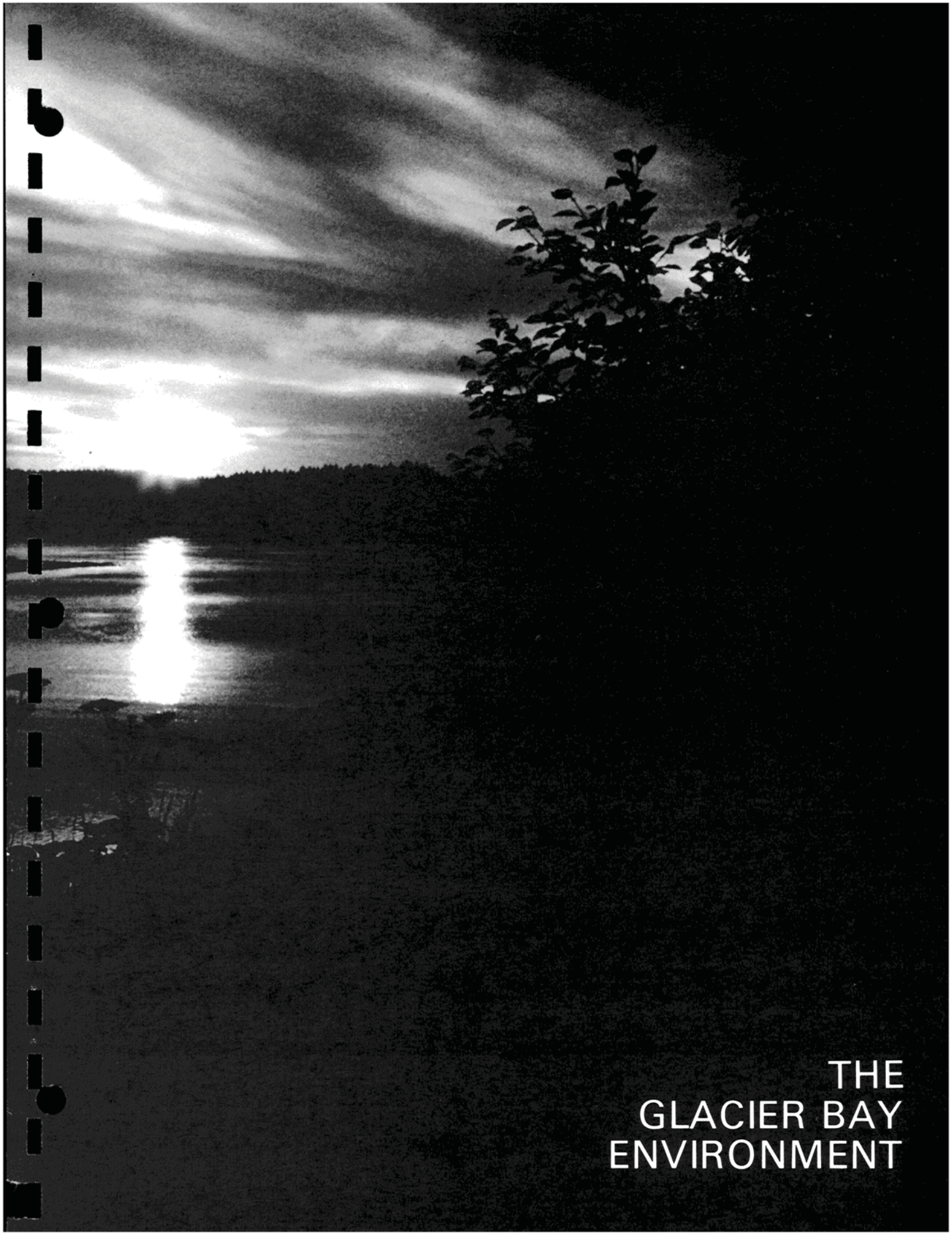

THE GLACIER BAY ENVIRONMENT

NATURAL ENVIRONMENT

CLIMATE

Glacier Bay National Park and Preserve has essentially three climatic zones: the outer coast along the Gulf of Alaska; upper Glacier Bay, north of a line drawn east-west through Tidal Inlet; and lower Glacier Bay, including the park waters of Cross Sound and Icy Strait. The outer coast has milder temperatures and more precipitation but less snowfall than the other areas, owing to the influence of the Japanese Current. Upper Glacier Bay is considerably colder than Bartlett Cove (a 20° F difference between the Bartlett Cove area and Muir Inlet has been recorded in August); the upper bay is also subject to the heaviest snowfall.

Daylight hours vary greatly at this latitude. On the longest day of the year, the sun rises at about 3:51 a.m. and sets at 10:09 p.m. On the shortest day, the sun rises at 9:45 a.m. and sets at 4:06 p.m. Prevailing cloudy weather appreciably shortens the usable daylight hours throughout the year.

Bartlett Cove is an indentation of Glacier Bay and is protected on the north by the Beardslee Islands. In the summer, temperatures average 50° to 60° F. Cloudiness and precipitation tend to be the rule during any month, and some form of precipitation occurs on an average of 228 days per year. Annual precipitation is 70 to 80 inches, including an annual snowfall of 14 feet, which accumulates to depths of 6 feet and persists for several months during severe winters. Winter temperatures average 20° to 30° F, with extremes of -10° F. Sun angles vary from a maximum of 55° on the longest day to 9° on the shortest day.

Fogs are common on the gulf coast and along the south end of Glacier Bay, where they can impede navigation. The prevailing winds are southerly and occur during most periods of precipitation. Northerly winds are usually associated with clear weather and are the strongest in winter, frequently reaching gale force.

WATER QUALITY

The waters of Glacier Bay are affected by seasonal variations. In winter minimal ice melt occurs, and freshwater and sediment input to the marine system are at their lowest level, creating a relatively homogeneous condition with ample bottom water mixing from Icy Strait (NPS 1979b). During warmer periods, a heterogeneous condition occurs, with fresh or brackish water overlying warmer salt water. Sediment input is high at these times, especially in the upper ends of the bay and tributary inlets.

Sampling in Glacier Bay for inorganic nutrients as well as for water clarity has been irregular. Inorganic nutrients are generally most concentrated in the winter months and decline to low levels during spring and summer because of phytoplankton blooms (NPS 1979b). Data on water clarity were not analyzed, and no data were referenced on water pollution.

Two potential sources of water pollution in Glacier Bay include vessels and existing NPS developments at Bartlett Cove. U.S. Coast Guard regulations stipulate that vessels are prohibited from discharging raw sewage into coastal waters (33 CFR 159). The ecological significance of this source has been discounted (NPS 1979b).

Wastewater disposal for NPS facilities at Bartlett Cove is from a secondary sewage treatment plant, which reduces biochemical demand and suspended solids by about 90 percent. Effluent is chlorinated and discharged into the ocean; sludge is disposed of in a landfill. Average discharge is about 10,000 gallons per day and is considered insignificant in its effect on local water quality because of tidal action and dilution ratios. All present and future systems will comply with state rules and regulations.

The National Park Service recognizes the potential for fuel and oil spills in the area. The sensitive nature of the resources in the park and preserve and the difficulty of containing spills on the water make oil and fuel spills of special concern. To minimize damage to the resources in and around the park, the Park Service will continue to work with the U.S. Coast Guard and state agencies to develop contingency plans for responding to spills.

AIR QUALITY

The Clean Air Act, section 162(b), designates Glacier Bay as a class II air quality area. This authorizes the prevention of significant air quality deterioration and gives special responsibilities to managers of class II air quality areas to do this.

Empirical air quality data for Glacier Bay is not currently available. However, a comparative analysis of climatological conditions concluded that Glacier Bay has a very low tolerance for air pollution because of frequent temperature inversions and minimal mixing of air layers (Benson et al. 1978).

The Alaska Department of Environmental Conservation maintains standards applicable to class II areas (18 AAC 50) and to marine vessels. Within 3 miles of the coastline visible stack emissions may not reduce visibility to 40 percent for longer than three minutes in any one hour, except during initial startup when the limitation is extended to six minutes.

GEOLOGY

Geologic Setting

Bedrock geology of the Glacier Bay area is complex because it is composed of slices of terrain moved hundreds of kilometers from the south along three major, northwest-trending, lateral faults: the Chatham Strait fault, the Border Ranges fault, and Fairweather-Queen Charlotte fault.

Widespread folds, metamorphism, and intrusions have complicated the stratigraphic record. Groupings of similar lithographic and structural pictures have differentiated five geologic provinces. These include the Coastal, Fairweather, Geikie, Muir, and Chilkat provinces (Geological Survey 1971). The highest range in the park is the Fairweather Range, with Mount Fairweather the highest peak at 15,300 feet. The region's northwesterly structural grain has been generated by the northwest-trending faults and fold axes. The bedrock ranges in age from at least early Paleozoic to middle or late Pleistocene, with ample evidence of volcanic activity, intrusive rock formations, and faulting.

Although no evidence of recent volcanic activity has been found, major movement occurred along the Fairweather fault during the July 10, 1958, earthquake. This quake (Richter magnitude 7.9) caused moderate property damage in Yakutat (130 miles to the northwest) and was reportedly felt as far as Seattle, Washington (Streveler et al. 1980). It was also supposedly the largest fault displacement on land in the United States since the April 18, 1906, California earthquake. The quake resulted in five deaths, and it caused 30 million cubic meters of rock to plunge into Lituya Bay, generating a surge of water that rose 1,690 feet on the opposite wall of the inlet.

Glacial History

The park and preserve area reflect a history of valleys filled with ice that has alternately retreated and advanced in response to climatic fluctuations. The earliest observations by La Perouse (1786) and Vancouver (1794) recorded the presence of glaciers at the mouth of Glacier Bay (cited in Bohn 1967). Subsequent observations by John Muir in 1879 recorded a retreat 32 miles up bay to a point at the mouth of Muir Inlet. In the following 90 years the ice has retreated another 24 miles. Current observations indicate that some glaciers within the Fairweather Range are advancing while those in the Chilkat Range are retreating.

Within the park there are currently 16 tidewater glaciers, that is, glaciers with termini washed by tidewater. Calving (ice fall) is frequent, and considerable amounts of ice often plunge into the sea. The Brady Glacier is the largest within the park, being an estimated 188 square miles in size. Most glaciers originate between elevations from 8,000 to 15,000 feet (see Significant Resources map).

Mineral Resources

A geologic reconnaissance of the former monument was published in 1978 by the U.S. Geological Survey at the request of the National Park Service. The work included reconnaissance-type geologic mapping and geochemical studies of metal distribution and concentrations to determine gross appraisal of mineral potential. Field studies did not cover a large part of the Fairweather Range, the area west of it, nor a small area northeast of Tarr Inlet. The Geological Survey report states,

> Glacier Bay National Monument contains a few mineral deposits that are likely to be minable in the near future, but which are well enough known to be evaluated; some that probably would be minable with economic or technologic changes; and many that are insignificant. The economic potential for petroleum, coal, and nonmetallic commodities in the Monument is low.

A layered gabbro complex extending over a 100-square-mile area near the park's southwest margin is known to contain at least one significant concentration of copper-nickel sulphides--the Brady Glacier mineral deposit. Some minor concentrations of minerals have been discovered and mined along coastal beaches. Of primary interest are concentrations of ilmenite, magnetite, gold, and platinum. Placer mining occurred primarily southeast of Lituya Bay between 1894 and 1917 (Streveler et al. 1980). At present a small-scale gold recovery operation is located at Ptarmigan Creek (LeRoy No. 1).

MAJOR TERRESTRIAL ECOSYSTEMS

The Glacier Bay environment is undergoing rapid change. As recently as 200 years ago the entire bay was filled with a glacier that terminated in Icy Strait. At that time few plant and animal species inhabited the area. As the ice retreated, pioneer plants and animals proliferated, eventually being replaced by seral and climax communities. This process is continuing in the wake of glaciation, with accompanying rapid changes in species distributions, population characteristics, and trophic relationships.

Of the 16 major land and marine ecosystems identified by the Joint Federal/State Land Use Planning Commission for Alaska, four land ecosystems are found in and around the park and preserve: wet tundra, coastal western hemlock/Sitka spruce forest, alpine tundra, and glaciers and icefields. (The following descriptions are primarily derived from unpublished NPS documents on file at the park.)

Wet Tundra

This ecosystem is located in one area of the park near Gustavus, where little topographical relief exists. Standing water is present in some locations during the summer, and a high water table exists in many areas. Dominant ground cover species include sedges and cottongrass, which usually form a mat. A few woody and herbaceous plants consisting of lodgepole pine, shrubby willow, and Sitka alder occur on the drier sites above the water table.

The soils supporting wet tundra are composed of thin organic soils overlying silty and sandy sediments. The sediments are underlain by water-laid gravels, sands, clays, and silts from outwash and marine sources.

Mammals inhabiting this ecosystem include bear, wolf, coyote, moose, and river otter. Birds include ravens and a variety of songbirds, waterfowl, and raptors. Large numbers of sandhill cranes stop in open marshes during migration.

Coastal Western Hemlock/Sitka Spruce Forest

This ecosystem occurs along the park's western and southern periphery and is dominated by mature western hemlock and Sitka spruce. The recently deglaciated shore of Glacier Bay as far north as Adams Inlet is primarily Sitka spruce forest less than 150 years old. Black cottonwood and Sitka alder are common along the streams, rivers, and beach fringes. Sitka spruce occurs more frequently than hemlock where there has been soil disturbance and an opening of the canopy. Throughout the system, the forest understory is composed of a thick moss layer, blueberry, Sitka alder, devil's club, skunk cabbage, and ferns.

Common mammals of this ecosystem include black bear, wolf, coyote, porcupine, marten, and red squirrel. Birds include the blue grouse, raven, hermit thrush, chickadee, fox sparrow, and bald eagle.

Soils of lower slopes are typically shallow, gravelly, and well drained. Poorly drained mucky peat soils occupy higher slopes and depressions interspersed throughout the timbered areas. The muskeg ecosystem of shrubs, sedges, and mosses is common in poorly drained lowland areas. These soils support lodgepole pine and some mountain hemlock. Decomposition of dead vegetation by soil organisms is inhibited by cool soils, resulting in more annual production than decomposition and favoring the accumulation of peat.

The park's major developed area, Bartlett Cove, is located in this ecosystem.

Alpine Tundra

The alpine tundra ecosystem is found on mountains in the park above treeline (approximately 2,500 feet in elevation). This system consists of barren rocks and rubble interspersed with woody herbaceous and shrubby plant communities. Plant mats consist of low heath shrubs, where snow lingers into late spring. Various alpine grasses are present as well as willows and dwarf blueberry. Vegetation regeneration is often extremely slow; some lichens may require over 60 years to recover after overuse or destruction.

Soils in this ecosystem are shallow, gravelly, silt loams over till, with intermittent deep permafrost.

Common mammals include black and brown bear, wolverine, mountain goat, marmot, and voles. Common birds include ptarmigan, ravens, water pipits, and juncos.

Glaciers and Icefields

This system is characterized by mountainous areas with heavy precipitation where accumulation of one season's snowfall is not entirely melted before the next season's snow begins to accumulate. Characteristics of glacial runoff include high year-round average flows, distinct day-to-night differences in discharge, high silt content in streamwater, and occasional flooding. All these characteristics have pronounced effects on Alaskan streams. Some plant communities grow on glacial moraines. Algae and iceworm webs occur on glaciers.

Glaciers carve larger drainages from narrow valleys and deposit materials upon the land surface. Coarse rock materials loosened by moving ice are carried forward in the ice to the glacial front or are ground to smaller size by the moving ice masses. From early spring to late winter, meltwaters carry rock materials downstream to form terraces and outwash deposits. Surface materials at glacial fronts are deposited as moraines, which are invaded by lichen and moss species, horsetail, willow, fireweed, and Dryas. These early plants are then followed by alder, willow, soapberry, and cottonwood.

Glaciers provide important rest areas and relief from insects for mountain goats and other mammals during the warm summer months. In dry summers, glaciers provide sources of free-running water, which normally does not exist at high elevation. This area is infrequently used by birds such as snow buntings and rosy finches.

MAJOR MARINE ECOSYSTEMS

Three major marine ecosystems have been identified in and around the park and preserve: continental shelf, wave-beaten coasts, and fjord estuaries.

Continental Shelf

This ecosystem in Glacier Bay is the offshore zone up to a depth of 650 feet and extends from Cape Fairweather in the north to Cape Spencer in the south in the Gulf of Alaska. Marine productivity on the shelf may exceed 12,000 pounds of dry matter per acre per year. Shelf depths are shallow enough that abundant marine life occurs on the bottom. Detritus is consumed on the bottom by various animals or is recycled to simple nutrients by enzymatic and bacterial action.

Filter feeders such as clams and bryozoans as well as bottom dwellers such as crabs, sea urchins, starfish, and bottom fish occur in this ecosystem. Free-swimming animals include various invertebrates, fishes, seals, sea lions, and several species of whales. Many species of oceanic birds and shorebirds also occur.

The continental shelf ecosystem supports roughly 9 percent of the ocean's fisheries. Waters of the park and preserve in this system are used for fishing, and several bays, such as Lituya Bay and Graves Harbor, are used as shelter during storms. Waters in the ecosystem are extensively used by man for intracoastal travel, freighting, and some small-boat recreation. The continental shelf is sufficiently shallow to allow for mineral exploration and offshore drilling.

Wave-Beaten Coasts

Approximately 125 miles of the Gulf of Alaska coast is included within the park and preserve and consists of sandy and gravel beaches from Dry Bay to Icy Point and rocky coast from Icy Point to Cape Spencer. Estuaries--generally wide, short indentations along the coast and with depths of less than 300 feet--support larvae of many marine invertebrate species. Plant productivity is high, particularly from kelp and clinging intertidal seaweed. This system is in a delicate balance with a small number of species significantly affecting the trophic structure. There is a high incidence of clinging and intertidal animals such as snails, limpets, chitons, barnacles, and mussels.

Many estuaries are highly productive of various species of animals, so fishing is productive. Beaches are usually narrow, and wind is often severe.

Fjord Estuaries

Dundas Bay and Glacier Bay are included within fjord estuaries. This system is protected from direct pounding of sea waves. Clayey silt from turbid glacial outwash is deposited up to 2.4 meters thick annually. This rate is highest in the upper portions of inlets. Kelp and clinging intertidal seaweeds are common.

Fresh water entering the bay results in generally low surface salinities, especially in glacially influenced inlets during the summer. Outflow of fresh, cold surface water is offset by an influx of dense, warmer saline water. Vertical mixing within the water column during winter increases surface salinities. By June, high nutrient levels in the euphotic zone and longer days combine to trigger phytoplankton blooms, which appear to be most intense in the lower bay. Fish and wildlife in the Glacier Bay/Cross Sound area include harbor seals and porpoises, whales, sea otters, halibut, crabs, five species of salmon, shrimp, and a variety of seabirds.

ENDANGERED SPECIES

Endangered and threatened animal species are listed in the Federal Register (vol. 45, no. 99, May 1980). The endangered species of primary concern in Glacier Bay is the humpback whale (Megaptera novaeangliae). Humpback whales are migratory and use southeast Alaskan waters during the summer months to take advantage of concentrations of euphausiids, herring, and capelin. Winter months are spent in more southern areas such as Hawaii and Mexico, although some individuals overwinter in southeast Alaskan waters. Calving and breeding reportedly occur in the southern latitudes, with Alaskan waters used as a major feeding area. Glacier Bay has only been a prominent feeding area for whales since the glacial retreat. The retreat has allowed land and marine succession to advance to a point where ample prey species exist for the humpback whale.

Whale fluke photographs identified 122 individual humpback whales in southeast Alaska in 1981 and 167 in 1982. Recent population estimates for southeast Alaskan waters are 300. Records from 1967 to 1977 showed that 10-24 whales stayed in the Glacier Bay area for much of the summer to feed and rear calves. Then in 1978 most of the whales departed by mid July. In 1979 a few whales entered the bay but remained only a short time. Since then between three and seven individually identified whales have stayed for four weeks or longer.

The reason for the decreased use of Glacier Bay is not known. Possible causes have been attributed to increased vessel use, underwater noise levels, varying levels of preferred prey species, or other unknown factors. Research efforts were intensified in 1981 to evaluate potential factors affecting whale use of the bay. Areas of investigation within the bay and elsewhere include distribution and abundance of whale food and feeding behavior, acoustic characteristics of vessels and the bay, and comparative behavioral responses of whales to vessels. Research in this area is continuing through 1984, and monitoring activities will be conducted in succeeding years.

Other endangered whale species occasionally frequent the outercoast area, including the blue whale (Balaenoptera musculus), finback whale (Balaenoptera physalus), gray whale (Eschrichtius robustus), right whale (Balaena glacialis), sei whale (Balaenoptera borealis), and sperm whale (Physeter catodon). Actual observations within the bay, however, are commonly limited to the humpback, minke (Balaenoptera acutorostrata), and killer (Orcinus orca) whales.

Recent observations have confirmed that the threatened arctic peregrine falcon (Falco peregrinus tundrius) has nested within the park. The observation was made in a more remote area of the park, well outside the influence of existing developed areas.

No endangered or threatened plant species are known to occur in the park or preserve. Cypridium montanum was previously considered as a candidate for future listing. However, because of the abundant habitat in southeast Alaska, it will be withdrawn.

CULTURAL ENVIRONMENT

Glacier Bay's prehistory and history have been documented by Robert E. Ackerman, The Archeology of the Glacier Bay Region (1968); Frederica de Laguna, Under Mount St. Elias (1972); Bruce Black, "A History of Glacier Bay National Monument" (1958); and Dave Bohn, Glacier Bay: The Land and the Silence (1967). A historical and archeological base map was prepared as part of a 1965 master plan and was based on the Ackerman surveys of 1963-1965; a historic structure survey was carried out in 1976. A reconnaissance survey of cultural resources of the lower Alsek River, which was added to the national preserve in 1980, was initiated in the summer of 1981. Although hampered by high water in the river, the reconnaissance team noted numerous fishing camps and commercial sites.

Various surveys have identified more than 60 distinct sites or structural complexes dating predominantly from the recent historic past. There is potential for significant archeological finds in stable unglaciated areas within Glacier Bay National Park and Preserve that have not yet been surveyed, as illustrated by Ackerman's work at Ground Hog Bay on Excursion Inlet just east of the park. Lithics from that site may date back 10,000 years. In addition, de Laguna's study of the Yakutat Tlingit provides an important cultural history of the Tlingit peoples who frequented the Glacier Bay region--from Yakutat, Hoonah, and the interior Tlingit-Athabascan villages.

There are currently two historic structure complexes on the park's List of Classified Structures. The Harbeson cabin and woodshed, dating from the 1930s and 1940s, is located on the east shore of Dundas Bay. These wood-frame structures are in fair to poor condition and are listed as structures that may be preserved and maintained (category C). The Dundas Bay cannery complex, located on the west shore of Dundas Bay, consists of the cannery building, boiler, and ramp. Dating from 1898, these wood and masonry remains range from poor to deteriorated condition and are also listed as category C. The Cape Spencer lighthouse, located just within the park's boundary, is listed on the National Register. There are currently no other historic or archeological sites or structures within Glacier Bay that are on or have been determined to be eligible to the National Register of Historic Places.

Based upon previous studies and current information, the thematic sequence of Glacier Bay's prehistory and history is as follows:

prehistory
Tlingit homeland
European exploration and rivalry
Russian influences
American exploitative period
Glacier Bay as a natural curiosity and scientific laboratory
preservation
scientific studies, tourism/recreational use, and preservation challenges

PREHISTORIC LIFEWAYS

The first signs of man's habitation of the Glacier Bay region appear approximately 10,000 years before the present (B.P.), when the land was recovering from the massive glacial onslaught of the last stages of the Pleistocene period. On the nearby Baranof Islands, the Hidden Falls site has been dated at 9,000-10,000 years B.P. At Ground Hog Bay, outside and southeast of the park boundary, Ackerman discovered a prehistoric site, with artifacts dating back 10,000 years. Preliminary testing at that site presents a picture of man in the early postglacial period striving to use the floral and faunal resources of the locality with chopping tools, scrapers, flake tools, and some kind of large stone-tipped projectiles. Ackerman states that the dating of this site is tentative, although the range is accurate, and that much work remains to be done before precise and defensible dates can be established.

How long this culture lasted or how long man remained at the site is unknown, for after this there is a long void of archeological evidence. Sometime towards the end of the thermal maximum or the beginning of the Little Ice Age (approximately 2,000 years B.P.), evidences of a house, microlithic tools, and heavy woodworking tools were found. Another long gap in the prehistoric picture then occurs, ending with the withdrawal of the glaciers approximately 200 years ago. Here the evidence becomes more concrete, based upon Ackerman's extensive field research.

Ackerman and his colleagues covered virtually all of Glacier Bay's open coastline, usually in protected areas of the bays. The following description of findings is adapted from their final report.

Within the national monument, many sites were found, but they were either late historic Tlingit fishing camps or traces of exploitation of mineral or fishing resources by Europeans. No sites were found in the coastal region, which can be explained by the steep cliffs and minimal beach frontage, nor were any sites found in the fjordlike inlets and bays. Lituya Bay was the one area that offered a suitable but risky location for village settlement, but it was wiped clean by the 1,690-foot high, eathquake-caused wave that rose from the back of the bay in 1958. From Cross Sound and Icy Strait toward the mainland, and more protected waters, Ackerman and his colleagues detected subtle changes. The winds were softer and the atmosphere gentler, in sharp contrast to the exposed coast. Numerous sites were found eastward along the shore from Excursion Inlet to Point Couverden, and for the first time they found winter villages, indicating this was a semipermanent settlement area.

In the Excursion Inlet area evidence was found of two villages, both European and Indian camps, and a split log burial house. Farther south along the shoreline toward Point Couverden, a large house (presumably Tlingit), camps, graveyards, and two villages (Village Point and Grouse Fort) were discovered. The Tlingit established permanent settlements here, with the large houses and competing kin groups familiar to the late historic period, and they sent out hunting and fishing parties.

Clearly the major settlements in the Glacier Bay region were in the Excursion Inlet/Point Couverden area and in the Port Frederick area

(Chichagof Island), where the present Tlingit village of Hoonah is located. The area within the former monument appears to have been used for hunting and fishing. Scattered permanent camps near the salmon streams indicate recognized kin claims to fishing sites. A notable exception to this pattern appears in the Dundas River valley, where the small village of Listi and the Tlingit Christian cemetery indicate a more permanent settlement. This settlement had to be comparatively recent (since the late 1800s) because of the relatively late cessation of outwash deposition, thus precluding any older occupation.

Ackerman's work reflects the general patterns of prehistoric life in southeastern Alaska. Small winter villages of a semipermanent nature formed the hub of life. The natives followed a seasonal hunting, fishing, and gathering pattern, leaving the winter villages to occupy recognized but fluctuating fishing and hunting camps. Tlingit folklore relates stories recalling and explaining the periodic destruction of villages and camps by natural forces such as shock waves. Dry Bay also had a permanent Tlingit village, indicating that the Alsek River was important in Tlingit and regional history.

HISTORIC LIFEWAYS

The prehistoric pattern of life was affected by gradual intrusions of European cultures into the area. As early as July 1741, Russian ships of the Bering expedition sailed in the vicinity of Glacier Bay's outer coast. Most important for cultural history was the expedition's discovery of sea otters in Alaskan waters, which led to Russian expansion eastward to Alaska and exploratory probes by European nations interested in the valuable furs.

Forty-five years later, in July 1786, the French explorer Jean Francois La Perouse arrived at Lituya Bay with two ships. During his 26-day stay, contacts were made with the Tlingits, trade was initiated, and the ship companies took advantage of the nearby resources to resupply and refit the ships. To frighten the Tlingits into submission, La Perouse "endeavoured to convince them of the superiority of our arms; for which purpose I fired a cannon, to show them that I could reach them at a distance, and pierced with a musket-ball, in the presence of a great number of Indians, several doubles of a cuirass they had sold us, after they had informed us by signs that it was impenetrable to arrows or poignards" (Bohn 1967).

In 1788 a Russian galleon exploring the northern coastline made a brief stop at Lituya Bay. The Tlingits were contacted and informed, through a Koloshi interpreter, that they were now part of the Russian Empire and subjects of Catherine the Great. After brief trading and fishing, the Russian ship set sail.

The next verified visit to the Glacier Bay region took place in 1794, when George Vancouver, captain of HMS Discovery, arrived at Port Althorp on Cross Sound. Proceeding across the ice-cluttered and fog-shrouded sound, Vancouver's men reached Cape Spencer and then turned east to chart the coastline. Proceeding cautiously, they sighted what became

known as Taylor Bay, Brady Glacier, Dundas Bay, and finally Glacier Bay. There was little of the latter bay to discover in 1794. The terminus of the glacier had just started to recede and at that time reached to the vicinity of Rush Point, 65 miles south of its present terminus. A few native canoes met the English on their exploration, and Vancouver noted that "excepting a few indifferent sea otter skins, these people brought with them no articles for traffic" (Bohn 1967).

A series of trading ventures by American and Russian seamen occurred between this initial contact period and the establishment of Russian sovereignty over the Alexander Archipelago in 1799. The Russians, however, did not venture far from their post at Sitka, so the region was left open to inroads by American and British trading enterprises. In 1840 an agreement established between the Russian American Company and the English government permitted the Hudson's Bay Company access to the area from 54°40' north to Cape Spencer. The company had established 36 hunting stations along the coast by 1849. The trade agreement with Britain was maintained until 1865, shortly after which the territory became the possession of the United States.

The effect of the transfer of Alaska to the United States was felt almost immediately in southeastern Alaska, although considerably less so in the rest of the territory. U.S. Army troops were garrisoned at Sitka, Tongass, and Fort Wrangell between 1867 and 1877. Between 1877 and 1879 the troops were withdrawn, but in response to the threat of a Tlingit uprising in 1878, the U.S. Navy maintained a ship in the area from 1879 to 1896, and a detachment of marines was based at Sitka.

The discovery of gold brought an influx of miners. In August 1880, a group of miners met on Willoughby Island in Glacier Bay and organized the Berry Mining District. Although the mining boom bypassed Glacier Bay for the most part, prospectors continued to do some placer mining in the Lituya Bay region in the 1890s, and prospectors were reported in the region as late as 1898. In Glacier Bay proper, small-scale mining operations were taking place as late as 1938.

Other development in the region included a saltery at Bartlett Cove in the late 1890s, several fox farms, and the Dundas Bay cannery, started in 1898. By 1900 the community supporting the cannery operation included some 40 houses ranged along the shore for 61 employees. By 1935 the cannery was abandoned. In the meantime prospectors, fishermen, traders, and settlers drifted in and out of the area, some living off the land for a few years before disappearing, and some establishing permanent pioneer-style homes carved out of the wilderness.

Glacier Bay's later history has been closely tied to the glaciers themselves, which have served as subjects of scientific investigations and tourist attractions since the 1880s. When John Muir made his first trip to Glacier Bay in 1879, he made extensive reconnaissances of the Glacier Bay region, being fascinated by the land, the people, and most of all by the glaciers. As the result of his explorations and the subsequent publicity, the Glacier Bay region was changed forever.

In 1883, the first tourist ship entered the harbor--the start of regular excursions for the Pacific Coast Steamship Company. The small fishery camp at Bartlett Cove became a stopping point for the excursions, and it slowly grew into a tourist-supply point. By 1890 the steamship excursions into the bay had become well known, with up to 230 passengers arriving on each ship. The steady retreat of the glaciers and the corresponding opening of Glacier Bay itself created an even more enticing tourist attraction. Ships were now able to sail very near the terminus of the glaciers, affording passengers awesome views of sheer cliffs of ice towering above their heads.

In the meantime, scientific curiosity about the rapidly retreating glaciers prompted scientists to begin a study of the phenomenon. John Muir returned to the region in 1890 and established a base camp, complete with a prefabricated wooden cabin. Botanists, geologists, ornithologists, and other experts studied the slow reclamation of the lands vacated by the glaciers, while other scientists argued about the extent and rapidity of the glacial retreat. The early scientific studies culminated in the Edward Harriman expedition of 1899, which was financed by the railroad magnate and was composed of scientists, artists, photographers, and naturalists (including John Muir).

This early era of tourism and scientific study abruptly ended on September 10, 1899, when the coast of Alaska was jarred by a violent earth tremor, which had an epicenter 150 miles northwest of Glacier Bay. The bay became an almost solid mass of floating ice. The saltery at the cove could not be reached by ship for two weeks, and the cannery boats operating out of Dundas Bay were unable to make regular trips. The terminus of Muir Glacier collapsed, calving enormous quantities of ice and creating an unbroken ice pack from shore to shore and extending more than 10 miles out from the glacier. For the next several years, tourist steamers were not able to get closer than 5 to 7 miles to the glacier's terminus, although in 1907 a ship was able to get within 1 mile. The quantities of floating ice in the following years, however, was so great that excursions to Glacier Bay were finally eliminated from cruises in the region.

When Glacier Bay National Monument was established in 1925, the area once again began to develop slowly as a prime tourist attraction.

SOCIOECONOMIC ENVIRONMENT

THE REGION

The area surrounding Glacier Bay National Park and Preserve is rural, with a number of small communities accessible by boat or plane within 50 miles of the park. Juneau, the capital of Alaska, is approximately 55 miles east of the park and had a population of 22,000 in 1980. Gustavus, just outside the park boundary, has a year-round population of 80-100 and a summer population of 250-300.

Employment is seasonal in the Glacier Bay vicinity. The primary industries within the region are fishing, timber production, and tourism.

VISITOR USE

Access

The majority of park visitors (76 percent in 1983) come on cruise ships that leave from West Coast and Canadian ports. Approximately 8 percent of the visitors arrive by commercial airline in Gustavus and use lodge facilities and services in Bartlett Cove as part of a package tour. (Concessioner buses travel a 10-mile road and provide access to Bartlett Cove and the lodge.) About 3 percent of the visitors arrive by private boat. The rest tour the park by scheduled or chartered tour service from outside the park.

Preserve users come by aircraft primarily through the Yakutat area or by river raft from Canada along the Tatshenshini/Alsek corridor. A few fishermen arrive by boat from the Yakutat area. The Visitor Access map (in the back pocket) shows traditional access routes to and within the park and preserve.

Water corridors are the primary means of access to the park's major scenic, biologic, and geologic features. Private and commercial vessels provide access for hikers to especially difficult terrain.

Any right-of-way proposals that might be considered under revised statute 2477 (43 USC 932) will be resolved in a manner consistent with the enabling legislation of the park and preserve and other applicable laws.

Visitor Trends and Activities

Visitation has grown rapidly since the early 1970s. Total annual use increased two and one-half times from 1970 to 1978. Until 1982 visitation increased at an annual rate of 5 to 10 percent; in the past two years visitation seems to have leveled off. The major element in this rapid growth has been the increase in numbers and sizes of commercial cruise ships, whose passengers account for approximately 76 percent (73,000 in 1983) of total park visitation (see table 1). Since 1981, cruise ship

Table 1: Glacier Bay Annual Visitation

Year	Cruise Ship Passengers	Cruise Ships	Lodge Visitors	Lodge Overnight Stays	Charter/ Private Boaters[b]	Overnight Back-country Users	Miscellaneous Use with Cruise Ship Crews[c]	Miscellaneous Use without Cruise Ship Crews[b]	Total without Cruise Ship Crews	Total with Cruise Ship Crews
1969	1,636[d]	NA	2,120	NA	1,090	105	1,349	NA	NA	6,300
1970	16,676[d]	NA	1,599	NA	496	85	10,884	NA	NA	29,740
1971	14,802[d]	NA	1,461	NA	400	118	8,927	NA	NA	25,708
1972	13,330[d]	NA	2,895	NA	955	186	7,309	NA	NA	24,675
1973	18,481[d]	43	3,174	NA	952	296	13,058	NA	NA	35,961
1974	41,531[d]	57	3,212	NA	644	452	2,049	NA	NA	47,888
1975	42,479	113	5,021	NA	1,058	400	23,117	3,598	48,791	71,908
1976	46,488	115	6,747	9,983	941	510	30,064	3,594	54,671	84,735
1977	74,870	139	7,678	11,518	1,602	561	35,783	4,841	84,726	120,509
1978	64,022	124	11,756	17,634	2,096	600	30,926	4,022	78,626	109,552
1979	70,895	127	7,824	11,737	6,433	576	36,710	6,806	85,907	122,617
1980	81,115	137	7,410	11,114	2,128	651	39,050	4,847	91,521	130,571
1981	69,615	118	8,726	12,881	2,890[e]	803[f]	37,271	4,816	82,103	119,374
1982	74,808	105	6,738	9,650	3,568[e]	1,276[f]	45,096	5,941	86,390	131,486
1983	72,541	93	7,409	8,962	5,430	930	NA	10,066	96,376	NA

NA - not available

a. Includes all visitors to the lodge, not just overnight guests.

b. Includes passengers on small charter tours.

c. Miscellaneous users include day visitors, Glacier Bay Explorer passengers, charter fishing boat passengers, campers, commercial fishermen, scenic overflight passengers, day users, prospectors and miners, fuel patrons, U.S. and Canadian naval vessels, commercial film crews, contractors, and barge operators.

d. Includes cruise ship crews.

e. Reflects improved counting techniques on commercial fishing and charter boats.

f. Includes Alsek River use (not included previously).

numbers have been regulated by the National Park Service, resulting in a stabilization of visitor numbers. Other factors that have led to higher visitation include the expansion of the lodge from 20 to 55 cabin units, the operation of a 64-passenger overnight vessel by Glacier Bay Lodge, Inc., more charter boat tours, and increases in river float trips and other uses in the preserve.

Currently visitors make only minimal winter use of the park. Commercial air service to Gustavus is discontinued when the lodge closes in the fall, and winter activities are largely confined to area residents or a few commercial and private boaters.

Backcountry users account for only 3 percent of the Glacier Bay visitors; however, the number of backcountry visitors has increased from about 100 in 1971 to 930 in 1983. Backcountry use increased at a rapid rate during the early 1970s; since 1975 backcountry use has increased at a slower rate.

Fishing, hunting, and trapping attract users to the preserve during the regulated seasons.

Lodge guests totaled about 1,500 in the early 1970s, and almost 9,000 in 1983. Most of the increase in lodge use occurred between 1975 and 1978. Since 1981, when 12,881 visitors stayed at the lodge, use has decreased slightly.

Virtually all visitor use occurs between May and October. The amount of time visitors stay in the park varies considerably between types of visitors. Cruise ship passengers form the largest group. They are generally on a one- or two-week cruise, and they spend one day (an average of 11 hours) in Glacier Bay. Lodge visitors who are on commercial tours form the next largest group, and typically they spend one day and night in the park. These visitors have indicated that the glaciers are the most impressive sight, followed by mountains, whales, and seals.

In 1985 two types of commercial tours for lodge visitors will be offered. On one tour, visitors will fly to Gustavus around 5 p.m. and will be bused 10 miles to the lodge, where they will stay overnight in concessioner-operated cabins. At 7 a.m. on the following morning they will board the Thunder Bay tour boat, which is operated by the same concessioner. The Thunder Bay will tour the Muir Inlet glaciers and return to Bartlett Cove at about 3:30 p.m. Visitors will disembark at the main dock, and most will later be bused to the Gustavus airport to leave that evening.

On the other tour, visitors will arrive in Gustavus on a midmorning flight and will be bused directly to the main dock at Bartlett Cove where they will board the Glacier Bay Explorer, an overnight tour boat operated by the lodge concessioner. This boat will leave the dock about 11:30 a.m., touring the west arm of the bay, staying overnight in the same area, and returning to Bartlett Cove about 7 a.m. the next day. Visitors will either be bused from the lodge to Gustavus to leave on the midday flight or will embark on the Thunder Bay for a tour of Muir Inlet, returning to Bartlett Cove about 3:30 p.m. and leaving on the 5 p.m. flight from Gustavus.

Fewer visitors come to Glacier Bay in concessioner-operated tour boats from Juneau or other towns in the region. One such boat provides an overnight tour for one, two, or three days, with visitors on the shorter tours being transferred to and from the Gustavus airport. Most visitors, however, typically spend only one very long day in the park.

Together Bartlett Cove and wilderness campers account for almost 2 percent of all visitors. Campers stay considerably longer than other visitors, with the average being five nights.

Based on a 1978 survey, backcountry users are typically young, well-educated, and do not live in Alaska. They are seeking a wilderness experience and also the opportunity to see tidewater glaciers. Over 75 percent of the visitors said they had at least an "excellent" backcountry trip and only 2 percent had a "fair to poor" trip. Over 60 percent did not feel crowded on their trip. Eighty-three percent felt some crowding, with the number of vessels and aircraft sighted contributing the most to that perception.

Without restrictions on visitation other than existing vessel regulations related to avoidance of impacts on whales, overall visitor use would probably continue to increase by about 10 percent per year if accommodations were available. The cruise ship industry has indicated that, based on demand and regional port capacities, the maximum probable annual number of cruise ship entries over the next five years would be about 135, if these entries were allowed by the National Park Service.

COMMERCIAL FISHING

Use of saltwater areas within Glacier Bay National Park and Preserve for commercial fishing has occurred since before the original monument was established in 1925. Four area communities (Hoonah, Elfin Cove, Pelican, and Gustavus) largely depend on commercial fishing in waters adjacent to the park. ADF&G figures for salmon catch areas include Icy Strait and Glacier Bay. For a five-year period ending in 1979-1980, they show an average annual salmon catch of 2,160,000 pounds, valued at $4 million, a portion of which comes from Glacier Bay. For the same five-year period, catches of tanner, king, and Dungeness crab solely from park waters averaged 344,000 pounds annually. The 10-year period ending in 1977 saw an average annual catch of halibut of 1,120,000 pounds (about 16 percent of the southeast Alaska catch) from an area mostly within park waters.

In addition to fishing in the main bay, a commercial trolling fleet operates along the outer coast of the park in the Gulf of Alaska. Some shrimp fishing (pot fishing only) is done in Lituya Bay. Many of the coves and bays of the outer coast harbor fishing boats during stormy periods, and commercial fish buyers anchor in these areas, operating under NPS permits. A purse seine fishery for chum salmon is operated in Excursion Inlet during open seasons.

In the preserve at Dry Bay, commercial fishing has been a predominant use on the Alsek, East Alsek, and Doame rivers. A gill net fishery has

existed for many years. The state of Alaska manages the catch, while the National Park Service manages use of the land. A fish-processing plant, several roads and airstrips, numerous temporary camps established by approximately 40-50 commercial gill net fishermen, and about 20 permitted fish camps (cabins and outbuildings) are located in this area. Prior to 1981 this area was under the jurisdiction of the U.S. Forest Service as part of Tongass National Forest.

The trend in commercial fishing is reasonably stable, with annual fluctuations dependent on allowed commercial harvest limits established by the state and the International Pacific Halibut Commission. There is a potential for developing interests in trawling and other forms of bottom fishing. At Dry Bay the fishery has increased approximately threefold since 1969 in the number of fishermen establishing temporary camps during the height of the season each year.