsevier, N.Y.

Orsi, J.A., and H.W. Jaenicke
1996 "Marine Distribution and Origin of Pre-recruit Chinook Salmon, *Oncorhynchus tshawytscha*, in Southeastern Alaska." *Fishery Bulletin* 94: 482-497.

Owens, N.W.
1977 "Responses of Wintering Brent Geese to Human Disturbance." *Wildfowl* 28:5–14.

Paige, B.

1986 “Birds of Glacier Bay National Park and Preserve.” Anchorage, AK: Alaska National History Association.

Palka, D.L., A.J. Read, A.J. Westgate and D.W. Johnston

1996 “Summary of Current Knowledge of Harbour Porpoises in U.S. and Canadian Atlantic Waters.” In *Forty-Sixth Report of the International Whaling Commission*. Cambridge: International Whaling Commission.

Parker, P.L. and T.F. King

1998 “Guidelines for Evaluating and Documenting Traditional Cultural Properties.” National Register Bulletin (revised). U.S. Department of the Interior, National Park Service, National Register, History and Education, National Register of Historic Places.

Parrish, A.

2002 Personal communication from A. Parrish, Vice President of Public Affairs (retired), Holland America Lines to Jim Calvin, McDowell Group, Juneau, AK, August 2002.

Payne, R.S., and S. McVay

1971 Songs of Humpback Whales. *Science* 173:585-597.

Pearson, W.H., J.R. Salski, and C.I. Malme

1992 “Effects of Sounds From a Geophysical Survey Device on Behavior of Captive Rockfish (*Sebastes* spp.).” *Canadian Journal of Fisheries and Aquatic Science* 49: 1343-1356.

Pelican Convention and Visitors Bureau

2000 Pelican, Alaska Visitors Association website. Available on the Internet @ http://www.pelican.net.

Peratovich, Nottingham, and Drage, Inc. (PND)

2002 Memorandum from Sandra Donohue, Anchorage, AK, to Ecology and Environment, Inc., Anchorage, AK, June 21, 2002. Regarding issues and observations from site visit on 6/12/02 by Orson Smith and Sandra Donohue—Ship wave effect on coastal morphology.

Perry, A., C.S. Baker, and L.M. Herman

1985 *The Natural History of Humpback Whales (Megaptera novaeangliae) in Glacier Bay*. Final report to the National Park Service, Alaska Regional Office, Anchorage, AK

Peterson, R.S. and G.A. Bartholomew

1969 “Airborne Vocal Communication in the California Sea Lion, *Zalophus californianus*.” *Animal Behaviour* 17(1): 12-24.

Petro Marine Services

2003 Personal communication From Deenie Roberson, Anchorage, AK to Elke Rank, Ecology and Environment, Inc., San Francisco, CA, January 6.

Piatt, J.F., and N.L. Naslund
1995 “Abundance, Distribution, and Population Status of Marbled Murrelets in Alaska.” In *Ecology and Conservation of the Marbled Murrelet*, General Technical Report PSW-GTR-152, edited by C.J. Ralph, G.L. Hunt, Jr., M.G. Raphael, and J.F. Piatt, 285–294. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station.

Piatt, J.F., B.D. Roberts, W.W. Lidster, J.L. Wells, and S.A. Hatch
1990b “Effects of Human Disturbance on Breeding Least and Crested Auklets at St. Lawrence Island, Alaska.” *Auk* 107:342–350.

Piatt, J.F., C.J. Lensink, W. Butler, M. Kendziorek, and D.R. Nysewander
1990a “Immediate Impact of the Exxon Valdez Oil Spill on Marine Birds.” *Auk* 107:387–397.

Piatt, J.F., J. Bodkin, and J. Taggert
2002 “Seabirds, Marine Mammals and Forage Fish in Glacier Bay National Park.” A slide presentation of data collected during June 1999 in a collaborative project funded by the U.S. Geological Survey and the National Park Service. Available on the Internet @ http://www.absc.usgs.gov/research/seabird_foragefish/maps/index.html

Piatt, J.F., L. Climo, A. Springer, and T. Duncan
1991 “Marine Bird Distribution in Glacier Bay National Park During the Summer of 1991.” Anchorage, AK: U.S. Fish and Wildlife Service.

Pierce, D.J., and T.R. Simons
1986 “The Influence of Human Disturbance on Tufted Puffin Breeding Success.” *Auk* 103:214–216.

Pitcher, K.W.
1980 Food of the Harbor Seal, *Phoca vitulina* richardsi, in the Gulf of Alaska. *Fishery Bulletin, U.S.* 78(2):544-549.

Pitcher, K.W., and D.C. McAllister.
1981 Movements and Haul Out Behavior of Radio-Tagged Harbor Seals, *Phoca vitulina*. *Canadian Field Naturalist* 95:292-297.

Pitcher, K.W., and D.G. Calkins
1979 “Biology of the harbor seal (*Phoca vitulina* richardsi) in the Gulf of Alaska.” U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, Outer Continental Shelf Environmental Assessment Program Final Report 19(1983):231

Pitcher, K.W., and F.H. Fay
1982 “Feeding by Steller Sea Lions on Harbor Seals.” *Murrelet* 63:70-71.

Polasky, C.
1992 “Bartlett Cove Beach Debris Survey, Glacier Bay National Park.” National Park Service, Glacier Bay National Park.

Poulter, T.C.
1968 "Underwater Vocalization and Behavior of Pinnipeds." In *The Behavior and Physiology of Pinnipeds,* edited by R.J. Harrison, R.C. Hubbard, R.S. Peterson, C.E. Rice and R.J. Schusterman. New York: Appleton-Century-Crofts.

Ralls, K., P. Fiorelli, S. Gish
1985 "Vocalizations and Voval Mimicry in Captive Harbor Seals, *Phoca vitulina*." *Canadian Journal of Zoology* 63(5): 1050-1056.

Raum-Suryan, K.
2001 "Trip Report: Brand Resights of Steller Sea Lions in Southeast Alaska and Northern British Columbia from 13 June – 3 July 2001."

Raum-Suryan, K., and K. Pitcher
2000 "Trip Report: Brand Resights of Steller Sea Lions within Southeast Alaska and Northern British Columbia from 19 June – 10 July 2000."

Read, A.J., and D.E. Gaskin
1990 "Changes in Growth and Reproduction of Harbour Porpoises, *Phocoena phocoena*, from the Bay of Fundy." *Canadian Journal of Fisheries and Aquatic Sciences* 47:2158-2163.

Read, A.J., and A.A. Hohn
1995 "Life in the Fast Line: The Life History of Harbor Seals for the Gulf of Mexico." *Marine Mammal Science* 11(4): 423-440.

Renaud, D.L., and A.N. Popper
1975 "Sound Localization by the Bottlenose Porpoise *Tursiops runcatus*." *Journal of Experimental Biology* 63(3): 569-585.

Rice, D.W.
1978 "The Humpback Whale in the North Pacific: Distribution, Exploitation, and Numbers." In *Report on a Workshop on Problems Related to Humpback Whales (Megaptera novaeangliae) in Hawaii*, edited by K. S. Norris, R.R. Reeves. Marine Mammal Commission.

1998 *Marine Mammals of the World Systematics and Distribution*. Lawrence, KS: Allen Press, Inc.

Richardson, W.J., and C.R. Greene, Jr.
1993 "Variability in Behavioral Reaction Thresholds of Bowhead Whales to Man-Made Underwater Sounds." *Journal of the Acoustical Society of America* 94(3, Pt. 2):1848.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme, and D.J. Thomson
1995 *Marine Mammals and Noise*. Academic Press. San Diego, CA.

Ricketts, E.F. and J. Calvin
1968 *Between Pacific Tides*. 4th ed. Stanford, CA: Stanford Unversity Press.

Robards, M., G. Drew, J. Piatt, P. Hooge, J. M. Anson, A. Abookire, S. Speckman, and J. Bodkin
2002 "Glacier Bay Small Schooling Fish Project." Anchorage, AK: U.S.Geological Survey, Alaska Science Center, Biological Science Office.

Robards, M., J. Piatt, and G. Drew
1999 *Distribution and Abundance of Small Schooling Fish in Nearshore Areas of Glacier Bay, Alaska During June, 1999*. Anchorage, AK: U.S. Geological Survey, Biological Resources Division, Alaska Biological Science Center.

Robert, H.C., and C.J. Ralph
1975 "Effects of Human Disturbance on the Breeding Success of Gulls." *Condor* 77:495–499.

Robertson, G.J., and R.I. Goudie
1999 "Harlequin Duck (*Histrionicus histrionicus*)." In *The Birds of North America*, No. 466, edited by A. Poole and F. Gill. Philadelphia, PA: The Birds of North America, Inc.

Rodway, M.S., W.A. Montevecchi, and J.W. Chardine
1996 "Effects of Investigator Disturbance on Breeding Success of Atlantic Puffins *Fratercula arctica*." *Biological Conservation* 76:311–319.

Rogers, J.A., Jr., and H.T. Smith
1995 "Set-back Distances to Protect Nesting Bird Colonies from Human Disturbance in Florida." *Conservation Biology* 9:89–99.

Rotterman, L.M., and T. Simon-Jackson
1988 "Sea Otter (*Enhydra lutris*)." In *Selected Marine Mammals of Alaska: Species Accounts with Research and Management Recommendations*, edited by J.W. Lentfer, 237-275. Washington D.C.: Marine Mammal Commission.

Safina, C., and J. Burger
1983 "Effects of Human Disturbance on Reproductive Success in the Black Skimmer." *Condor* 85:164–171.

Salvi, W.C., and D.R. Johnson
1985 "Glacier Bay Backcountry User Study 1984: Statistical Abstract." Seattle WA: University of Washington, Cooperative Research Park Studies Unit.

Sandegren, F.E., E.W. Chu, and J.E. Vandevere
1973 "Maternal Behavior in the California Sea Otter." *Journal of Mammalogy* 54(3): 668-679.

Santoro, A.K., K.L. Marten, and T.W. Cranford
1989 "Pygmy Sperm Whale Sound (*Kogia breviceps*)." In *Abstracts 8th Biennial Conference on Biology of Marine Mammals, Pacific Grove, CA, December 1989,* page 59.

Scheffer, V.B., and J.W. Slipp
1944 "The Harbor Seal in Washington State." *American Midland Naturalist* 32:373-416.

Schevill, W.E., W.A. Watkins, and C. Ray
1963 “Underwater Sounds of Pinnipeds.” *Science* 141(3575): 50-53.

Schlundt, C.E., Finneran, J.J., Carder, D.A., and S.H. Ridgway
2000 “Temporary Shift in Masked Hearing Thresholds of Bottlenose Dolphins, *Tursiops truncatus*, and White Whales, *Delphinapterus leucas*, After Exposure to Intense Tones.” *Journal of the Acoustic Society of America* 107 (6): 3496-3508.

Schoenberg, K.M.
1999 “Archaeological Overview and Assessment: Glacier Bay National Park and Preserve (Draft).” Anchorage, AK: National Park Service.

Scholik, A.R. and H.Y. Yan
2001 “The Effects of Underwater Noise on Auditory Sensitivity of Fish.” *Proceedings of the Institute of Acoustics* 23 (4): 27-36.

2002 “Effects of Boat Engine Noise on the Auditory Sensitivity of the Fathead Minnow, Pimephales promelas.” *Environmental Biology of Fishes* 63: 203-209.

Schroeder, R.F.
1995 “Historic and Contemporary Tlingit Use of Glacier Bay. “ In *Proceedings of the Third Glacier Bay Science Symposium*, *1993*, edited by D.R. Engstrom, 278-293. Anchorage, AK: U.S. Department of the Interior, National Park Service, Alaska System Support Office.

Schroeder, R.F. and M. Kookesh
1990 *Subsistence Harvest and Use of Fish and Wildlife Resources and the Effects of Forest Management in Hoonah, Alaska.* Technical report 142. Alaska Department of Fish and Game.

Schusterman, R.J.
1981 “Behavioral Capabilities of Seal and Sea Lions: A Review of Their Hearing, Visual, Learning and Diving Sills.” *The Psychological Record* 31(2): 125-143.

Schusterman, R.J., R. Gentry, and J. Schmook
1966 “Underwater Vocalization by Sea Lions: Social and Mirror Stimuli.” *Science* 154(3748): 540-542.

Schusterman, R.J., R.F. Balliet, and J. Nixon
1972 “Underwater Audiogram of the California Sea Lion by the Conditioned Vocalization Technique.” *Journal of the Experimental Analysis of Behavior* 17(3): 339-350.

Schwarz, A.L., and G.L. Greer
1984 “Responses of Pacific Herring, *Clupea harengus pallasi*, to Some Underwater Sounds.” *Canadian Journal of Fisheries and Aquatic Sciences* 41:1183–1192.

Sease, J.L.
1992 "Status review: Harbor Seals (*Phoca vitulina*) in Alaska." Alaska Fisheries Science Center Processed Report 92-15. Anchorage, AK: United States Geological Survey, Alaska Fisheries Science Center.

Serrano, A. and J.M. Terhune
2001 "Within-Call Repetition May Be an Anti-Masking Strategy in Underwater Calls of Harp Seals (*Pagophilus groenlandicus*)." *Canadian Journal of Zoology* 79: 1410-1413.

Sharman, L.C., A.M. Milner, F.S. Chapin III, and D.R. Engstrom
1995 "Qualitative Successional Models in Glacier Bay: A Comparison of Terrestrial, Marine, Stream and Lake Ecosystems." In *Third Glacier Bay Science Symposium, 1993,* edited by D.R. Engstrom, 190-195. Gustavus, AK: Glacier Bay National Park and Preserve, National Park Service.

Sharman, L., B. Eichenlaub, D. VanLeeuwen, S. Croll, J.S.Grover, G. Lenhart and P. Hooge
2002 "Alaska Coastal Resources Inventory and Mapping Field Protocol - The Polygon Method: CoastWalkers-Access2000.mdb." Gustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

Sharpe, F.A., L.M. Dill, V. Beaver, and B. Spellman
1998 "Killing Me Softly: Feeding Calls of the Alaskan Humpback Whale." In *Abstracts of the World Marine Mammal Science Conference, Monaco January 20-24, 1998*. Lawrence, KS: The Society for Marine Mammalogy.

Shealer, D.A., and J.A. Haverland
2000 "Effects of Investigator Disturbance on the Reproductive Behavior and Success of Black Terns." *Waterbird* 23:15–23.

Sinclair, M.
1988 *Marine Populations: An Essay on Population Regulation and Speciation*. Washington Sea Grant Program. Seattle, WA: University of Washington Press.

Sinclair, M., R.K. Mohn, G. Robert, and D.L. Roddick
1985 "Consideration for the Effective Management of Atlantic Scallops." Technical Reports, Canadian Journal of Fisheries and Aquatic Science.

Sitka Convention and Visitors Bureau
2000 Sitka Convention and Visitors Bureau website. Available on the Internet @ http://www.sitka.org.

Skagway Convention and Visitors Bureau
2000 Skagway Convention and Visitors Bureau website. Available on the Internet @ http://www.skagway.org.

Small, R.J., G.W. Pendelton, and K.M. Wynne
1997 "Harbor Seal Population Trends in the Ketchikan, Sitka, and Kodiak Island Areas of Alaska." In Annual Report: Harbor Seal Investigations in Alaska, 7-32. NOAA Grant NA57FX0367. Anchorage, AK: Alaska Department of Fish and Game, Division of Wildlife Conservation.

Snow, C.D. and E. Journal Wagner

1965 “Tagging of Dungeness Crabs With Spaghetti and Dart Tags.” *Fish Commission of Oregon, Research Briefs* 11(1): 5-13.

Soiseth, C.R. and A.M. Milner

1995 “Predicting Salmonid Occurance from Physical Characteristics of Streams in Glacier Bay National Park and Preserve.” In *Proceedings of the Third Glacier Bay Science Symposium, 1993,* edited by D.R. Engstrom, 174-183. Anchorage, AK: National Park Service

Southeast Alaska Petroleum Resource Organization (SEAPRO)

2002a Southeast Alaska Petroleum Resource Organization web site. Available on the Internet @ http://www.seapro.org.

2002b Personal communication from Pete Pritchard, Operations Manager, to Elke Rank, Ecology and Environment, Inc., San Francisco, CA, October 9.

Southeast Strategies and Dean Runyan Associates

2000 Skagway Economic Impact Study. Prepared for the City of Skagway. Juneau, AK: Southeast Strategies, Inc.

Spicer, R., and L. Prussin

1989 “Molting Canada Goose Census, Adams Inlet, Glacier Bay National Park and Preserve, 5–7 July 1989.” Gustavus, AK: Glacier Bay National Park and Preserve.

Stalmaster, M.V., and J.L. Kaiser

1998 “Effects of Recreational Activity on Wintering Bald Eagles.” *Wildlife Monographs* 137:1–46.

Stalmaster, M.V., and J.R. Newman

1978 “Behavioral Responses of Wintering Bald Eagles to Human Activity.” *Journal of Wildlife Management* 42:506–513.

Steidl, R.J., and R.G. Anthony

1996 “Experimental Effects of Human Activity on Breeding Bald Eagles.” *Ecological Applications* 10:258–268.

2000 “Responses of Bald Eagles to Human Activity During the Summer in Interior Alaska.” *Ecological Applications* 6:482–491.

Stone, R.P., C.E. O’Clair, and T.C. Shirley

1992 “Seasonal Migration and Distribution of Female Red King Crabs in a Southeast Alaskan Estuary.” *Journal of Crustacean Biology* 12: 546-560.

Stottlemeyer, R. and D. Rutkowski
1987 *Baseline Stream Water Chemistry for Watersheds of Glacier Bay National Park and Preserve, Alaska*. Michigan Technological University, Department of Biological Sciences.

Straley, J.M.
1994 "Seasonal Characteristics of Humpback Whales (*Megaptera novaeangliae*) in Southeastern Alaska." M.S. Thesis. University of Alaska, Fairbanks, AK.

Straley, J.M., C.M. Gabriele, and C.S. Baker
1994 "Annual Reproduction by Individually Identified Humpback Whales (*Megaptera novaeangliae*) in Alaskan Waters." *Marine Mammal Science* 10(1):87-92.

Straley, J.M, T.J. Quinn II, and C.M. Gabriele.
2001 "Estimate of the Abundance of Humpback Whales." Sitka, AK: University of Alaska Southeast Alaska, Sitka Campus. Juneau, AK: University of Alaska Fairbanks, School of Fisheries and Ocean Sciences. Gustavus, AK: Glacier Bay National Park and Preserve.

Sturdevant, M.V.
1999 *Exxon Valdez Oil Spill Restoration Project Final Report: Forager Fish Diet Overlap, 1994-1996.* Restoration Project 98163C, Final Report. Juneau, AK: National Marine Fisheries Service, Alaska Fisheries Science Center, Auke Bay Laboratory.

Swanton, J.
1909 *Tlingit Myths and Texts.* Smithsonian Institution. Bureau of American Ethnology Bulletin 39.

Tamura, T., and Y. Fujise
2000 "Geographical and Seasonal Changes of Prey Species in the Western North Pacific Minke Whale." IWC/SC/F2K/J22.

Terhune, J.M.
1974 "Directional Hearing of a Harbor Seal in Air and Water." *Journal of the Acoustical Society of America* 56(6): 1862-1865.

Terhune, J. M. and W. C. Verboom
1999 "Right Whales and Ship Noise." *Marine Mammal Science* 15: 256-258.

Thayer, J.A., W.J. Sydeman, N.P. Fairman, and S.G. Allen
1999 "Attendance and Effects of Disturbance on Coastal Common Murre Colonies at Point Reyes, California." *Waterbirds* 22:130–139.

Thiel, M., G. Nehls, S. Bräger, and J. Meissner
1992 "The Impact of Boating on the Distribution of Seals and Moulting Ducks in the Wadden Sea of Schleswig-Holstein." In *Proceedings of the 7th International Wadden Sea Symposium, Ameland, 1990*, edited by N. Dankers, C.J. Smit, and M. Scholl, 221–233. Texel, The Netherlands: Netherlands Institute for Sea Research.

Thompson, R.K.R., and L.M. Herman
1975 "Underwater Frequency Discrimination in the Bottlenosed Dolphin (1-140 kHz) and the Human (1-8 kHz)." *Journal of the Acoustical Society of America* 57(4): 943-948.

Thompson, T.J., H.E. Winn, and P.J. Perkins
1979 "Mysticete Sounds." In *Behavior of Marine Animals, Volume 3: Cetaceans*, edited by H.E. Winn and B.L. Olla. New York: Plenum. M.M. Hearing 3.2.1

Thornburg, D.D.
1973 "Diving Duck Movements on Keokuk Pool, Mississippi River." *Journal of Wildlife Management* 37:382–389.

Todd, S. P. Stevick. J. Lienp, F. Marques, and D. Ketten. 1996.
1996 "Behavioural Effects of Exposure to Underwater Explosions in Humpback Whales (*Megaptera novaeangliae*)." *Canadian Journal of Zoology* 74: 1661-1672.

Trapp, J.L.
1978 "Effects of Human Disturbance on a Red-Faced Cormorant Colony." Paper presented at Fifth Annual Meeting of the Pacific Seabird Group, Asilomar, California.

Trillmich, F.
1981 "Mutual Mother-Pup Recognition in Galápagos Fur Seals and Sea Lions: Cues Used and Functional Significance." *Behaviour* 78(1): 21-42.

Tuite, C.H., M. Owen, and D. Paynter
1983 "Interaction Between Wildfowl and Recreation at Llangorse Lake and Talybont Reservoir, South Wales." *Wildfowl* 34:48–63.

Tuite, C.H., P.R. Hanson, and M. Owen
1984 "Some Ecological Factors Affecting Winter Wildfowl Distribution on Inland Waters in England and Wales and the Influence of Water-Based Recreation." *Journal of Applied Ecology* 21:41–61.

Tyack, P.L.
1981 "Interactions Between Singing Hawaiian Humpback Whales and Conspecifics Nearby." *Behavioral Ecology and Sociobiology* 8(2): 105-116.

1986 "Population Biology, Social Behavior and Communication in Whales and Dolphins." *Trends in Ecology and Evolution* 1(6): 144-150.

Tyack, P.L., and H. Whitehead
1983 "Male Competition in Large Groups of Wintering Humpback Whales." *Behaviour* 83(1/2): 132-154.

U.S. Coast Guard (USCG)
1995 "Report of the Cruise Ship Safety Review Task Force." October, 1995. Washington, DC.

U.S. Department of Justice (USDJ)

1991 “Summary of Effects of the Exxon Valdez Oil Spill on Natural Resources and Archeological Resources.” Report to Judge Russell Holland, Anchorage, AK.

U.S. Environmental Protection Agency (EPA)

2002a “U.S. Environmental Protection Agency Global Warming Site: Emissions-Carbon Dioxide Emissions Based on State Energy Data Report, Energy CO2 Inventories.” (Annual emissions based on 1999 data converted from the EPA global warming site) Available on the Internet @ http://yosemite.epa.gov/globalwarming/ghg.nsf/emissions/ CO2EmissionsBasedOnStateEnergyData.

2002b “U.S. Environmental Protection Agency Global Warming Site: Emissions: Individual: In the Home.” (Data on household CO2) Available on the Internet @ http://yosemite.epa.gov/oar/globalwarming.nsf/content/EmissionsIndividualIntheHome.html?OpenDocument.

2002c “Effects of Oil Spills, Oil Spill Program, US EPA.” Available on the Internet @ http://www.epa.gov/oilspill/edueff.htm.

2002d “Do Motorboat Engines Cause Water Pollution?” Available on the Internet @ http://www.epa.gov/region1/questions/archive/200106_boatpollution.html.

2003 Electronic mail from M. Carr to C. Overpeck, Ecology and Environment, Inc., Anchorage, AK, February 24, 2003.

U.S. Fish and Wildlife Service (USFWS)

1996 “Population Estimates for Waterbirds Wintering in Southeast Alaska—1996.” Juneau, AK: U.S. Fish and Wildlife Service.

2002a Sea Otter (*Enhydra lutris*): Alaska stock. Anchorage, AK: U.S. Fish and Wildlife Service, Marine Mammals Management.

2002b Personal communication from Steve Brockman, U.S. Fish and Wildlife Service, Juneau, AK to Robert Day, ABR, Inc., Fairbanks, AK, May 29.

U.S. Fish and Wildlife Service (USFWS)

2002c “Beringian Seabird Colony Catalog”—computer database and colony status record archives. Anchorage, AK: U.S. Fish and Wildlife Service, Migratory Bird Management. Available on Internet @ http://fw7raptor.r7.fws.gov/seabird/index.html.

U.S. Forest Service (USFS)

1997 *Tongass National Forest Land and Resource Management Plan*. U.S. Department of Agriculture, Forest Service. Available on the Internet @ http://www.fs.fed.us/r10/WELCOME.PDF.

2002 *Draft Supplemental Environmental Impact Statement for the Tongass Land Management Plan Revision - Roadless Area Evaluation for Wilderness Recommendations* (May 2002)

U.S. Geological Survey (USGS)

2002a "Seabird and Forage Fish Study Sites in Glacier Bay"—computer database. Anchorage, AK: U.S. Geological Survey. Available on Internet under "HTML Slide Show" @ http://www.absc.usgs.gov/research/seabird&foragefish/maps/index.html.

2002b "Quantify the Effects of Commercial Dungeness Crab Fishing on the Glacier Bay Marine Ecosystem." Alaska Science Center – Biological Science Office, Available on the Internet @ http://www.absc.usgs.gov/glba/Dungeness_crab.htm

2002 Personal communication from James Bodkin, U.S. Geological Survey, Anchorage, AK to Robert Day, ABR, Inc., Fairbanks, AK, May 10, at the the Glacier Bay Science Symposium.

2002 Personal communication from Gary Drew, U.S. Geological Survey, Anchorage, AK to Robert Day, ABR, Inc., Fairbanks, AK, May 10, at the the Glacier Bay Science Symposium.

2002 Personal communication from Micheal Litzow, U.S. Geological Survey, Anchorage, AK to Robert Day, ABR, Inc., Fairbanks, AK, May 10, at the the Glacier Bay Science Symposium.

U.S. National Marine Fisheries Service (NMFS)

1991 "Recovery Plan for the Humpback Whale (*Megaptera novaeangliae*)." Prepared by the Humpback Whale Recovery Team for the National Marine Fisheries Service, Silver Spring, MD.

1992 "Recovery Plan for the Steller Sea Lion (*Eumetopias jubatus*)." Prepared by the Steller Sea Lion Recovery Team for the National Marine Fisheries Service, Silver Spring, MD.

1993 "National Marine Fisheries Service Biological Opinion Issued 02-19-93 Under Section 7 Consultation of the Endangered Species Act, Considering Activities Under the Proposed Vessel Management Plan for Glacier Bay National Park and Preserve (1993 Humpback Whale Biological Opinion)."

1995 "Small Takes of Marine Mammals Incidental to Specified Activities: Offshore Seismic Activities in Southern California." Federal Register Volume 60, 17 October 1995, pages 53753-53760.

1996 "Fishery Management Plan for the Scallop Fishery Off Alaska." Juneau, AK: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

2000a "Final 2000 Pacific Stock Assessment Report." Silver Spring, MD: National Marine Fisheries Service.

2000b "Taking Marine Mammals Incidental to Construction and Operation of Offshore Oil and Gas Facilities in the Beaufort Sea, Final rule." Federal Register 65(102, 25 May): 34014-34032.

U.S. National Marine Fisheries Service (NMFS)

2000c "Small Takes of Marine Mammals Incidental to Specified Activities: Marine Seismic-Reflection Data Collection in Southern California. Notice of Receipt of Application." Federal Register Volume 65, 28 March 2000, pages 16374-16379.

2001a "Humpback Whale (*Megaptera novaeangliae*): Central North Pacific Stock."

2001b "Final 2001 Pacific Stock Assessment Report. Silver Spring, MD: National Marine Fisheries Service."

2001c "Small Takes of Marine Mammals Incidental to Specific Activities: Oil and Gas Exploration Drilling Activities in the Beaufort Sea. Notice of Issuance of an Incidental Harassment Authorization." Federal Register, Volume 66, Number 26, 7 February 2001: 9291-9298.

2002 "Alaska Marine Mammal Viewing Guidelines." Available on the Internet @ http://www.fakr.noaa.gov/protectedresources/mmviewingguide.html.

2003 Essential Fish Habitat (EFH) Habitat Conservation Division website. Available on the Internet @ http://www.fakr.noaa.gov/habitat/efh.htm. Juneau, AK: National Marine Fisheries Office, Alaska Regional Office.

UK Marine

2002 "UK Marine Special Areas of Conservation: The Potential Effects of Engine Emissions from Water-Based Recreation." Available on the Internet @ http://www.ukmarinesac.org.uk/activities/recreation/r03_01.htm.

Urick, R.J.

1983 *Principles of Underwater Sound*. 3rd Edition. New York: McGraw Hill.

van Vliet, G.

1993 "Status Concerns for the 'Global' Population of Kittlitz's Murrelet: Is the 'Glacier Murrelet' Receding?" *Pacific Seabird Group Bulletin* 20:15–16.

Vancouver Sun

2002 "Second Cruise Line Cancels Trips: Vancouver to Lose 28 Ship Visits." Alan Daniels. *Vancouver Sun*, December 31, 2002.

Vequist, G.

1989 "Frequency of Visible Cruise Ship Emissions in Glacier Bay, NPS Report 11." National Park Service.

1993 "Air Pollution from Cruise Ships in Glacier Bay National Park: An Analysis of Stack Emissions." National Park Service.

Vequist,G.W., and C.S. Baker

1987 "Humpback Whales in Glacier Bay, Alaska: A Long-Term History of Habitat Use." Gustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

Vitousek, P.M., J.D. Aber, C.L. Goodale, and G.H. Aplet
2000 *Global Change and Wilderness Science. Wilderness Science in a Time of Change Conference, Missoula, MT, 2000. Volume 1: Changing Perspectives and Future Directions.* Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Walker, W.A.
1996 "Summer Feeding Habits of Dall's Porpoise, *Phocoenoides dalli*, in the Southern Sea of Okhotsk." *Marine Mammal Science* 12(2):167-181.

Ward, D.H., R.A. Stehn, and D.V. Derksen
1994 "Response of Staging Brant to Disturbance at the Izembek Lagoon, Alaska." *Wildlife Society Bulletin* 22:220–228.

Ward, D.H., R.A. Stehn, W.P. Erickson, and D.V. Derksen
1999 "Response of Fall-Staging Brant and Canada Geese to Aircraft Overflights in Southwestern Alaska." *Journal of Wildlife Management* 63: 373-381.

Water Quality Standards
1997 Alaska Administrative Code Title 18 Chapter 70. Effective November 1, 1997, and distributed in Register 143.

Watkins, W.A.
1980 "Click Sounds From Animals at Sea." In: *Animal Sonar Systems*, edited by R.G. Busnel and J.F. Fish. New York: Plenum.

1981 "Activities and Underwater Sounds of Fin Whales." *Scientific Report of the Whales Research Institute* 33: 83-117.

1986 "Whale Reactions to Human Activities in Cape Cod Waters." *Marine Mammal Science* 2(4): 251-262.

Watson, J.W.
1993 "Responses of Nesting Bald Eagles to Helicopter Surveys." *Wildlife Society Bulletin* 21: 171-178.

Weinstein, J.
2002 "Reed Business Information." London: World Travel and Tourism Council.

Welty, J.C.
1975 *The Life of Birds*. Second edition. Philadelphia, PA: W. B. Saunders Company.

Wenz, G.M.
1962 "Acoustic Ambient Noise in the Ocean: Spectra and Sources." *Journal of the Acoustic Society of America* 34(12): 1936-1956.

Wiens, J.A.
1995 "Recovery of Seabirds Following the Exxon Valdez Oil Spill: An Overview." In *Exxon Valdez Oil Spill: Fate and Effects in Alaskan Waters*, edited by G. Wells, J.N. Butler, and J.S. Hughes, 854–893. Philadelphia, PA: American Society for Testing and Materials.

Wiens, J.A., T.O. Crist, R.H. Day, S.M. Murphy, and G.D. Hayward
1996 "Effects of the Exxon Valdez Oil Spill on Marine Bird Communities in Prince William Sound, Alaska." *Ecological Applications* 6:828–841.

Wik, O.
1967 "Birds of Glacier Bay National Monument." Updated by G. Streveler in 1968. Gustavus, AK: Glacier Bay National Monument.

Wildeness Act of 1964
1964 Public Law 88-577, 78 Statute 890, 16 U.S. Code 1 1 21 (note), 1 1 31-1136. September 3, 1964.

Wilderness Information Network
2002 "National Wilderness Preservation System" University of Montana, School of Forestry, Wilderness Institute. Available on the Internet @ http://nwps.wilderness.net/advsearch.cfm.

Wing,B.L., and K. Krieger
1983 "Humpback Whale Prey Studies in Southeastern Alaska, Summer 1982". Juneau, AK: U.S. National Marine Fisheries Service, Auke Bay Laboratory.

Würsig, B., and M. Würsig
1980 "Behavior and Ecology of the Dusky Dolphin, *Lagenorhynchus obscurus*, in the South Atlantic." *Fishery Bulletin* 77(4): 871-890.

Yalden, D.W.
1992 "The Influence of Recreational Disturbance on Common Sandpipers *Actitis hypoleucos* Breeding by an Upland Reservoir in England." *Biological Conservation* 61:41–49.

Yalden, P.E., and D.W. Yalden
1990 "Recreational Disturbance of Breeding Golden Plovers *Pluvialis apricarius*." *Biological Conservation* 51:243–262.

Yan, H.Y and A.R. Scholik
In Press "Effects of Noise on the Auditory Sensitivity of the Bluegill Sunfish, *Lepomis macrochirus*." *Comparative Biochemistry and Physiology*, Part A.

York, A.E., R.L. Merrick, and T.R. Loughlin
1996 "An Analysis of the Steller Sea Lion Metapopulation in Alaska." Chapter 12. In *Metapopulations and Wildlife Conservation,* D.R. McCullogh, 259-292. Covelo, CA: Island Press,

Young, C.
1999 "Glacier Bay National Park and Preserve Marine Vessel Emissions Program." Prepared in 1997, Signed by Park Superintendent in 1999. Gustavus, AK: National Park Service, Glacier Bay Park and Preserve, Park Ranger Office.

2000 "Visible Emissions Report." Gustavus, AK: National Park Service, Glacier Bay Park and Preserve, Park Ranger Office.

Young, C.
2002 “Visible Emissions Report.” Gustavus, AK: National Park Service, Glacier Bay Park and Preserve, Park Ranger Office.

Zador, S.G., and J.F. Piatt
1999 “Populations and Productivity of Seabirds at South Marble Island, Glacier Bay, Alaska, During May–July 1999.” Anchorage, AK: U.S.Geological Survey, Biological Resources Division, and Seattle, WA: University of Washington.

6.2 MAP CITATIONS

Figure 1-1: Location Map for Glacier Bay National Park and Preserve

Alaska Department of Natural Resources, Land Records Information Section

1994 Alaska Coastline: alaska.e00. Anchorage, AK: Alaska Department of Natural Resources.

Alaska Department of Natural Resources, Land Records Information Section

1994 Canadian Coastline: canada.e00. Anchorage, AK: Alaska Department of Natural Resources.

National Park Service

2002 Boundary.shp (20020422). Gustavus, AK: National Park Service, Glacier Bay National Park.

Figure 1-2: Planning Area of the Vessel Quota and Operating Requirements Environmental Impact Statement

Geiselman, J., J. Dunlap, P. Hooge, and D. Albert, eds.

1997 Landpoly.e00. In: *Glacier Bay Ecosystem GIS CD-ROM Set*. Anchorage and Juneau, AK: U.S. Geological Survey and Interrain Pacific.

National Park Service.

2002 Boundary.shp (20020422). Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service.

2002 LandWater.shp (20020422) Gustavus, AK: National Park Service, Glacier Bay National Park.

Figure 2-1: Vessel Restrictions and Operating Requirements under Alternatives 1, 2, and 3

Geiselman, J., J. Dunlap, P. Hooge, and D. Albert, eds.

1997 Landpoly.e00 In: *Glacier Bay Ecosystem GIS CD-ROM Set*. Anchorage and Juneau, AK: U.S. Geological Survey and Interrain Pacific.

National Park Service

2002 Boundary.shp (20020422). Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service

2002 ClosedWaters.shp (20020422). Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service

2002 LandWater.shp (20020422) Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service

2002 NoiseRestrictions.shp (20020422). Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 NonMotorized.shp (20020422). Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 SpeedRestrictions.shp (20020422). Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 WhaleWaters.shp (20020422). Gustavus, AK: National Park Service, Glacier Bay National Park.

Figure 2-2: Changes from Existing Conditions in Vessel Operating Requirements under Alternatives 4

Geiselman, J., J. Dunlap, P. Hooge, and D. Albert, eds.
1997 Landpoly.e00 In: *Glacier Bay Ecosystem GIS CD-ROM Set*. Anchorage and Juneau, AK: U.S. Geological Survey and Interrain Pacific.

National Park Service
2002 Boundary.shp (20020422). Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 LandWater.shp (20020422) Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 WhaleWaters.shp (20020422). Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 Wilderness.shp (20020422). Gustavus, AK: National Park Service, Glacier Bay National Park.

Figure 2-3: Changes from Existing Conditions in Vessel Operating Requirements under Alternatives 5

Geiselman, J., J. Dunlap, P. Hooge, and D. Albert, eds.
1997 Landpoly.e00 In: *Glacier Bay Ecosystem GIS CD-ROM Set*. Anchorage and Juneau, AK: U.S. Geological Survey and Interrain Pacific.

National Park Service
2002 Boundary.shp (20020422). Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 LandWater.shp (20020422) Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 WhaleWaters.shp (20020422*)*. Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 Wilderness.shp (20020422). Gustavus, AK: National Park Service, Glacier Bay National Park.

Figure 3-1: Bathymetry of Glacier Bay Proper

Hooge, P.N. and E.R. Hooge
2002 *Fjord Oceanographic Processes in Glacier Bay, Alaska.* Gustavus, AK: U.S. Geological Survey, Alaska Science Center, Glacier Bay Field Station.

Figure 3-4: Distribution of Threatened and Endangered Species in Glacier Bay

Gabriele, C.
2003 Humpback whale sighting data: hbw2001.dbf and hbw2002.dbf. Gustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

Geiselman, J., J. Dunlap, P. Hooge, and D. Albert, eds.
1997 Landpoly.e00 In: *Glacier Bay Ecosystem GIS CD-ROM Set*. Anchorage and Juneau, AK: U.S. Geological Survey and Interrain Pacific.

National Park Service
2002 Boundary.shp (20020422). Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 Glacier Bay Predator Survey Data, 2002-06-11: predators.shp (20020612). Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 LandWater.shp (20020422) Gustavus, AK: National Park Service, Glacier Bay National Park.

Research Planning, Inc.
2002 Marine Mammal Points: m_mampt.shp. SE Alaska ESI

Research Planning, Inc.
2002 Marine Mammal Polygons: m_mammal.shp. SE Alaska ESI

Figure 3-5: Distribution of Marine Mammals in Glacier Bay

Geiselman, J., J. Dunlap, P. Hooge, and D. Albert, eds.
1997 Landpoly.e00 In: *Glacier Bay Ecosystem GIS CD-ROM Set*. Anchorage and Juneau, AK: U.S. Geological Survey and Interrain Pacific.

National Park Service
2002 Boundary.shp (20020422). Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 Glacier Bay Predator Survey Data, 2002-06-11: predators.shp (20020612). Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 LandWater.shp (20020422) Gustavus, AK: National Park Service, Glacier Bay National Park.

Figure 3-6: Seabird Colonies

Geiselman, J., J. Dunlap, P. Hooge, and D. Albert, eds.
1997 Landpoly.e00 In: *Glacier Bay Ecosystem GIS CD-ROM Set*. Anchorage and Juneau, AK: U.S. Geological Survey and Interrain Pacific.

National Park Service
2002 Boundary.shp (20020422). Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 LandWater.shp (20020422) Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 Glacier Bay Seabird Roosts and Nesting Areas: seabirds.shp (20020529). Gustavus, AK: National Park Service, Glacier Bay National Park.

Figure 3-7: Concentrations of Marbled and Kittlitz's Murrelets

Geiselman, J., J. Dunlap, P. Hooge, and D. Albert, eds.
1997 Landpoly.e00. In: *Glacier Bay Ecosystem GIS CD-ROM Set*. Anchorage and Juneau, AK: U.S. Geological Survey and Interrain Pacific.

National Park Service
2002 Boundary.shp (20020422). Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 LandWater.shp (20020422) Gustavus, AK: National Park Service, Glacier Bay National Park.

U.S. Geological Survey
2002 *Seabird and Forage Fish Study Sites in Glacier Bay*—computer database. U.S. Geological Survey, Anchorage, AK. Available on Internet under "HTML Slide Show" @
http://www.absc.usgs.gov/research/seabird&foragefish/maps/index.html

Figure 3-8: Bald Eagle Nest Locations

Geiselman, J., J. Dunlap, P. Hooge, and D. Albert, eds.
1997 Landpoly.e00. In: *Glacier Bay Ecosystem GIS CD-ROM Set*. Anchorage and Juneau, AK: U.S. Geological Survey and Interrain Pacific.

National Park Service
2002 Boundary.shp (20020422*)*. Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 LandWater.shp (20020422) Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 Glacier Bay Bald Eagle Nests: Eagle_Nests.shp (2002-06-06). Gustavus, AK: National Park Service, Glacier Bay National Park.

Figure 3-9: Concentrations of Summering Waterfowl

Geiselman, J., J. Dunlap, P. Hooge, and D. Albert, eds.
1997 Landpoly.e00. In: *Glacier Bay Ecosystem GIS CD-ROM Set*. Anchorage and Juneau, AK: U.S. Geological Survey and Interrain Pacific.

National Park Service
2002 Boundary.shp (20020422*)*. Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 LandWater.shp (20020422) Gustavus, AK: National Park Service, Glacier Bay National Park.

U.S. Geological Survey
2002 *Seabird and Forage Fish Study Sites in Glacier Bay*—computer database. U.S. Geological Survey, Anchorage, AK. Available on Internet under "HTML Slide Show" @ http://www.absc.usgs.gov/research/seabird&foragefish/maps/index.html

Figure 3-10: Essential Fish Habitat

Geiselman, J., J. Dunlap, P. Hooge, and D. Albert, eds.
1997 Landpoly.e00. In: *Glacier Bay Ecosystem GIS CD-ROM Set*. Anchorage and Juneau, AK: U.S. Geological Survey and Interrain Pacific.

National Park Service
2002 Boundary.shp (20020422*)*. Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 LandWater.shp (20020422) Gustavus, AK: National Park Service, Glacier Bay National Park.

U.S. National Marine Fisheries Service (NMFS)
2003 Essential Fish Habitat (EFH) Habitat Conservation Division, Essential Fish Habitat Shapefiles website. Available on the Internet @ http://www.fakr.noaa.gov/efh/download/efhshp.htm. Juneau, AK: National Marine Fisheries Office, Alaska Regional Office

Figure 3-11: Shoreline Characteristics at 22 Selected Sites in Glacier Bay

Geiselman, J., J. Dunlap, P. Hooge, and D. Albert, eds.
1997 Landpoly.e00. In: *Glacier Bay Ecosystem GIS CD-ROM Set*. Anchorage and Juneau, AK: U.S. Geological Survey and Interrain Pacific.

National Park Service
2002 LandWater.shp (20020422) Gustavus, AK: National Park Service, Glacier Bay National Park.

Sharman, L., B. Eichenlaub, D. VanLeeuwen, S. Croll, J.S.Grover, G. Lenhart and P. Hooge
2002 "Alaska Coastal Resources Inventory and Mapping Field Protocol - The Polygon Method: CoastWalkers-Access2000.mdb." Gustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

Figure 3-16: AHRS Sites in Glacier Bay and Dundas Bay

Alaska Department of Natural Resources, Division of Parks and Outdoor Recreation, Office of History and Archaeology
2002 *Alaska Heritage Resource Survey*. Anchorage, AK: Alaska Department of Natural Resources.

Figure 3-17: Map of 15 Preliminary Huna Tlingit Traditional Cultural Properties

Geiselman, J., J. Dunlap, P. Hooge, and D. Albert, eds.
1997 Landpoly.e00. In: *Glacier Bay Ecosystem GIS CD-ROM Set*. Anchorage and Juneau, AK: U.S. Geological Survey and Interrain Pacific.

National Park Service
2002 LandWater.shp (20020422) Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 Traditional Cultural Property at Glacier Bay National Park, tcp-2002-09-19.shp. Gustavus, AK: National Park Service, Glacier Bay National Park.

Figure 3-21: Backcountry Use Locations

Geiselman, J., J. Dunlap, P. Hooge, and D. Albert, eds.
1997 Landpoly.e00. In: *Glacier Bay Ecosystem GIS CD-ROM Set*. Anchorage and Juneau, AK: U.S. Geological Survey and Interrain Pacific.

National Park Service
2002 Backcountry Survey Campsites: camps.shp (20020529). Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 Boundary.shp (20020422*)*. Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 Glacier Bay Kayaker Drop-offs and Pickups: dp020529.shp (20020529). Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 LandWater.shp (20020422) Gustavus, AK: National Park Service, Glacier Bay National Park.

Figure 3-22: Cruise Ship Routes in Glacier Bay

Geiselman, J., J. Dunlap, P. Hooge, and D. Albert, eds.
1997 Landpoly.e00. In: *Glacier Bay Ecosystem GIS CD-ROM Set*. Anchorage and Juneau, AK: U.S. Geological Survey and Interrain Pacific.

National Park Service
2002 Glacier Bay Cruise Ship and Tour Boat Routes: csroutes-2002-09-26.shp. Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 LandWater.shp (20020422) Gustavus, AK: National Park Service, Glacier Bay National Park.

Figure 3-23: Tour and Charter Routes and Vessel Anchorages

Geiselman, J., J. Dunlap, P. Hooge, and D. Albert, eds.
1997 Landpoly.e00. In: *Glacier Bay Ecosystem GIS CD-ROM Set*. Anchorage and Juneau, AK: U.S. Geological Survey and Interrain Pacific.

National Park Service
2002 Charter Boat Routes: Charter.shp (20020715). Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 Glacier Bay Cruise Ship and Tour Boat Routes: csroutes-2002-09-26.shp. Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 LandWater.shp (20020422) Gustavus, AK: National Park Service, Glacier Bay National Park.

Figure 3-24: Wilderness Land and Water

Geiselman, J., J. Dunlap, P. Hooge, and D. Albert, eds.
1997 Landpoly.e00. In: *Glacier Bay Ecosystem GIS CD-ROM Set*. Anchorage and Juneau, AK: U.S. Geological Survey and Interrain Pacific.

National Park Service
2002 Boundary.shp (20020422). Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 LandWater.shp (20020422) Gustavus, AK: National Park Service, Glacier Bay National Park.

National Park Service
2002 Wilderness.shp (20020422). Gustavus, AK: National Park Service, Glacier Bay National Park.

6.3 Glossary

°C – degrees Celsius
°F – degrees Fahrenheit
μPa – micropascal
AAC – Alaska Administrative Code
ABSC – Alaska Biological Science Center
ACHP – Advisory Council on Historic Preservation
AD – Anno Domini
ADCED – Alaska Department of Community and Economic Development
ADEC – Alaska Department of Environmental Conservation
ADFG – Alaska Department of Fish and Game
ADLWD – Alaska Department of Labor and Workforce Development
ADNR – Alaska Department of Natural Resources
ACFEC – Commercial Fisheries Entry Commission
AHRS – Alaska Heritage Resource Survey
AIRFA – American Indian Religious Freedom Act
ANCSA – Alaska Native Claims Settlement Act
ANILCA – Alaska National Interest Lands Conservation Act (1980)
AOU – American Ornithologist's Union
APE – area of potential effect
AQI – Air Quality Index
AQRV – Air Quality Related Values
ARPA – Archaeological Resources Protection Act
ATIA – Alaska Travel Industry Association
AVHRR – Advanced Very High Resolution Radiometry
BMP – best management practice
bpd –barrels per day
CAA – Clean Air Act
CEQ – Council on Environmental Quality
CFR – Code of Federal Regulations
CLAA – Cruise Line Agency of Alaska
CLI – Cultural Landscapes Inventory
CLIA – Cruise Lines International Association
CO – carbon monoxide
CO_2 – carbon dioxide
COLREG – International Regulations for Preventing Collisions at Sea
COW – California/Oregon/Washington (stock)
CPVEC – Commercial Passenger Vessel Environmental Compliance (Program)
CR – critical ratios
Ct. Cl –Court Civil Law
CWA – Clean Water Act; i.e., Federal Water Pollution Control Act
CZMA – Coastal Zone Management Act
dB – decibel
dB re 1 μPa – decibels relative to 1 micropascal
DEIS – draft environmental impact statement
Department of Environmental Conservation, the – Alaska Department of Environmental Conservation
Department of Fish and Game, the – Alaska Department of Fish and Game
Department of Interior, the – U.S. Department of Interior
DOJ – U.S. Department of Justice
DOT – U.S. Department of Transportation
double thermocline – four layers of water
Dundas Bay – all contiguous marine waters with Dundas Bay lying north of an imaginary line between Point Dundas and Point Wimbledon
e.g. – *exempli gratia,* for example
EA – environmental assessment
EEZ – Exclusive Economic Zone
EFH – essential fish habitat
EIS – environmental impact statement
ENP – eastern north Pacific (stock)
Environmental Protection Agency, the – U.S. Environmental Protection Agency
EPA – U.S. Environmental Protection Agency
et seq. – *et sequentes*, and the following
Executive Order 12898 –Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations
FEIS – final environmental impact statement
Fish and Wildlife Service, the – U.S. Fish and Wildlife Service
Fisheries Service, the – National Marine Fisheries Service
FMP – fishery management plan

FONSI – finding of no significant impact
GAO – General Accounting Office
GBNPP – Glacier Bay National Park and Preserve
GIS – geographic information system
Glacier Bay – Glacier Bay proper; all marine waters contiguous with Glacier Bay lying north of an imaginary line between Point Gustavus and Point Carolus
GPS – Global Positioning System
GT – gross tons
HAL – Holland America Line
HAZWOPER – Hazardous Waste Operations and Emergency Response
HC – hydrocarbons
HIA – Hoonah Indian Association
HSR – historic structural resources
Hz – hertz
i.e. – *id est,* that is
IBP – incidental business permits (which is correct)
ICCL – International Council of Cruise Lines
IFO – intermediate fuel oil
isostatic rebound – the rising of land after the removal of glacial weight as the glacier retreats
IWC – International Whaling Commission
JCVB – Juneau Convention and Visitors Bureau
kHz – kilohertz
kWh – kilowatt-hour
lbs/day – pounds per day
LCS – List of Classified Structures
L_s – ? (see table 3-1b – needs key)
Magnuson-Stevens Act – Magnuson-Stevens Fishery Conservation and Management Act
MARPOL – The International Convention for the Prevention of Pollution from Ships
mixed semidiurnal tidal cycle – two high and two low tides per day of unequal heights
MLLW – mean lower low water
MMPA – Marine Mammal Protection Act of 1972
MSD – marine sanitation devices
NA – Not applicable
NAAQS – National Ambient Air Quality Standards
NAGPRA – Native American Graves Protection and Repatriation Act
NCHPO – National Conference of Historic Preservation Officers
n.d. – no date
NEPA – National Environmental Policy Act of 1969
NESHAPS – National Emission Standards for Hazardous Air Pollutants
NHPA – National Historic Preservation Act
NiCad – nickel-cadmium
NMFS – National Marine Fisheries Service (not NOAA Fisheries)
NO_2 – nitrogen dioxide
NOI – notice of intent
NOAA Fisheries– National Oceanic and Atmospheric Administration Fisheries (formerly NMFS)
NOV – notice of violation
NO_X – nitrogen oxides
NPS – National Park Service
NSWC – Naval Surface Warfare Center
NWPS – National Wilderness Preservation System
O_3 – ozone
OCS – Outer Continental Shelf
OPA – Oil Pollution Act (1990)
Organic Act – National Park Service Act of 1916
OSRO – oil spill removal organization
P.L. – public law
Park Service, the – National Park Service
park, the – Glacier Bay National Park
Pb – lead
PERC – perchloroethylene
PL – Public Law
planning area, the – the two areas of Glacier Bay and Dundas Bay evaluated in this environmental impact statement
PM – particulate matter
PM_{10} – particulate matter of 10 microns or less
$PM_{2.5}$ – particulate matter of 2.5 microns or less
PND – Peratrovich, Nottingham, and Drage, Inc.
PSD – Prevention of Significant Deterioration
PTS – permanent threshold shift
RAC – response action contractor
RCRA – Resource Conservation and Recovery Act
rms – root mean squared. The integration of the noise pulse divided by the duration of the pulse. The duration of the pulse can be an arbitrary value; therefore, rms refers to

the fact that most acousticians now determine the duration of the pulse by the amount of time in which 90 % of the energy of the pulse is received.

ROD – record of decision

SAIP – System-Wide Archaeological Inventory Program

SEAPRO – Southeast Alaska Petroleum Resource Organization

Service, the – National Park Service

SHPO – state historic preservation officer

sill – a shoal of underwater glacial deposit

SO_2 – sulfur dioxide

SOA – *Spirit of Adventure*

SOPEP – Shipboard Oil Pollution Emergency Plan

SPCC – spill prevention control and countermeasures

Stat. – statute

STCW – International Convention on Standards of Training, Certification and Watchkeeping

TCP – traditional cultural properties

thermocline – stratification

TL – transmission loss

TPY – tons per year

TTS – temporary threshold shift

USC – United States Code

USCG – U.S. Coast Guard

USDI – U.S. Department of Interior

USFS – U.S. Forest Service

USFWS – U.S. Fish and Wildlife Service

USGS – U.S. Geological Survey

W/m^2 – watts per square meter

WTTC – World Travel and Tourism Council

6.4 Index

The National Park Service cares for special places
saved by the American people
so that all may experience our heritage.

EXPERIENCE YOUR AMERICA.

October 2003

UNITED STATES DEPARTMENT OF THE INTERIOR • NATIONAL PARK SERVICE