3.0 AFFECTED ENVIRONMENT

3.1 Inventory of Invasive Plants in Alaska NPS Units

The areas of concern include all parklands in the Alaska Region. Several parks in northwest and southwest Alaska have no documented invasive plants (see figure 1.1), and the majority of lands in all Alaska parks are free of invasive plants. The areas with the highest concentrations of invasive plants are areas with higher human traffic along roads, airstrips, and trails and near campsites and cabins. Because the arrival and discovery of invasive plants is unpredictable and control measures could be necessary anywhere in Alaska's National Parks, the entire Region is the project area for this analysis.

The NPS Alaska Region Exotic Plant Management Team (EPMT) program was established in 2003. Before then invasive plant management was limited in Alaska NPS units to preliminary surveys in about half of the parks, small-scale control efforts in several parks, and revegetation only for some construction and road maintenance projects. Since 2003, the EPMT has coordinated efforts throughout the region toward invasive plant prevention, inventory, control, monitoring, and restoration. Field employees watch for new infestations, control and monitor existing infestations, and map and collect relevant data about each site. Table 3.1 summarizes invasive plant species found in Alaska NPS units. Appendix E includes a complete list of the invasive plants found in and around the NPS units. Appendix B highlights those invasive plants species found inside (yellow) or within 15 miles (orange) of NPS units in Alaska.

Table 3.1 Selected invasive plants found in surveys of Alaska NPS units[1]

Invasive plant	DENA	GAAR	GLBA	KATM	KEFJ	KLGO	LACL	SITK	WRST	YUCH
annual sowthistle	S									
bigleaf lupine	S		X		N	S				
bird vetch	S	N				N			N	N
Canada thistle			N							
common dandelion	X	X	X	X	X	X	X	X	X	X
common comfrey			X							
common eyebright						X				
common sheep sorrel			X	X	X	X	X	X		X
common tansy			N			N				
common timothy	S		X		X	X	N	S	N	
creeping buttercup	S		X			X		X		
European mountain-ash			S			N		X		
Japanese knotweed								X		
lambs-quarters	X					S	X	X	X	X
narrowleaf hawksbeard	X			S	S	N			X	X
orange hawkweed	N		N							
orchardgrass			S							
ornamental jewelweed						N				
oxeye daisy	X	N	X	N	X	X	N	X	X	

Table 3.1 Selected invasive plants found in surveys of Alaska NPS units[1]										
Invasive plant	**DENA**	**GAAR**	**GLBA**	**KATM**	**KEFJ**	**KLGO**	**LACL**	**SITK**	**WRST**	**YUCH**
perennial cornflower			X					X		
perennial sowthistle			X			N		S		
(purple) foxglove								X		
quackgrass			X		N	X			X	N
red clover	X		X		S	X		N	X	
reed canarygrass			X			N		N		
Siberian peashrub									X	
smooth brome (grass)	X		N			X	S		X	S
white clover	X		X	S	X	X	X	X	X	
white sweetclover	X	N				X			N	N
yellow alfalfa					N					
yellow toadflax	X		N		X	X		N	X	

X: one or more substantial infestations; may be target of extensive control
S: small isolated populations
N: found near Park
1 ALAG, ANIA, BELA, CAKR, KOVA, and NOAT have not yet been surveyed extensively

Invasive plant control efforts in Alaska NPS units have targeted particular species that are not yet widespread in a given park unit and present a threat to park resources and values. Where feasible, field employees manually or mechanically remove infestations, with volunteer crew assistance for large infestations. Because most infestations are extremely small and root removal maximizes control effectiveness relative to cutting, hand-pulling with minor digging is the prevailing control method. In a few cases, brush trimmers have been used for large populations of species for which root reserves are not a concern. Most infestations are monitored and retreated for multiple years, and the establishment of new infestations requires ongoing attention. In 2005, 16.1 gross acres of invasive plants were controlled across the Alaska Region by pulling, digging, and cutting, and in 2006, 32.5 gross infested acres were controlled in addition to the repeated treatment of 2005 acres. For detail by park, see Table 3.2.

The following subsections describe the extent of surveys, findings and management actions in each Alaska NPS unit.

3.1.1 Alagnak National Wild River (ALAG)

No invasive plant surveys or management have yet been performed by the EPMT along the Alagnak Wild and Scenic River.

3.1.2 Aniakchak National Monument and Preserve (ANIA)

No invasive plant surveys or management have yet been performed in Aniakchak National Monument and Preserve, although second-hand reports indicate the possible presence of common dandelions along the Aniakchak River.

Table 3.2. Acreages of management activities for invasive plant species by park unit, 2004-2008.

Park	Inventoried	Infested	Treated	Eradicated
Throughout Alaska Region	8299.653	3501.812	113.485	79.192
ALAG	0.000	0.000	0.000	0.000
ANIA	0.000	0.000	0.000	0.000
BELA	4.296	0.000	0.000	0.000
CAKR	215.656	0.000	0.000	0.000
DENA	845.758	67.280	62.297	0.094
GAAR	637.806	0.000	0.000	0.000
GLBA	2909.047	1129.347	6.150	78.381
KATM	198.593	11.977	6.150	0.000
KEFJ	58.860	13.601	7.707	0.056
KLGO	215.362	82.837	15.921	0.479
KOVA	0.000	0.000	0.000	0.000
LACL	71.632	22.355	1.118	0.000
NOAT	0.000	0.000	0.000	0.000
SITK	25.127	19.244	3.611	0.000
WRST	3004.147	2102.388	10.060	0.182
YUCH	113.369	52.783	0.471	0.000

Note: Acreages represent non-overlapping areas in and near park units mapped by the EPMT. Inventoried areas include areas with and without invasive species. Infested areas include at least one invasive species. Treated areas are locations where at least one control effort has occurred. Eradicated areas are places where an invasive species is no longer present.

3.1.3 Bering Land Bridge National Preserve (BELA)

No invasive plants were found in the vicinity of the Serpentine Hot Springs, the most visited area of Bering Land Bridge National Preserve, which was surveyed in 2004.

3.1.4 Cape Krusenstern National Monument (CAKR)

No invasive plants were found along the 23 miles of the DMTS Road to the Red Dog Mine within Cape Krusenstern National Monument or in the vicinity of the Kakagrak Hills in 2004.

3.1.5 Denali National Park and Preserve (DENA)

Denali National Park and Preserve has the longest history of invasive plant management within the Alaska Region. Beginning in the early 1990s, the Denali Park Road corridor has been annually surveyed, and invasive plants have been pulled. In addition, Denali has a consistent history of restoring native vegetation following ground-disturbing park operations. Nevertheless, the influx of summer visitors every year, development along the Park Road and just outside the park, and vehicle traffic

along the Parks Highway result in increasing opportunities for the establishment of invasive plants. Three species have been the target of the most extensive control efforts to date: white sweetclover, common dandelion, and narrowleaf hawksbeard. Other species are present as isolated small populations, including bird vetch, yellow toadflax, oxeye daisy, annual sowthistle, smooth brome grass, common timothy, and bigleaf lupine. Almost all of the populations of these species are found within the first two miles of the Park Road or along the Parks Highway. See figure 3.1 for a summary of invasive plants near the entrance area of the park.

3.1.6 Gates of the Arctic National Park and Preserve (GAAR)

Common dandelion is the only known invasive plant species in Gates of the Arctic National Park and Preserve and has been found and controlled only at Walker Lake despite surveys of other areas in 2002 and 2006. Several species are spreading northward along the Dalton Highway, a main entry corridor for park visitors, including white sweetclover, oxeye daisy, common dandelion, and bird vetch.

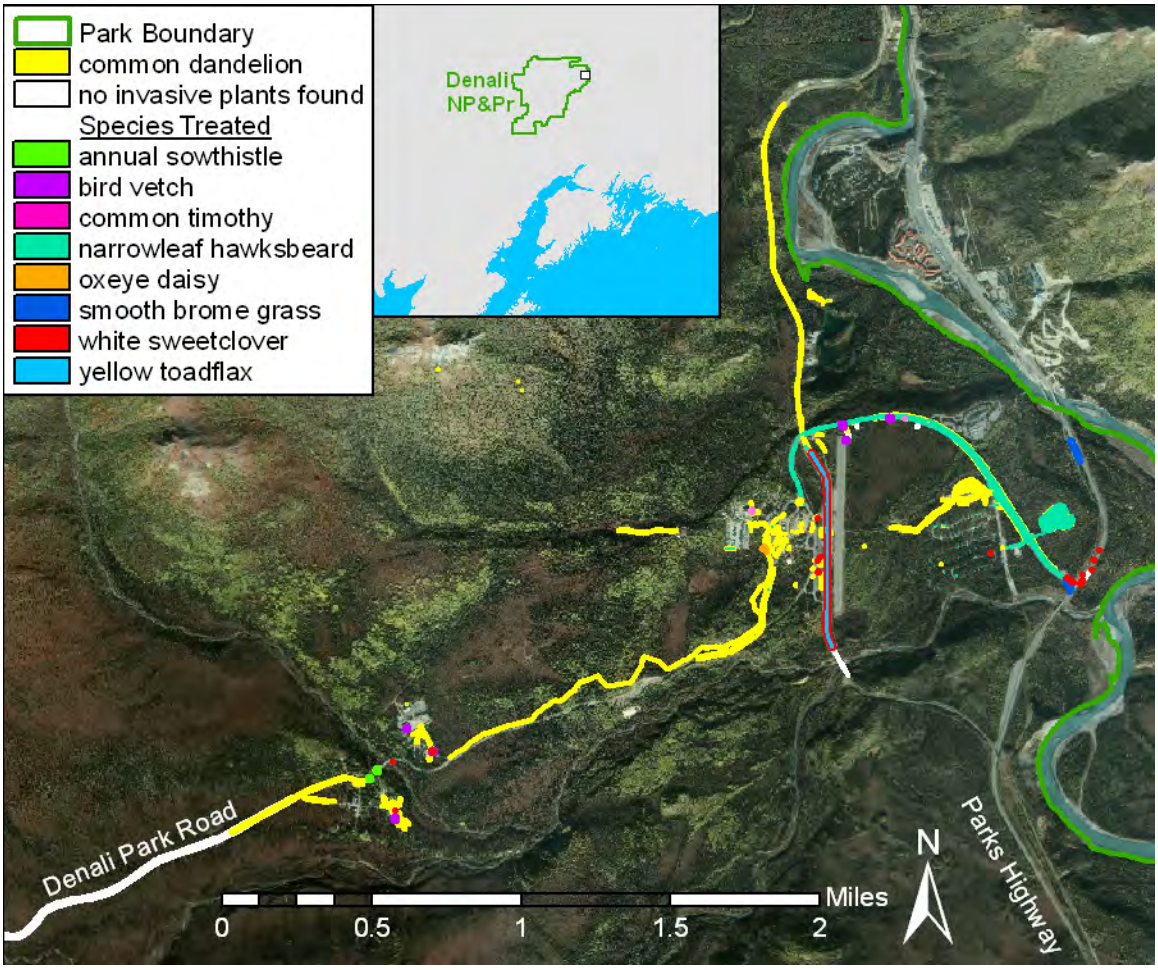

Figure 3.1. Invasive plant survey and control efforts in the DENA entrance area, 2004-2006. Note: For this and subsequent maps, portions of certain species'

populations are covered by those of others. Where this occurs, the outline of the underlying species is visible around the edge of the overlying shape.

3.1.7 Glacier Bay National Park and Preserve (GLBA)

Numerous invasive plant species are found in Glacier Bay National Park and Preserve, as documented by the survey and control efforts since 2004. In Bartlett Cove, high priority species include reed canarygrass, oxeye daisy, and common timothy, among others. On Strawberry Island a 2.4 acre infestation of perennial sowthistle was found in 2005 where removal was attempted in 2005, 2006, and 2008 but without sufficient resources or effectiveness for success. Oxeye daisies are also found in Dry Bay and Reid Inlet, common dandelions are widespread around the Bay, and bigleaf lupines are abundantly distributed at Dry Bay, well beyond control feasibility. Despite the small numbers of visitors that come ashore in the park, new species are found each year and glacial retreat provides ever more opportunities for invasive plants to colonize disturbed lands. Several high priority invasive plants have been found in nearby Gustavus but not the park, including Canada thistle, orange hawkweed, yellow toadflax, and common tansy. See figures 3.2 and 3.3 for a summary of invasive plants near Bartlett Cove and in the Dry Bay area of the park and preserve, respectively.

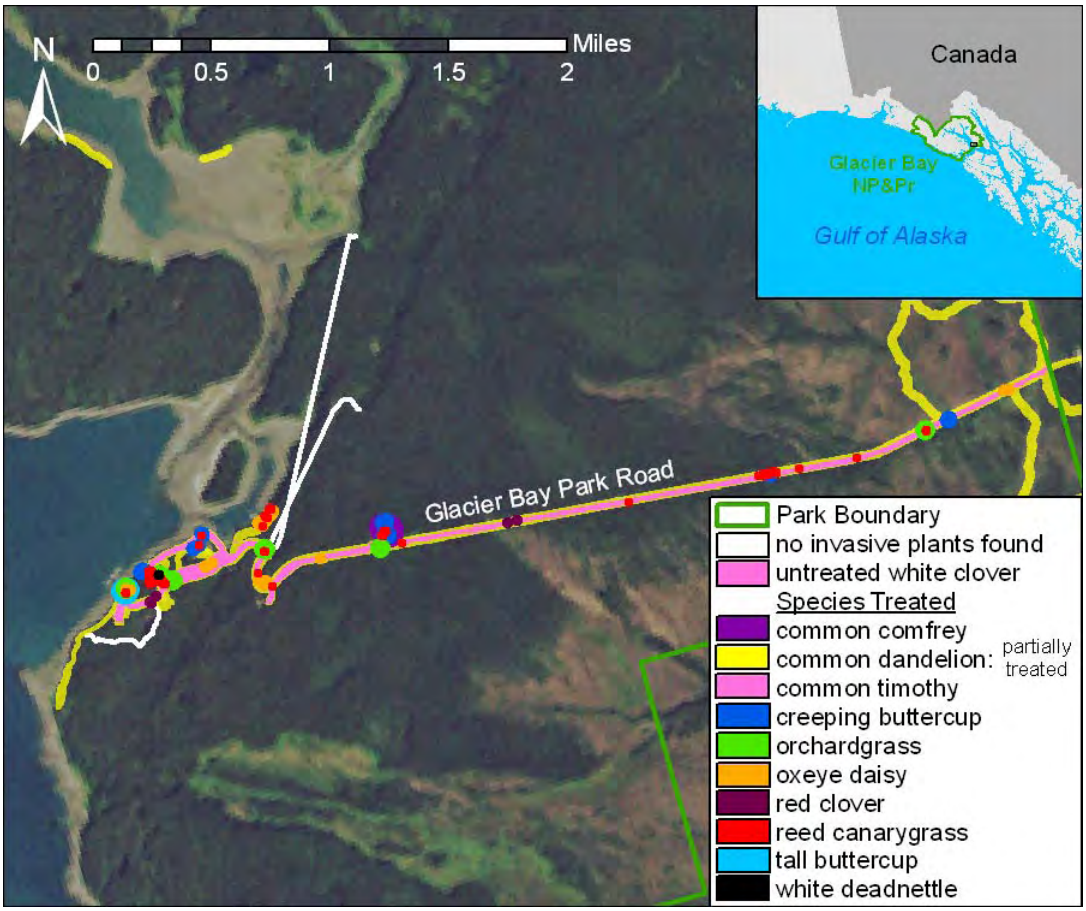

Figure 3.2. Invasive plant survey and control efforts in the GLBA Bartlett Cove area, 2004-2006.

3.1.8 Katmai National Park and Preserve (KATM)

In Katmai National Park and Preserve, common dandelion is widespread in Brooks Camp and has been the focus of control efforts over the past two years. Only pineapple weed, a species of little concern, has established along the road to the Valley of Ten Thousand Smokes. Of particular concern at a material site near the beginning of the road is a small population of narrowleaf hawskbeard that was manually controlled in 2005 and 2006 and is a species thriving in King Salmon. Oxeye daisy is present on private land adjacent to parkland on the Lake Camp Road, and common sheep sorrel grows in the Lake Camp parking lot.

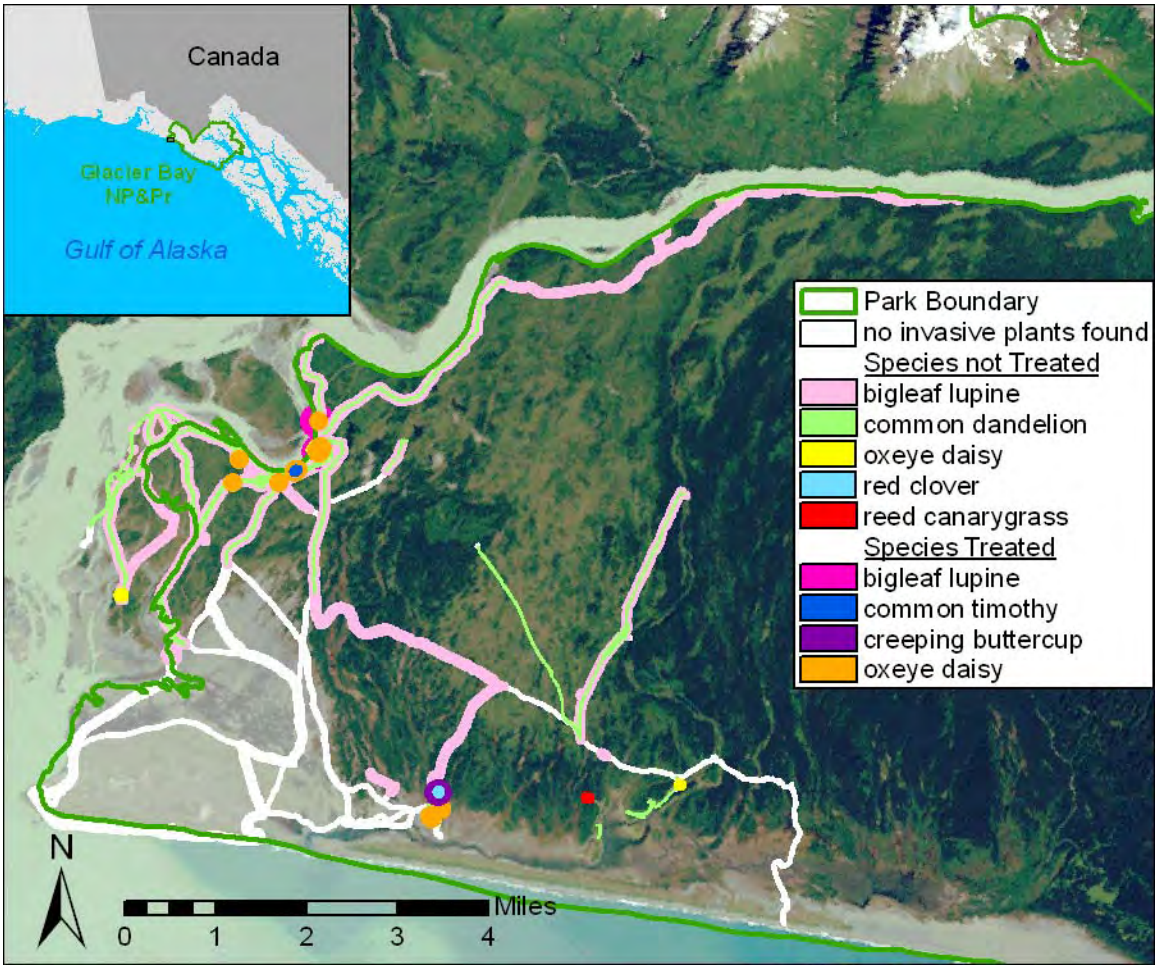

Figure 3.3. Invasive plant survey and control efforts in the GLBA Dry Bay area, 2004-2006.

3.1.9 Kenai Fjords National Park (KEFJ)

Kenai Fjords National Park is remarkably free of invasive plants despite its relative accessibility. Exit Glacier, the only road-accessible area, is home to the majority of invasive plant species found in the park. Control efforts have targeted common

dandelion, timothy, yellow toadflax, narrowleaf hawksbeard, and oxeye daisy in this area, while yellow alfalfa thrives outside the park along Exit Glacier Road. See figure 3.4 for a summary of invasive plants near Exit Glacier in the park.

3.1.10 Klondike Gold Rush National Historic Park (KLGO)

Invasive plant management over the past several years at Klondike Gold Rush National Historical Park has built upon the foundation of information compiled in a 2001 report on species within the Chilkoot Trail Unit. Skagway itself is partially managed as another unit of the park, as is the White Pass railroad corridor. Management efforts over the past two years have focused on removing yellow toadflax, oxeye daisy, and narrowleaf hawksbeard from Dyea and white sweetclover and bird vetch from Skagway. See figure 3.5 for a summary of invasive plants in the park.

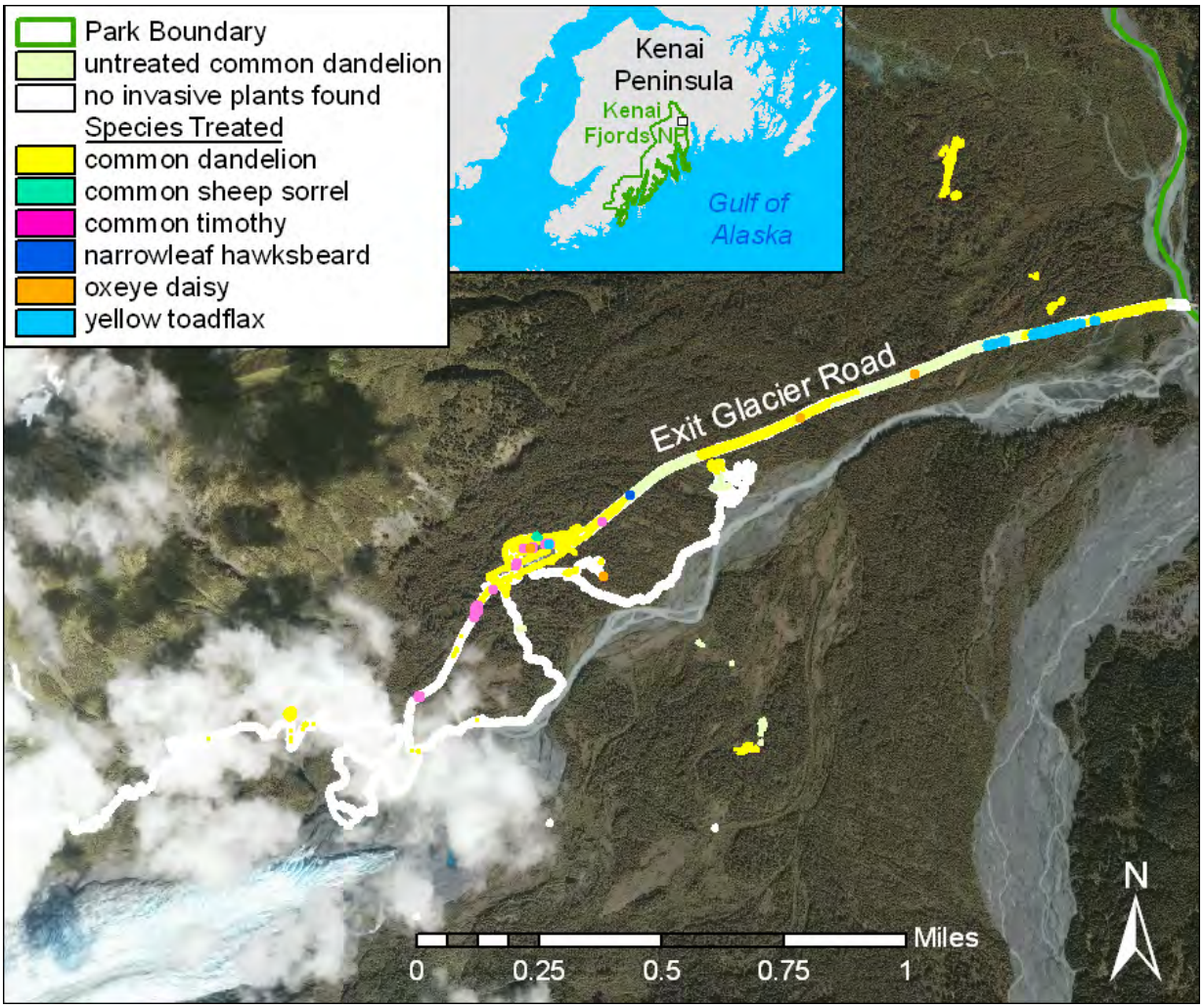

Figure 3.4. Invasive plant survey and control efforts in the KEFJ Exit Glacier area, 2004-2006.

3.1.11 Kobuk Valley National Park (KOVA)

No invasive plant surveys or management have yet been performed in Kobuk Valley National Park.

3.1.12 Lake Clark National Park and Preserve (LACL)

The most successful invader in Lake Clark National Park and Preserve so far is common dandelion, which is well established at Twin Lakes, Silver Salmon Creek, and Port Alsworth. Other species, including orange hawkweed and oxeye daisy, are present primarily on private lands adjacent to the park.

3.1.13 Noatak National Preserve (NOAT)

No invasive plant surveys or management have yet been performed in Noatak National Preserve.

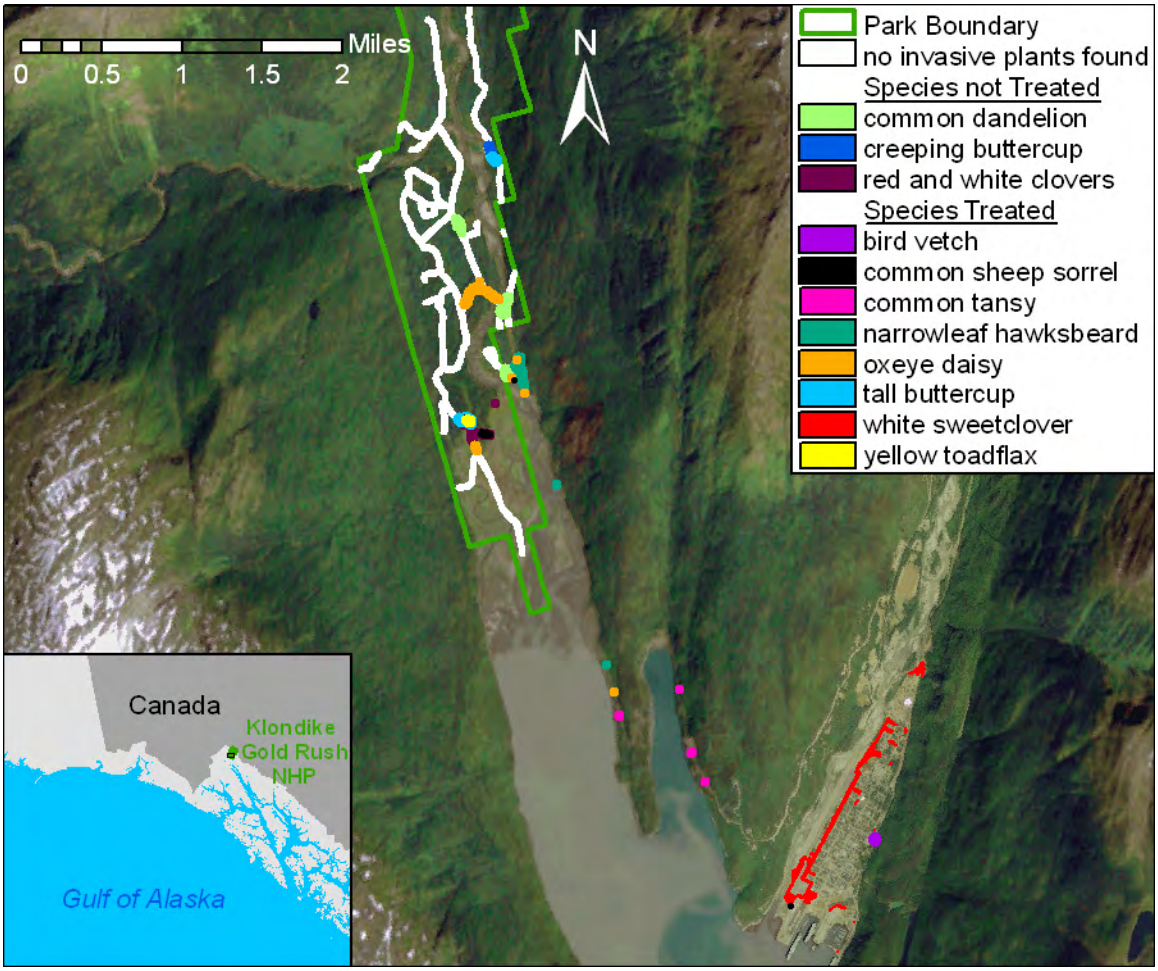

Figure 3.5. Invasive plant survey and control efforts in KLGO Dyea and Skagway areas, 2004-2006.

3.1.14 Sitka National Historic Park (SITK)

As a park in an urban setting, Sitka National Historical Park is surrounded by lands colonized by invasive plants. Nevertheless, its closed canopy forests have limited habitat suitability for many of these species. The species of greatest potential threat in the park is Japanese knotweed, which has been relocated and pulled out for more than five consecutive summers but grows back each year. Creeping buttercup is well established in the forest understory, and European mountain-ash has overtaken several acres of the forest overstory. Other problematic species include common dandelion, white clover, and foxglove. See figures 3.6 and 3.7 for a summary of invasive plant surveys and control efforts and in the park, respectively.

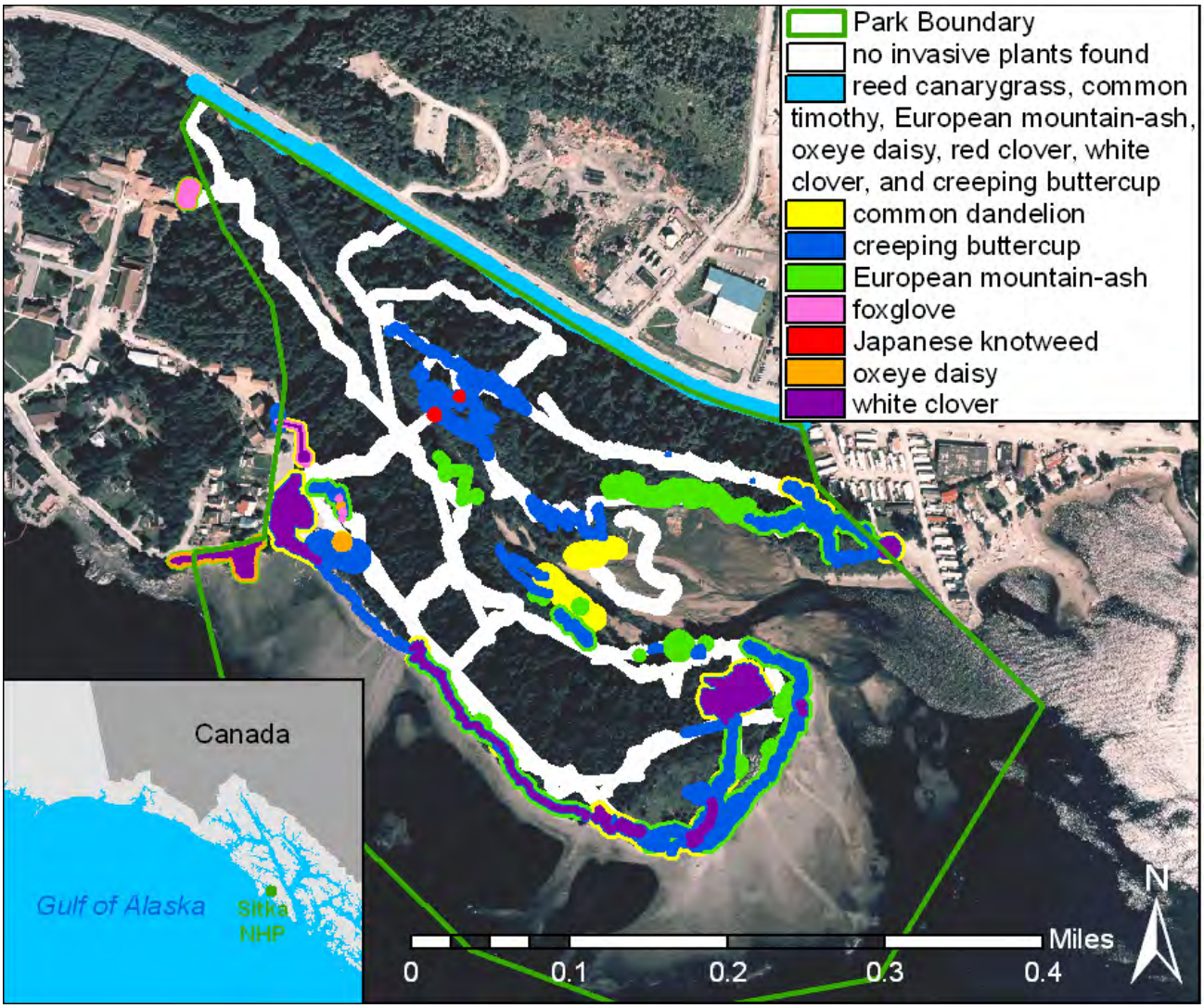

Figure 3.6. Invasive plant survey efforts in SITK, 2004-2006.

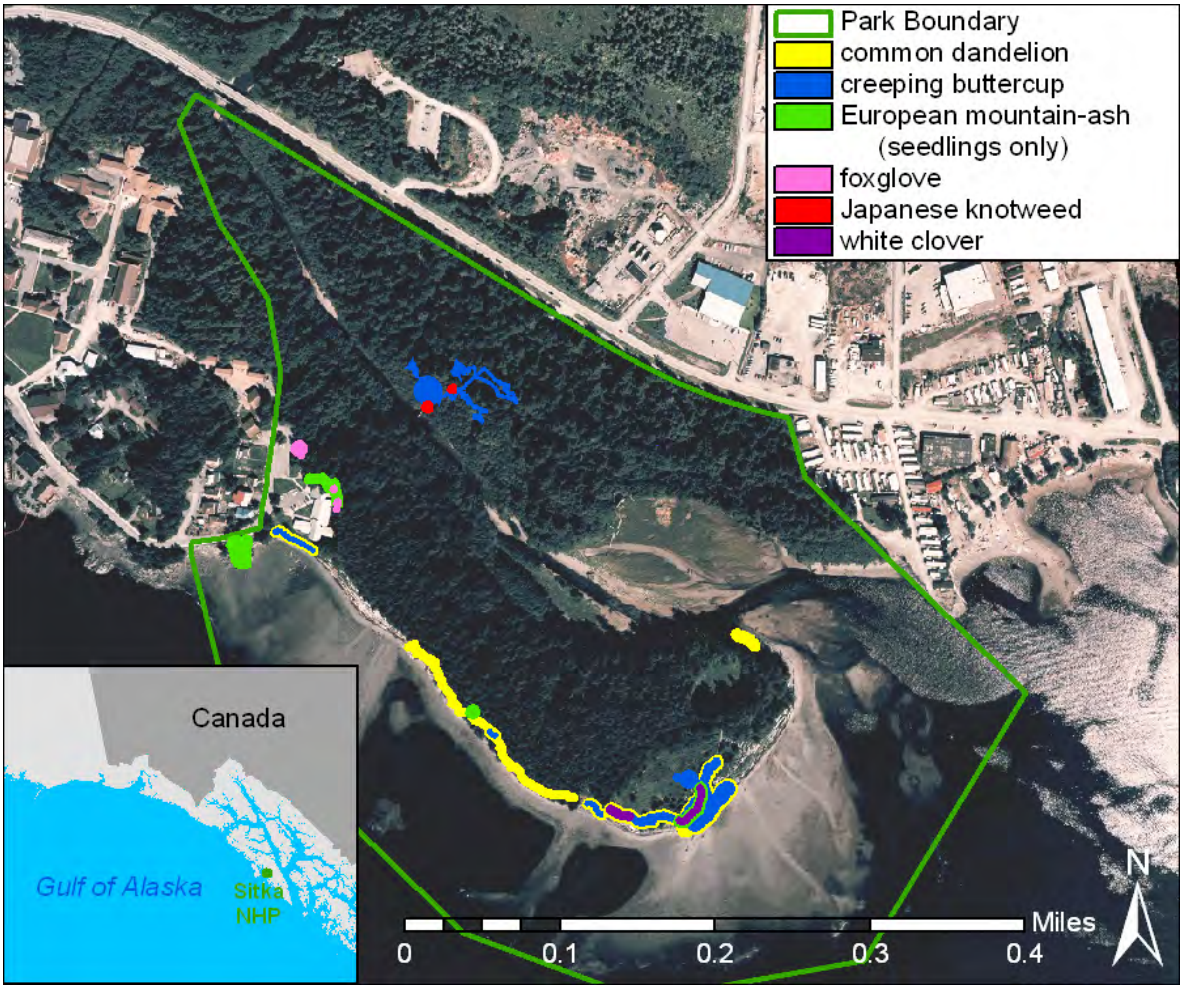

Figure 3.7. Invasive plant control efforts in SITK, 2004-2006.

3.1.15 Wrangell-Saint Elias National Park and Preserve (WRST)

Wrangell-St. Elias National Park and Preserve faces the greatest risk of invasive plant establishment due to the presence of two roads into the park and numerous inholdings. White sweetclover and bird vetch are spreading along the roads of the Copper Basin and is likely to reach the park soon via roads or rivers. Oxeye daisies have been controlled for multiple years in Kennecott, below the Recreation Hall. Common dandelions are of concern to the park beyond Kennecott in the Root Glacier Valley, on the McCarthy Creek floodplain, and along the Nabesna Road. Yellow toadflax and Siberian peashrub are present in McCarthy and the latter in Kennecott. Smooth brome grass is present along the McCarthy Road and on the McCarthy Creek floodplain. The Nabesna road has very few infestations, which are controlled annually, but white sweetclover, narrowleaf hawksbeard, and common dandelion are growing threats. See figures 3.8 and 3.9 for invasive plants found along the McCarthy and Nabesna Roads, respectively.

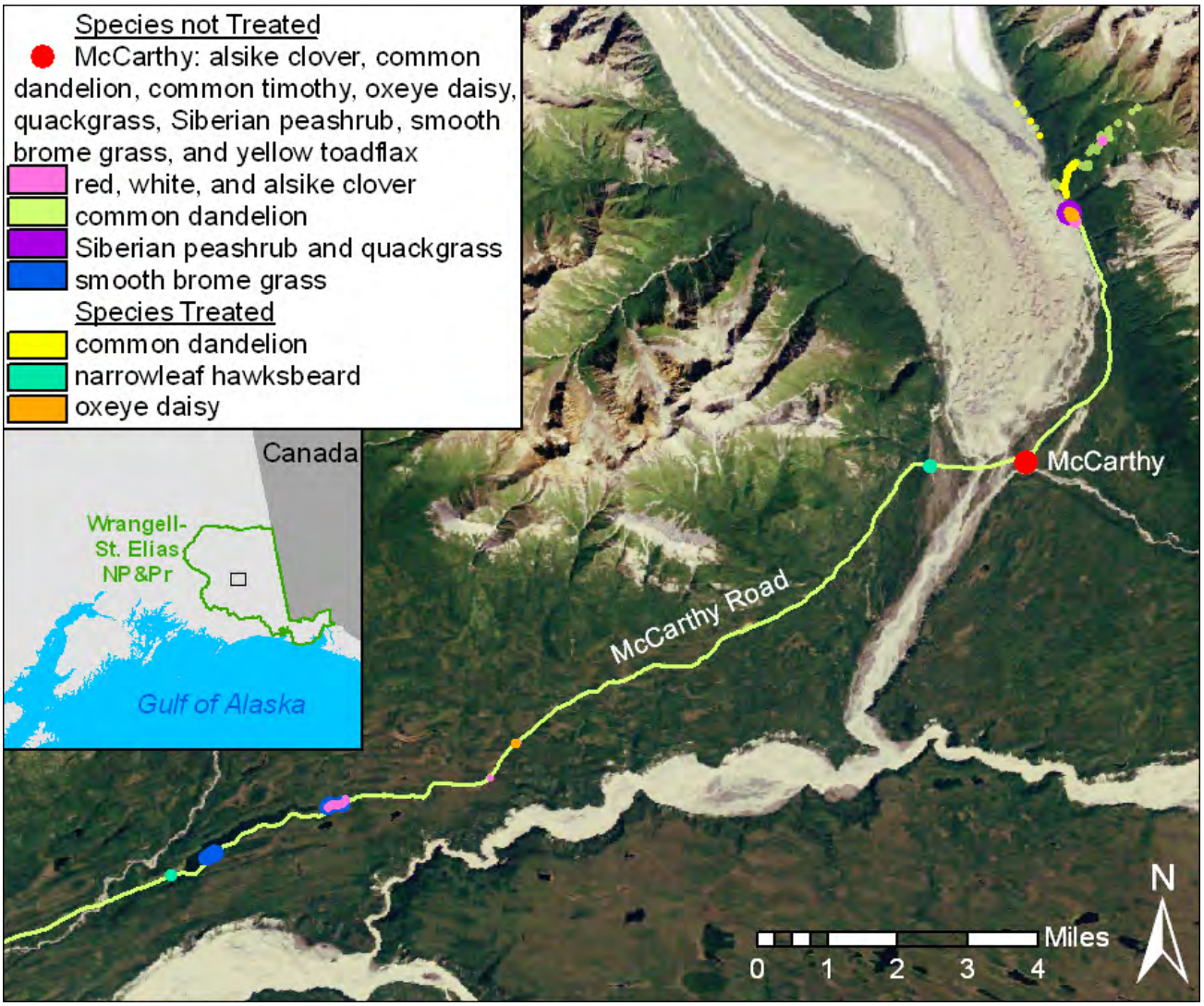

Figure 3.8. Invasive plant survey and control efforts in the McCarthy/Kennecott area of WRST, 2004-2006.

3.1.16 Yukon-Charley Rivers National Preserve (YUCH)

Yukon-Charley Rivers National Preserve has two species of primary management concern: narrowleaf hawksbeard and smooth brome grass, both known only from the Coal Creek Valley. Both species were manually controlled in 2005, and the narrowleaf hawksbeard was controlled again in 2006 and 2008 and had spread significantly beyond its 2005 extent. Other species are found in the valley, but other than common dandelion, none warrant control efforts. Concurrently, white sweetclover and bird vetch are becoming pervasive in Fairbanks, suggesting that they will soon arrive in Yukon-Charley.

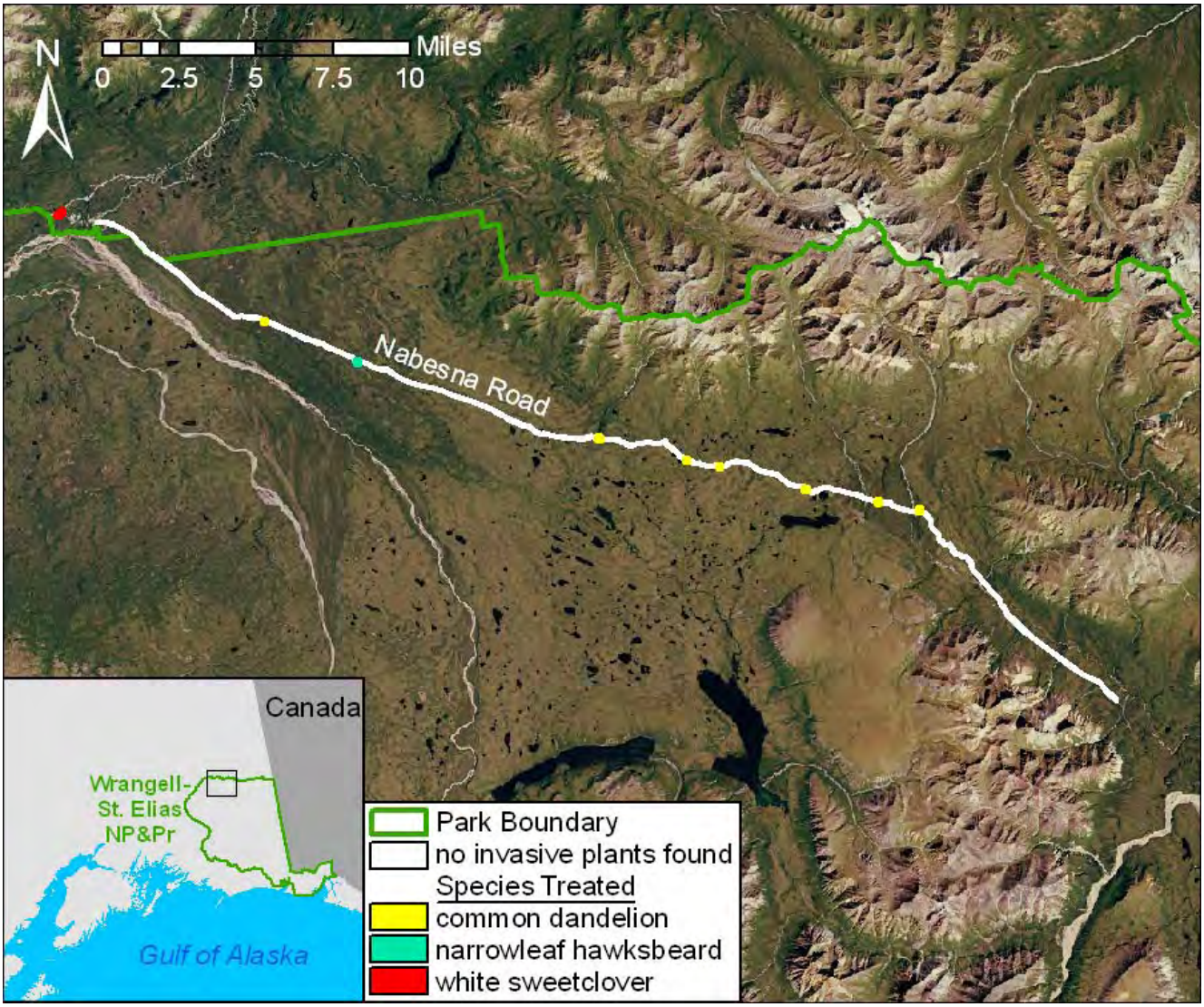

Figure 3.9. Invasive plant survey and control efforts along the Nabesna Road in WRST, 2004-2006.

3.2 Aquatic Resources and Fish

The 54 million acres of Alaska National Parks and Preserves constitute 2/3 of all park land in the United States, and probably a greater percentage of its rivers, streams and lakes. Tens of thousands of pristine lakes and thousands of largely untouched rivers and streams are found on these parklands, including 13 designated National Wild and Scenic Rivers. This great diversity of aquatic ecosystems provides critical habitat for dozens of native fishes, including all 5 species of anadromous Pacific salmon, as well as other ecologically and economically important species such as whitefish, Dolly Varden, northern pike, burbot and steelhead. In addition, Alaskan parklands (ALAG, KATM, LACL, and WRST) contain a substantial portion of the spawning and rearing habitat for two of the richest salmon fisheries in the world, Bristol Bay and the Copper River. Finally, the lakes and streams of Alaskan parklands provide important breeding

and rearing habitat for 2 species of amphibians, the western toad and the wood frog. Water quality in Alaska park units is generally excellent, although there are some cases in which water quality has been impaired due to the effects of extensive historic mining activity. For example, several streams in the Kantishna Hills in DENA are impaired, as are streams in the Chisana area of WRST.

The aquatic resources that could be most affected by invasive plants and management response actions are streams, rivers, lakes and ponds that are near high human traffic areas. Examples include SITK and KLGO and the entrance area to DENA. Other areas of primary concern would be those that have a long history of human use, like Anaktuvuk Pass in GAAR, Coal Creek in YUCH, the McCarthy road corridor in WRST, or the area around Lake Minchumina near DENA. Of secondary but still substantial concern are other areas, like the Nabesna road in WRST, or backcountry airstrips and ATV trails in a number of parks that see less but still significant visitation. A third type of area of concern would be river corridors that cross or are adjacent to highways and roads and either flow into or out of a park unit. Invasive riparian species like white sweetclover are aggressive colonizers of open river bars, and are able to spread along river corridors through otherwise undisturbed areas. Examples include the Nenana River and its tributaries (DENA), the Koyukuk River (GAAR) and the Tanana River and its tributaries (WRST). Summary aquatic resources information about potentially affected areas is provided below. No invasive plants have been found in ALAG, ANIA, BELA, CAKR, KOVA or NOAT; although few plant surveys have been conducted in these units. Because these units are also relatively remote and see little visitation, their potentially affected aquatic resources are not summarized below.

3.2.1 DENA Aquatic Resources

To date, invasive plants have largely been confined to the eastern entrance area, park road, Alaska Railroad, and to the surrounding areas. NPS EPMT crews have manually removed white sweetclover from river bars and road sides in the front country of DENA. This area includes the catchments of several small streams, three of which cross the park road, and one larger stream, Hines Creek. The Nenana River, a large glacially-influenced river, forms part of the eastern boundary of the park itself. Although limitations on the number of private vehicles allowed past Savage River reduces the potential for spreading propagules of invasive plant species further into the park via the park road, the large number of visitors from all over the world makes eventual infestation in the park interior likely. Approximately 40 streams and rivers cross the park road between the park entrance and Kantishna, ranging in size from small 1st order creeks and springs to major glacial rivers. Spring-fed streams may be of particular biological importance to both aquatic invertebrates and fish because they tend to stay open year round and have stable flow regimes. Several of the larger rivers in the park, including the Teklanika and Toklat rivers, are known to support spawning runs of chum and chinook salmon. Wonder Lake, one of the major visitor destinations in the park, abuts the park road and also features a campground with 30 campsites.

Any of these areas has the potential over the long term of experiencing infestation with invasive plant species and subsequently being subject to management action.

3.2.2 GAAR Aquatic Resources

At present, the presence of the common dandelion in upland areas near Walker Lake remains the only recorded instance of invasive plants in GAAR. However, a number of species, including white sweetclover, a riparian invasive, are known to be spreading northward along the Dalton Highway towards GAAR. The Middle Fork of the Koyukuk River and the Dietrich River run parallel to the Dalton Highway for over 70 miles before flowing into the park and joining the North Fork of the Koyukuk, a National Wild and Scenic River, northeast of Bettles. A permanent settlement, Bettles is approximately 15 miles downstream of GAAR on the Koyukuk River and is a major staging area for excursions into the park. The village of Anaktuvuk Pass is another major entry point to the park and is surrounded by a network of ATV trails into the park. It sits at the headwaters of the John River, another National Wild and Scenic River in GAAR.

3.2.3 GLBA Aquatic Resources

Numerous invasive plant species have been documented in and near GLBA. Infestations are concentrated at Bartlett Cove, Dry Bay, and scattered backcountry locations in the park and at Gustavus near the park. The Bartlett Cove area is less than 2 miles from the mouth of the Bartlett River. Gustavus is located at the mouth of the Salmon River, which flows out of the park and supports spawning runs of multiple salmon species. Dry Bay forms the mouth of the Alsek River, a major glacially-influenced river that flows out of Canada and through GLBA. ATV trails originating at Dry Bay cross riparian areas of the East Alsek River and a number of tributary drainages. ATV trails across the Doame River and duplicative trails elsewhere in the area have recently been closed (USDI-NPS 2007a). Receding glaciers throughout GLBA are exposing new areas of barren ground and creating miles of new stream and river habitats. Such early successional stream banks and gravel bars are prime habitat for the establishment of invasive riparian plants.

3.2.4 KATM Aquatic Resources

The lakes and rivers in this park are famous for their rainbow trout and red salmon fisheries, among others. Brooks Camp and the road to the Valley of Ten Thousand Smokes are areas in KATM where invasive plants have been identified and controlled. Brooks Camp sits on the shores of Naknek Lake and the Brooks River. Access to the area is by boat, float plane, and amphibious plane. The gravel road fords three tributaries of Margot Creek. The town of King Salmon is less than 10 miles from the western border of KATM and is on the banks of the Naknek River. A road from King Salmon reaches the border of the park on the Naknek River, where boats are launched into the river to access Naknek Lake.

3.2.5 KEFJ Aquatic Resources

The Exit Glacier road runs along the Resurrection River, which forms part of the eastern border of KEFJ. There are a number of small streams, including the Exit Creek and Paradise Creek, another braided glacial outwash, in the vicinity of the Exit Glacier visitor center, where the majority of invasive plants have been identified. Resurrection River has a significant silver salmon fishery, and dolly varden and grayling are known to venture up Exit Creek.

3.2.6 KLGO Aquatic Resources

KLGO sits largely on the delta of the Taiya River. A number of invasive plants have been identified near Dyea and also in nearby Skagway, where the Skagway River enters Taiya Inlet. These rivers contain salmon and trout fisheries. The Klondike Highway and White Pass and Yukon Railway run parallel to the Skagway River. The railroad runs through the White Pass unit of KLGO.

3.2.7 LACL Aquatic Resources

Invasive plants have been found along Lake Clark, Twin Lakes, and Silver Salmon Creek. Port Alsworth sits on the shore of Lake Clark and very near the delta of the Tanalian River, which drains Kontrashibuna Lake. Twin Lakes form the headwaters of the Chilikadrotna River. Silver Salmon Creek is a low-gradient clear-water side channel of West Glacier Creek along the west side of Cook Inlet.

3.2.8 SITK Aquatic Resources

Indian River runs through SITK where it enters Sitka Sound. As documented in figures 3.6 and 3.7, numerous invasive plants species occur in SITK, and Japanese knotweed is known to be a pervasive riparian species. Estuary and floodplain aquatic ecological units exist in the park, which house a rich diversity of macroinvertebrates, six species of anadromous fish, and resident rainbow trout. Water quality and temperatures in Indian River are “OK”, but the SITK Coastal Water Resources and Water Conditions Assessment indicate aquatic invasive species and contaminants are a concern for these areas (USDI-NPS 2006b).

3.2.9 WRST Aquatic Resources

NPS EPMT crews have so far successfully removed white sweetclover from river bars and roadsides near Slana in WRST where streams feed into the Copper River. The Copper River is a large dynamic glacial river with an extensive active channel. Numerous tributaries, many of them draining glaciers in the Wrangell Mountains enter the Copper from park land. The Copper River supports one of the most productive sockeye salmon fisheries in the world, and also supports runs of chinook and coho salmon. The upper Copper River basin, near the Nabesna Road, contains an extensively connected network of small lakes and streams that provide critical

sockeye, Chinook and coho spawning areas. Streams along the Nabesna Road vary from dynamic alluvial systems, both perennial and seasonal, to small stable groundwater-fed streams. Extensive ATV trails originate at the Nabesna Road and run to, alongside, or cross several streams, including Tanada Creek, Caribou Creek, Lost Creek and Trail Creek. Streams crossing the Nabesna Road drain into both the Copper River and the Nabesna River, which flows north out of the park and joins the upper Tanana River. The McCarthy Road is in the Chitina River basin, which contains a substantial portion of the Copper River salmon spawning and rearing habitat. All streams near the McCarthy Road are tributaries of the Chitina River. The Kennicott River is a glacial outwash from the Root and Kennicott Glaciers. McCarthy Creek is a small glacial river originating at McCarthy Creek Glacier. The majority of streams that cross the McCarthy Road are non-glacial in origin, with the exception of the Kuskulana River, and are therefore important for fish spawning. Long Lake is a particularly important sockeye spawning area and the site of a fish weir used to quantify spawning populations.

3.2.10 YUCH Aquatic Resources

Coal Creek is the major area impacted by invasive plants in YUCH. Coal Creek has been extensively disturbed by past mining activity. The gateway communities to YUCH, Eagle and Circle, are connected by road to the Alaska Highway and Fairbanks, respectively, which support large established populations of a variety of invasive plants that could be transported into YUCH. The Charley River, a National Wild and Scenic River, flows 106 miles north to its confluence with the Yukon River entirely within the boundaries of YUCH. A central portion of the Yukon River flows 128 miles through YUCH. Eighteen species of fish occur in two rivers and support a limited amount of subsistence, sport, and commercial fishing, especially for king and chum salmon (USDI-NPS 1985b).

3.3 Cultural Resources

3.3.1 Introduction

Alaska in general, and Alaska's NPS lands more specifically, have often been perceived as an uninhabited wilderness – and perhaps as a way to underscore that perception, more than 32 million acres of the 54 million-plus acres of NPS land in Alaska is now part of the National Wilderness Preservation System. This perception, however, is largely a political and cultural construct, because people—both during the prehistoric and historic periods—have lived and traveled throughout the vast majority of lands within Alaska's national park units. Physical evidence of this human activity is collectively known as cultural resources. These are found throughout Alaska parks as archeological sites, cultural landscapes, ethnographic resources, and historic structures. Not all of these cultural resources would likely be affected by invasive plant management methods, such as historic structures, unless a nearby weed-burning effort got out of control.

3.3.2 Overview

As an integral part of their lives and travels, people—wittingly or unwittingly—brought animals, plants, and seeds with them. Animals, plants, and seeds travel in a variety of ways. Some have moved due to natural forces, such as when a new plant community emerges from a burned-out area or after a glacier's recession. Some have moved when prehistoric peoples migrated from one region to another, and still others have moved as part of trading networks. An academic case could be made that in all of these cases, the plants involved were "exotic" and perhaps "invasive." As a practical matter, however, it is broadly recognized that "invasive plants," as noted in this report, do not fit under any of these definitions. Instead, they are defined more narrowly to include those plants that are harmful to the natural environment or economy.

Although Alaska's archeological database remains both limited and sketchy, archeologists recognize that a vast array of prehistoric archeological sites resides within the park units. The earliest of these can be dated from the last part of the Pleistocene, some 11,000 years BP, and continued until the time of the first European contacts (ca. 1740 A.D.). These sites document the diverse and changing adaptations of Alaska's major native groups—Aleut, Eskimo, and Indian. The climatic range of these sites is enormous, from the rainy and forested Pacific Northwest to the arid and treeless Arctic coastal plain. As a rough generalization, the highest concentrations of prehistoric human activity have been located along rivers, particularly at river confluences or where rivers meet the sea). But human habitation, either permanent or temporary, can also be found along trails, at overview points, along lakeshores, or in any number of other geographic situations. And in addition to the most obvious human habitation sites, many Alaska Natives moved seasonally in order to take best advantage of the available fish and game; as a result, trails as well as camps were important aspects of Native lifestyles. Perhaps the only places that are predictably lacking in cultural impacts are glaciated areas, although some trails wound through these areas and other evidence of past human activity has been revealed from melting glaciers. In short, virtually no areas within Alaska's parks can be categorically excluded from consideration as potential locations for prehistoric sites.

Between 1741 and 1867, present-day Alaska was ostensibly a Russian colony, and most settlement and travel was along Alaska's southern shorelines, with this phase of Alaska history evident at SITK with the Tlingit fort and battlefield site and the Russian Bishop's House. Beginning in the late 1870s, and continuing until the outbreak of World War I, a wave of prospectors swept over Alaska and the neighboring Yukon and discovered gold, silver, copper, and other minerals throughout the territory. The so-called mining frontier was felt most strongly in the Skagway and Dyea areas, now part of the KLGO, at various camps along the upper Yukon River near Eagle, in the Nome and Fairbanks areas, and around smaller camps, such as Circle, Iditarod, Chisana, Livengood, and elsewhere. In some cases miners and other pioneers established gardens around their homes or campsites, such as those at Coal Creek Camp and Slaven's Road House in YUCH. Supplying these camps demanded trails,

roads, wood camps, roadhouses, gear caches, supply stations, Army forts, telegraph lines, and a host of other support facilities.

Also in the late 1870s the commercial fishing and packing industry began with canneries at Sitka and Klawock. Fish processing sites (which also included salteries, trap sites, floating canneries, and other facilities) were soon found along shorelines and near river mouths from Metlakatla all the way north to Bristol Bay. As with mining and prospecting, the fish packing industry also had a marked effect on the lives of existing residents; many who moved to sites adjacent to the canneries to take advantage of work opportunities. Others adjusted their lifestyles to one in which summertime fish cannery work complemented winters spent at trapping cabins and on trap lines, with remains of these buildings, structures and sites found in several parks including GLBA, KATM, and LACL.

A few large scale ventures drew people to Alaska, including the Kennecott Copper Mine complex and company town, now part of WRST. In more recent years, new settlement forms in Alaska have been related to agriculture, the military, the petroleum industry, and tourism. All of these new sites and areas supported ancillary and support facilities, such as roads and airfields where nonnative plants have been introduced.

Because of the many economic activities that have taken place in Alaska since 1867 and because each of these has increased migration of people into, and out of, a variety of previously undisturbed sites, a large number of areas in Alaska have been subjected to many years—sometimes a century or more—of impacts from outside visitors. Given the duration of these impacts, it is highly likely that various plant species have invaded many parts of Alaska. The extent and impact of these plant species is perhaps greatest in and around cities, canneries, mines, and other sites where the most intensive human activity has taken place. But because people have invaded most of Alaska at one time or another during the historic period, and because people —for better or worse—have brought plants along with them, it is quite likely that invasive plants will be found along trails and roads and at historic wood camps, cabins, fish camps, and other historic sites. And even in the most remote wilderness setting. It can never be assumed that any area in Alaska is free of invasive plants.

3.3.3 Archeological Resources

All NPS units in Alaska contain archeological sites. Archeological sites in Alaska document a range of occupation periods from the late Pleistocene era to the Mid-Twentieth century embracing broad range of themes including early migrations to the new world to the development of profitable mining technology. The distribution of known archeological sites is skewed by the size, remoteness, rugged terrain and harsh climate of Alaska. Permafrost, loess deposition, volcanism, sea level change and glaciation may preserve sites while making many of them almost impossible to find. Funding, permitting and management policies have restricted unfettered archeological investigation. Despite these obstacles, each year archeologists find new sites; sites

which are significant in terms of their capacity to enhance our understanding of past cultures by contributing unique, new information.

Archeological sites do not occur randomly - they are located in the most advantageous locations for efficiently exploiting various aspects of the local environment. The spatial distribution of archeological sites produced by a human group's paleo-ecological adaptation to its environment is called a subsistence/settlement pattern. Because archeological sites are often occupied by people in modern times too, these sites could be at risk from invasive plant infestations.

Wide spread across Alaska are surface lithic scatters on exposed ridges and hill tops, glacial moraines, ancient river bars, beach ridges and terraces. These have in common exposed stone artifacts and debris from producing and maintaining stone tools, and absent or thin archeological sediments that are usually churned by frost action. Many lithic scatters contain rifle cartridges and other modern debris, which provides evidence that these sites could be infested with invasive plants if modern hunters transport their seed.

An important theme in Alaska prehistory and history is that people subsisted by means of a hunting/gathering economy. This means that wild food supported society rather than produced goods. Alaska Natives exploited many plants species including berries and sour dock, but these species were collected from wild populations and were not farmed. Archeological sites often support luxuriant stands of colonizing vegetation such as fireweed, sage, alder and cow parsnip to name a few, but these also occur naturally after burns or natural events.

Alaska Natives did not cultivate plants prehistorically; however, in historic archeological sites, culturally significant exotic plant taxa may be present.

3.3.4 Cultural Landscapes

Currently there are 74 cultural landscapes identified in Alaska, 22 of which have been listed on or determined eligible for listing to the National Register of Historic Places (NRHP). They occur in every park and preserve in the system and vary widely from small village or camp sites associated with Alaska's earliest inhabitants, to sprawling mining sites devoted to a complex culture of historic resource extraction. Landscapes themselves encompass a wide variety of resources, which can include natural systems and features, vegetation, buildings and structures, archeological sites, views and vistas, topography, land use and small scale features. All of these landscape characteristics could be affected by invasive species and invasive species management practices in Alaska's National Parks and Preserves.

3.3.5 Ethnographic Resources

Plants used for subsistence, medicinal purposes, or to make tools or buildings can be ethnographic resources. Invasive plants may threaten such ethnographic resources by

supplanting traditionally-used plants, or by impeding access to harvesting areas. Alternatively, possibly after several generations, exotic plants may eventually come to be used in traditional ways. A further consideration is that efforts to eradicate invasive plants may have greater impacts than the invasive plants themselves, since chemical and other treatments might also damage native plants and animals.

In some cases, traditional properties will not be adversely affected by the invasive plant program, and some will even benefit. For example, within Glacier Bay Park and Preserve is a former village site at Bartlett Cove. The park considers that the integrity of this 3,800 acres site, determined eligible to the NRHP, would be enhanced by the removal of invasive plants.

People living in communities associated with parks are well positioned to observe changes occurring as a result of invasive plants or treatments. Knowledgeable local people should be consulted to learn the potential risks to ethnographic resources, either as a result of invasive plants or of efforts to rid the area of invasive plants.

3.3.6 Historic Structures

Historic structures are defined as a constructed work, usually immovable by nature or design, created to serve some human activity, such as buildings, bridges, earthworks, roads, and rock cairns. Many historic structures in the Alaska Region are constructed of wood. They range in size from one room log houses to large wood frame or log office buildings and road houses. The structures are located in remote towns and sites throughout the state. From the functional simplicity of the trapper's cabin and cache to the weathered, austere beauty of a Russian Orthodox chapel, they give evidence of human's adaptability to a harsh and challenging environment.

3.4 Human Health and Safety

NPS environments in Alaska are generally pristine and clean with the greatest threats to human health and safety occurring from automobile and aircraft accidents, climbing accidents (slips, trips, and falls), and wildlife encounters (mostly bear and moose, but also stinging insects). Other threats to human health and safety are from improper lifting of luggage, packs and other items and diseases from impure or infected water. Giardia is a growing issue in Alaska as are West Nile virus and avian influenza. The NPS follows the national protocol for Integrated Pest Management and any use of chemicals to control insects or other pests is carefully screened. Only trained applicators are allowed to spray chemicals with appropriate personal protective equipment (PPE).

3.5 Soils

Soils in interior and arctic Alaska National Parks are characterized by wind-deposited silt loam and have developed under low rainfall and cycles of freezing and thawing. Soils in Alaskan National Parks in maritime climates have evolved with less aeolian

deposition, much higher rainfall and little to no influence of soil freezing, except at high elevations. Glacial processes have reworked soils in many of the mountainous parks. Forested soils are characterized by surface and sometimes buried organic layers. Soils under coniferous forests are often characterized by organic layers that are 6 inches or greater in depth. Thick organic soils also exist in some wetlands through the accumulation of moss brought about by slow decomposition rates. Exposed mineral soil is found where water erosion or deposition occurs in conjunction with sheet erosion, glacial action, rivers, lakes and oceans; landslips/soil creep, and human-caused clearing, trampling and construction. The soil types present in Alaska national parks have *not* been characterized and mapped in detail with the exception of Denali National Park and Preserve (Clark and Duffy 2004). Soils in most parks are described generally in "Exploratory Soil Survey of Alaska" (Rieger, S., et. al. 1979).

An example of a known effect of invasive plants on soils is provided below. White sweetclover is a legume and consequently a nitrogen fixer. In addition to changing soil chemistry, it affects soil conditions by reducing erosion (Carlson et al. 2008). Although Rutledge and McLendon (1996) indicate in their assessment that sweetclover did not appear to be affecting native plant communities in Rocky Mountain National Park (RMNP), Wolf et al. (2004) showed that sweetclovers in montane grasslands of RMNP had variable diversity between patches of sweetclover and those not invaded. More exotic, annual/biennial, and forb species occurred with sweetclover, while more native, perennial, and grass species occurred in the control patches. In addition, several exotic species were found only with sweetclover and certain native species were only found in control patches. Furthermore, the presence of sweetclover appeared unrelated to disturbance and the extent of infestations increased over the course of the two year study. Wolf et al. (2004) demonstrated lower nitrogen availability in soils invaded by white sweetclover. *M. officinalis* is known to be an N-fixing species. Any alteration in nitrogen metabolism in riparian or even upland soil has the potential to impact nutrient cycling in streams, which tend to be extremely nitrogen limited in Alaska. This is a basic aspect of riparian/stream biogeochemistry. The extent and type of watershed vegetation has a large influence on stream water chemistry, especially nutrient chemistry (e.g. Schlesinger 1997). Conn et al. (2008) found sweetclovers associated with soil disturbance in Alaska.

3.6 Subsistence

ANILCA Section 101 (c) states a purpose of the Act is to provide the opportunity for rural residents engaged in a subsistence way of life to continue to do so, consistent with recognized scientific principles to manage fish and wildlife resources and the purposes for which the conservation system units were established. ANILCA Title II identifies those National Park System units permitting subsistence activities in accordance with Title VIII, Subsistence Management and Use. Section 203 states continued subsistence uses are allowed in all national preserves. Sections 201 and 202 identify parks and monuments where subsistence uses may continue. In ANILCA Title VIII Congress declared its policy that conservation of healthy populations of fish and wildlife and the utilization of public lands in Alaska are to cause the least adverse

impact possible on rural residents who depend upon subsistence uses of the resources of such lands. All ANILCA land use decisions are to include an evaluation of the effects to subsistence uses prior to making the decision. An ANILCA 810 subsistence evaluation is attached as appendix A. Table 3.3 summarizes subsistence activities in NPS units as described in park general management plans and other park documents. Special Alaska park regulations at 36 CFR Part 13 provide for subsistence activities in Alaska National Park system, such as § 160 which allows the use of cabins and other structures.

The great majority of invasive plants listed as found in surveys in Alaska NPS units (Table 3.1 of the EA) or throughout the State of Alaska (Appendix B) are not used by subsistence users in Alaska, but a few are. The common dandelion (*Taxaxacum officinale*) has been used by Aleut peoples for arthritis, sore throat, and stomach troubles where the leaves are steamed and wilted before being applied as a poultice. This plant is widespread across Alaska and occurs in several NPS units, but its invasiveness ranking is moderate (59).

Other invasive plant species now known to inhabit NPS areas in Alaska (including species that could be listed in table 3.1) and also used for subsistence are common sheep sorrel (*Rumex acetosella*), lambs-quarters (*Chenopodium album*), pineapple weed (*Matricaria discoidea*), shepherd's purse (*Capsella bursa-pastoris*), and common plantain (*Plantago major*). Sheep sorrel leaves are famous for their sour taste and have been used to treat inflammations, scurvy, and fevers (AKEPIC 2005). Lambsquarters is an edible herb and is gathered as a salad green (AKEPIC 2005) or used as a poultice for skin sores (Garibaldi 1999). Pineapple weed is brewed into a tea or chewed to treat stomache troubles, colds, or menstruation and pregnancy discomfort (Garibaldi 1999, AKEPIC 2005). Shepherd's purse has been used as a poultice to help stop external bleeding or as a tea to help stop internal bleeding (ENRI 1999). Common plantain is drunk as a tonic for general ill health or leaves applied as wrap for bunions and cracked sore feet (ENRI 1999). All of these species have an invasive risk ranking of 51 (sheep sorrel) to as low as 32 (pineapple weed). None of these species would likely warrant the use of herbicides according to the decision tree in the EA (figure 2.1) and, therefore, they should not become an issue for subsistence users or wildlife. Generally these invasive species would be removed physically or contained.

Invasive species can displace important subsistence plants (e.g. white sweetclover (*Melilotus alba*) can overrun gravel bars and displace Eskimo or wild potato (*Hedysarum alpinum*), which has been collected by Native Alaskans for centuries and is an important forage food for brown bears.

3.7 Terrestrial Vegetation

Across Alaska's NPS units, there exists a wide variety of plant communities that could be affected by invasive plants and management strategies. Intact and widespread plant communities range from the coastal temperate rainforests of Southeast Alaska parks to boreal forests of Interior Alaska parks to arctic or alpine tundra in most Alaska parks.

The majority of plant communities categorized by the Alaska Vegetation Classification (Viereck et al. 1992) are represented in at least one park, and this system provides a more thorough description of the range of plant communities in Alaska than can be effectively presented here. Except for scattered invasive plant infestations in developed and frequently visited areas, the plant communities found in Alaska NPS units are entirely composed of native species, setting them apart from NPS lands in other states.

Areas most affected by invasive plants and management strategies currently and in the near future are those disturbed by human activity or natural processes. Examples of areas disturbed by human activity include facilities, roadways, trails, airstrips, and campsites. Natural disturbances include wildfire, periodic flooding, glacial retreat, avalanches, and landslides. Both types of disturbances provide habitat for different native plant communities than in the surrounding landscape. The vast majority of invasive plant infestations in Alaska NPS units are found in areas of human disturbance, and the natural areas most immediately threatened by invasive plants are those disturbed by natural processes. Typically, an invasive plant species has a lag phase when it is introduced in its new environment. Next the invasive plant exhibits an exponential growth or colonization phase, followed with a sustained high density when it becomes naturalized (Fig. 3.10). For most of Alaska's invasive plant species we are between those first two phases, which coincidentally are the stages that are most treatable and most likely to result in eradications. The invasion process is described in the following web page: http://www.weedcenter.org/textbook/3_rados_invasion.html .

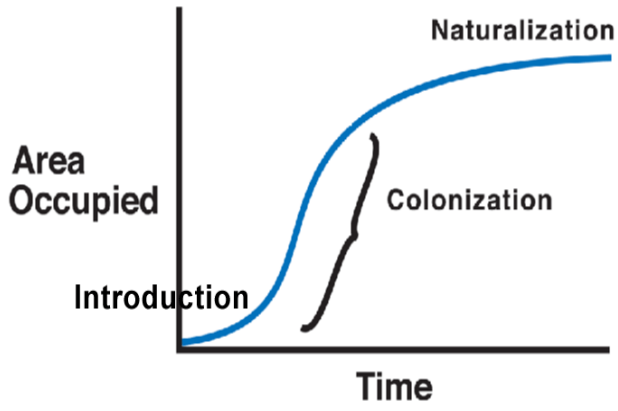

Figure 3.10. Diagram of invasion process showing extent of infestation over time (http://www.weedcenter.org/textbook/3_rados_invasion.html**).**

Table 3.1 summarizes nonnative plants found in Alaska NPS units and appendix E provides more detail.

Table 3.3. Summary of Subsistence Activities in Alaska NPS Units (excerpts from park GMPs)

Park	Resident Communities/Zone	Traditional Activities and Resources Used	Primary Access Methods
ANIA	Chignik, Chignik Lagoon, Chignik Lake, Meshik, and Port Heiden	Fishing, hunting, and trapping. Cabins may be maintained or built in support of subsistence in the monument.	Mostly motorboats. ORVs and airplanes are prohibited unless a special provision is made.
BELA	Not listed, but Shishmaref, Wales, Teller, Brevig Mission, Deering, Nome, White Mountain, Golovin, Elim, and Koyuk are user communities.	Hunting, fishing, trapping, and gathering. Resources harvested are marine mammals (seal, walrus, whale, and polar bear), fish, game (caribou, muskoxen, and moose), birds, and wild plants and berries. Fur and natural fibers are made into clothing and handicrafts, and some are sold for cash income.	Motorboat, snow-machine, ORV, dog team, canoe, kayak,
CAKR	NANA Region	Hunting, fishing, trapping, and gathering. Resources harvested are caribou, moose, muskox, seals, fish, berries, plants, driftwood.	Motorboat, snow-machine, ORV.
DENA	Cantwell, Minchumina, Nikolai, and Telida.	Hunting (mostly moose and some caribou), trapping, and wood cutting for cabins and firewood. Cabins and shelters are typically used along trap lines. Subsistence fishing may occur in the park additions and preserve	ORVs are traditional in the Cantwell area. Trucks and snowmachines are used in park additions and preserve.
GAAR	Alatna, Allakaket, Ambler, Anaktuvuk Pass, Bettles/Evansville, Hughes, Kobuk, Nuiqsut, Shungnak, and Wiseman.	Hunting, fishing, trapping, timber cutting, use of shelters and cabins. Resources harvested are Caribou, Moose, Dall's sheep, Arctic Char, Salmon, and trout.	Motorboat, snow-machine, ORV. Airplanes for Anaktuvuk Pass residents with a permit.
GLBA	Mostly Yakutat	Fishing, hunting, and trapping in preserve near Dry Bay only.	ORV's, trucks, motorboats
KATM	Hallersville, Levelock, Igiugig, Kakhonak, and possibly other Bristol Bay and Iliamna Lake area communities	Subsistence activities (fishing, hunting, and trapping) are only allowed in the preserve part of KATM and Alagnak Wild River in the northern parts of the unit.	Mostly motorboat.
KEFJ	English Bay (Nanwalek)	Subsistence for moose and bear retained only on lands sold to NPS in North Arm area of Nuka Bay.	Fishing boats.

Park	Resident Communities/Zone	Traditional Activities and Resources Used	Primary Access Methods
KOVA	NANA Region communities	Hunting and fishing activities are major contributors to local diets. A limited amount of trapping in the park provides furs to residents for personal clothing or sale to provide cash for subsistence tools and supplies. Berries, roots, and other edible plants round out subsistence diets. Birch bark and spruce roots are harvested for the construction and sale of baskets. Wood taken from the park provides fuel to heat camps and homes during long cold winters.	Motorboats, snowmachines, dog teams.
LACL	Iliamna, Lime Village, Newhalen, Nondalton, Pedro Bay, and Port Alsworth.	Salmon fishing, moose and caribou hunting, berry gathering, and firewood and house log gathering. Limited subsistence trapping primarily occurs on lands adjoining Lake Clark, Chulitna River, and the coast	Motorboat, ORVs, and snowmachines.
NOAT	NANA Region communities	Hunting and fishing activities are major contributors to local diets. Trapping in the preserve provides furs to residents for personal clothing or sale to provide cash for subsistence tools and supplies. Berries, roots, and other edible plants round out the subsistence diets. Wood taken from the park provides fuel to heat camps and homes during the long cold winters.	Motorboat, snow-machine, ORV's. The use of airplanes for subsistence access to resources in the preserve is permitted.
WRST	Chisana, Chistochina, Chitina, Copper Center, Dot Lake, Gakona, Gakona Junction, Glennallen, Gulkana, Healy Lake, Kenny Lake, Lower Tonsina, McCarthy, Mentasta lake, Nabesna, Northway, Slana, Tanacross, Tazlina, Tetlin, Tok, Tonsina, and Yakutat. Over 100 people reside within WRST boundaries.	Fish, game, vegetable foods, and wood are gathered from public lands. The greatest use of subsistence resources occurs off of major access corridors and centers at Nabesna Road, McCarthy Road, Chisana, May Creek/Dan Creek and Malaspina Forelands. Residents of Yakutat use the Malaspina Forelands to hunt moose, waterfowl, seal, and bear, and to trap. Sheep and goats are also taken, but non-subsistence take of these animals is more prevalent. Trapping occurs throughout the park and preserve north of the Bagley Icefield. Wild berries and plants are gathered in substantial quantities. Spruce logs are cut for cabin logs, and wood gathering for home heating and cooking is a common subsistence activity.	Motorboats, trucks, ORVs are typical access means. Access by boat or airplanes is allowed on the Malaspina Forelands.
YUCH	Eagle, Eagle Village, and Circle are main subsistence communities in the vicinity.	Hunting, trapping, fishing, and wood gathering are the primary subsistence activities in the preserve, and the use of cabins and shelters to support subsistence activities are allowed.	Motorboat, snowmachines, and dog teams.
KLGO SITK	Neither of these units have federal subsistence areas. Personal use is likely to occur in both units, but adequate public notification with signs and other outreach should mitigate conflicts.		

The following subsections summarize the plant communities found in each park unit and those in the vicinity of current invasive plant infestations. Percentage values for vegetation types by park were adapted from the most recent analyses available from the NPS Landcover Mapping Program in the Alaska Regional Office, except where otherwise noted, using terminology drawn from the Alaska Vegetation Classification. More detail is provided for parks with more extensive invasive plant infestations.

3.7.1 ANIA Terrestrial Vegetation

Only a coarse statewide landcover map exists for ANIA, and its analysis suggests that low and dwarf shrub, tussock and wet sedge, moist herbaceous, and lichen communities compose 55% of its area. An additional 13% is covered by tall and low shrublands and 20% by alpine tundra and barrens, with over 12% unvegetated. No invasive plants have been documented in ANIA, and therefore no plant communities are directly threatened by invasive plants.

3.7.2 BELA/CAKR Terrestrial Vegetation

The plant communities of BELA and CAKR are composed primarily of low shrubs, sedges, grasses, forbs, mosses, and lichens. Nearly 60% of the two units are covered by moist upland systems, and almost 30% is covered by moist lowland systems. The remaining vegetation consists of dry alpine dryas, dry upland systems, riverine willow shrublands, and coastal meadows, in order of decreasing abundance. No invasive plants have been documented in BELA or CAKR, and therefore no plant communities are directly threatened by invasive plants.

3.7.3 DENA Terrestrial Vegetation

More than 30% of DENA is unvegetated, with surfaces of rock, ice and snow, and water. Over one quarter of the park supports spruce forests and woodlands, with the majority stunted by conditions on the north side of the Alaska Range. Another quarter supports low and dwarf shrublands and herbaceous plant communities, collectively referred to as tundra, and 5% is sparsely vegetated. Alder and willow shrublands comprise 6% of the park and broadleaf and mixed spruce-broadleaf forests 4%. As of 1998, 3% of the park/preserve had recently burned.

Plant communities in the park entrance area and along the Parks Highway are dominated by spruce forest and woodland and mixed spruce-broadleaf forest. By contrast, most plant communities along the Denali Park Road beyond the first several miles are shrublands of various composition and structure with occasional tree cover near rivers. Areas disturbed by heavy equipment within the park, including roadsides and around buildings, are inhabited by sown and transplanted pioneer herbaceous plants and shrubs. River floodplains are similar in composition or unvegetated due to natural processes.

3.7.4 GAAR Terrestrial Vegetation

In GAAR, 10 to 15% of the landscape is unvegetated. About 53% of the park consists of low and dwarf shrublands and herbaceous plant communities (arctic and alpine tundra), 6% supports tall

shrubs, and an additional 7% is sparsely vegetated. Almost 18% of the park supports spruce forests and woodlands, and 1% supports broadleaf and mixed spruce-broadleaf forests.

Plant communities near where common dandelion has established on Walker Lake are a mosaic of spruce and broadleaf forest types and tall and low shrublands. Vegetation types along the park boundary near the Dalton Highway include spruce and broadleaf forests and tall shrublands to the south and in riparian zones, with low to dwarf shrublands and herbaceous communities to the north and on upland zones, accounting for the majority of the area.

3.7.5 GLBA Terrestrial Vegetation

The plant communities in GLBA exist along a continuum of plant succession as its glaciers retreat, with the oldest communities on the outer coast and near the mouth of the Bay. According to a statewide landcover map, 68% of GLBA is covered by water, ice, and snow. 17% supports conifer forests, 14% supports alpine tundra and barrens, and 1% supports shrub and herbaceous communities. Natural and human-caused fires generally do not occur in this park and preserve (USDI NPS 1984). Vegetation at Dry Bay and Strawberry Island are provided in more detail because larger infestations occur in these areas.

3.7.5.1 Dry Bay

A description of vegetation in the Dry Bay area of Glacier Bay National Preserve is available in the Dry Bay ORV trails EA (USDI NPS 2007a). This vegetation is strongly influenced by the wet, cool, coastal maritime climate and dynamic geomorphologic processes. The area is bound by the Alsek River to the north and west, the North Gulf of Alaska to the south/southwest, and the Deception Hills to the east. The vegetation in the area is generally young in terms of primary and secondary succession except in the hills, where vegetation is generally more mature and has escaped recent glacial cover and massive floods.

Vegetation around Dry Bay is changing due to rapid uplift from isostatic rebound after deglaciation, which has been measured at rates approaching 25 millimeters per year (0.25 meters per decade) in recent research (Larsen *et al.* 2004, 2005). As streams incise at rates to accommodate this uplift and maintain stream base level, an increase in stream-associated floodplains results in a decrease in groundwater elevation. Declining groundwater elevations in soils result in drier surface conditions and changes in associated vegetation communities over time. Shifts in vegetation community composition and distribution from wetland to drier (shrub) communities are evident in aerial photos dating back to 1948.

ORV trails in the area traverse various vegetation and wetland vegetation types, but the trails do not penetrate the Deception Hills to the east. The ORV trails provide access through vegetation along the Alsek River, through young forest, shrub, and herbaceous/graminoid vegetation, across estuarine areas, sand dunes, palustrine wetlands, to fishing sites near East Alsek River, and across riparian zones of the East Alsek River, Doame River, and other drainages. Where needed, the trails are periodically brushed to keep the passageways clear.

3.7.5.2 Vegetation in Lower Glacier Bay including Bartlett Cove

Vegetation on Strawberry Island and other islands in the Beardslee Islands and lower Glacier Bay is dominated by a successional forest community of Sitka spruce and Sitka alder. More mature parts of this forest are changing to a hemlock-dominated forest with a diverse understory of shrubs and forbs. Coastal areas above high tide have ryegrass meadows. Native plants species in the area include strawberry, salmonberry, yellow rattle, large-leaved avens, and silverweed (near the high tide line). Nonnative species on Strawberry Island include perennial sowthistle, common dandelions, and red raspberry. The sowthistle and red raspberry were probably introduced when the area was a fox farm in the 1930s. Bartlett Cove's invasive plants are the most numerous and diverse of any area within the park with nearly 30 species present. Dandelions are wide spread, but most of the other species still grow in restricted areas.

3.7.6 KATM/ALAG Terrestrial Vegetation

While no landcover map exists specifically for ALAG, its plant communities are similar to those of KATM as reported here. Roughly 10% of KATM is covered by spruce, broadleaf, and mixed forest types, 22% by tall shrublands, 32% by low and dwarf shrublands and herbaceous plant communities, and 22% is sparsely vegetated. The remaining 14% is unvegetated.

Plant communities along the Lake Camp road include spruce woodland and tall, low, and dwarf shrublands. Brooks Camp is primarily forested, with spruce, broadleaf, and mixed types interspersed. Lawns are present in the camp itself, and pioneer plants have colonized the edges of disturbances throughout the area. The Valley of 10,000 Smokes Road gradually transitions from the forests present in Brooks Camp to the tall and low shrublands at the end of the road. The Valley is accessible from the end of the road and is almost entirely unvegetated.

3.7.7 KEFJ Terrestrial Vegetation

Only the eastern and southern coastal zones of KEFJ are vegetated, totaling just over 20% of the park; the rest of the park area is rock and glacial ice. Of the vegetated area, roughly a quarter supports conifer forests and woodlands and less than 1% supports broadleaf and mixed broadleaf-conifer forests. 35% of the vegetated area of the park is covered by tall and low shrublands and 17% by dwarf shrublands, herbaceous communities, and beach meadows, while 23% is sparsely vegetated.

Plant communities along the Exit Glacier Road and trail system include broadleaf forests and tall shrublands, whereas the glacial outwash plain is primarily unvegetated. Proceeding up the Harding Icefield Trail, the vegetation transitions from broadleaf forests to shrublands and then to herbaceous and sparsely vegetated alpine communities. Plant communities along the coastal fringe are mostly a mosaic of conifer forests and tall shrublands, with supratidal meadows in certain locations.

3.7.8 KLGO Terrestrial Vegetation

Only a coarse statewide landcover map exists for KLGO to summarize its vegetation types. Lower elevations support conifer forests on greater than half of the park, while higher elevations support alpine tundra and barrens in the remaining area. Areas threatened by invasive plants include Dyea, where conifer forests border supratidal meadows, and the Chilkoot Trail, White Pass Railroad, and Klondike Highway corridors, all of which transition from conifer forests to alpine tundra and barrens.

3.7.9 KOVA Terrestrial Vegetation

According to a coarse statewide landcover map, about 54% of KOVA consists of low and dwarf shrub, tussock and wet sedge, moist herbaceous, and lichen communities. An additional 24% is covered by tall and low shrublands, 19% by conifer forests and woodlands, and 3% by alpine tundra and barrens. No invasive plants have been documented in KOVA, and therefore no plant communities are directly threatened by invasive plants.

3.7.10 LACL Terrestrial Vegetation

Approximately 30% of LACL is unvegetated, and an additional 19% is sparsely vegetated. The remaining land area is covered by spruce, broadleaf, and mixed forests (11%), tall shrublands (16%), low and dwarf shrublands (17%), and grasslands, marshes, and meadows (3.5%), with 3.5% unknown due to cloud cover and shadows.

3.7.11 NOAT Terrestrial Vegetation

According to a coarse statewide landcover map, about 73% of NOAT consists of low and dwarf shrub, tussock and wet sedge, moist herbaceous, and lichen communities. An additional 15% is covered by alpine tundra and barrens, 12% by tall and low shrublands, and a minor amount by conifer woodland. No invasive plants have been documented in NOAT, and therefore no plant communities are directly threatened by invasive plants.

3.7.12 SITK Terrestrial Vegetation

No landcover map exists for SITK to summarize its vegetation types. Given its small size, however, it is sufficient to characterize the park's vegetation as primarily composed of closed conifer forest, supratidal meadows along the coast, and riparian and wetland types along Indian River.

3.7.13 WRST Terrestrial Vegetation

The landcover map for WRST is currently being updated, and so the following information was drawn from a coarse statewide landcover map. Almost half of WRST is covered by water, ice, and snow (49%) and an additional 18% by alpine tundra and barrens. Forests account for 21% of the land area, nearly all of which are conifer forests and woodlands. Tall, low, and dwarf

shrublands and herbaceous communities cover 10% of WRST, and the remaining 2% was unknown under this analysis.

3.7.13.1 McCarthy Road Area Vegetation

Roads, trails, and facilities accessible from the McCarthy Road are on river terraces and moraines in the Kuskulana and Kotsina River drainages, alluvial fans emanating from the southern Wrangell Mountains in the Chokosna River drainage and terraces in the Crystalline Hills formed by the retreat of glacial Lake Ahtna. Facilities in the Kennicott and McCarthy Creek drainages are in inactive river channels, on ground and terminal moraines and on outwash floodplains. Outwash areas on the Kennicott River floodplain have primary succession vegetation. Most of the forested area directly adjacent to the McCarthy Road has been logged for the Kennicott railroad construction or was burned in historical fires. This area has been heavily infested by the spruce bark beetle. The following vegetation types are found near the McCarthy Road: closed white spruce forest, open white spruce forest, white spruce woodland, closed mixed aspen-white spruce forest, open mixed white spruce-poplar forest, closed mixed poplar-white spruce forest, open black spruce forest, open low willow-graminoid shrub bog and open low mixed shrub-sedge tussock bog (Loso 2006). The vegetation types in the upper Kotsina River drainage in the vicinity of facilities are: willow-birch shrub (90%), woodland needle leaf forest, open mixed forest and closed mixed forest (ADNR 1985). Vegetation types near facilities in the Upper Kuskulana River drainage are alpine forb herbaceous (90%), open dwarf scrub and willow-birch shrub.

3.7.13.2 The Nabesna Road Area Vegetation

Vegetation communities in the vicinity of the Nabesna Road are primarily distributed in relation to depositional features created by glacial Lake Ahtna, ground moraines left behind after the Wisconsin Glaciation in the Alaska Range, recent alluvial deposits from drainages flowing from the Mentasta Mountains, older alluvial deposits on these river terraces and inactive fluvial terraces. The dominate vegetation types along the Nabesna Road associated with roads and facilities are: open white spruce forest, white spruce woodland, black spruce woodland, open mixed white spruce-poplar forest, open low willow-graminoid shrub bog, open tall willow scrub and herbaceous seral communities (Loso 2006).

3.7.14 YUCH Terrestrial Vegetation

The dominant vegetation types of YUCH are open and woodland spruce forest, which account for 58.5% cover of its area. Other common plant communities include broadleaf and mixed forests, covering 12.5% of the land area, tall and low shrublands (14%), and dwarf shrublands, dry herbaceous communities, and wet sedge and tussock tundra communities (5%). 2% of YUCH's area is sparsely vegetated, 3% is rock, water, or snow, 4% was unknown due to cloud shadows on the landscape, and 1% had been burned by wildfire as of 1997.

Plant communities in the Coal Creek area are dominated by conifer, broadleaf, and mixed forests, much of which burned in 2004 during the Woodchopper Fire. Areas that were dredged

by mining operations are covered by scattered shrublands, with substantial areas remaining unvegetated.

3.8 Wetlands and Floodplains

Floodplains and wetlands in areas potentially affected by invasive plants and NPS management actions are widely spaced and highly variable. Floodplains are generally located near rivers, lakes, estuaries, and intertidal areas. Seasonally or temporarily inundated wetlands are similarly located near these areas, and wetlands are also located in poorly drained catchment areas, such as areas with permafrost or slow-draining clay soils.

Below are brief descriptions of the effects invasive plant species in Alaska NPS units might have on floodplains or wetlands. This information is gleaned from *Invasive Plants of Alaska* (AKEPIC 2005).

Invasive plant species in Alaska NPS units that might infest unconsolidated sediments in coastal estuarine areas or river floodplains are: perennial sowthistle, white sweetclover, oxeye daisy, and yellow toadflax. Perennial sowthistle may occur in lake or ocean shores, meadows, and along streams. White sweetclover establishes extensively along early-succession river bars in Alaska, and its seeds may be dispersed by water. This species alters soil conditions by fixing nitrogen and has the potential to alter sedimentation rates of river ecosystems, where it forms large single species stands. Extensive infestations already occur along the Stikine, Nenana, and Matanuska Rivers, and it is showing up near the Copper River. Oxeye daisy is an escaped ornamental species that may invade beach meadows. Yellow toadflax is a versatile invader, which may also infest beach shores and other sandy, gravelly soils.

Invasive plant species in Alaska NPS units that might invade various riparian, palustrine, and lacustrine wetland areas are: perennial sowthistle, smooth brome or cheatgrass, reed canarygrass, Japanese knotweed, and yellow toadflax. Perrennial sowthistle may occur in meadows, along streams, and lake or ocean shores. Dense stands can drastically reduce water resources, decrease native plant diversity, and retard successional establishment of native species. First reported in Hoonah in 1979, it is now known to occur on Strawberry Island in GLBA.

Smooth brome has been observed colonizing a stream bank in Alaska with potential impacts on riparian processes. Smooth brome may inhibit natural succession processes, especially because it burns readily and is fire adapted.

Reed canarygrass forms dense, persistent, monotypic stands in wetlands that exclude and displace other plants, which may also slow stream flows, eliminating regular scouring actions needed to provide gravelly stream bottoms for salmon reproduction. Seeds and rhizome fragments may wash downstream to readily spread this species.

Japanese knotweed clogs waterways and lowers habitat quality for wildlife and fish. It reduces food supplies for juvenile salmon in spring. Dead stems and leaf litter decompose slowly and form deep organic layers that prevent native seeds from germinating, thereby altering succession

of native species. Small fragments can reproduce this species, which may wash downstream and form new colonies. Dispersal may even occur across marine waters.

Yellow toadflax may occur along lake shores and in meadows, where it may readily spread into adjacent undisturbed areas. Taproots may extend to 3 feet depth or up to 10 feet from the parent plant, thereby reducing soil moisture and changing soil texture and composition. This plant contains a poisonous glucoside, which is unpalatable and moderately poisonous to livestock, and therefore possibly detrimental to ungulate wildlife too.

Areas most affected by invasive plants and management response actions are near high human traffic corridors or historical uses of tracts where nonnative plants may have been introduced. Examples of high human traffic are the entrance area to DENA where hundreds of thousands of visitors from around the world enter this area each summer season, and SITK and KLGO where hundreds of thousands of visitors from around the world disembark from cruise ships each summer season. Other areas with lesser or emerging invasive plant concerns are targeted fly-in or roadside areas with less traffic, such as Brooks Camp in KATM or gravel roads in WRST.

Where high human use areas intersect floodplains or wetlands invasive plants could affect such areas. More detailed information about the potentially affected areas with floodplains and wetlands is provided below for the involved parks. Where available, the National Wetlands Inventory maps were consulted via the internet at: http://wetlandsfws.er.usgs.gov/wtlnds/launch.html . These maps were used to identify potential floodplain and wetlands areas affected by invasive plants and management responses to their presence. Wetlands mapping units follow the Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et. al. 1979), which includes areas that are saturated or flooded temporarily, intermittently, seasonally, and permanently.

3.8.1 DENA Floodplains and Wetlands

Near the entrance area in DENA and elsewhere along the park road and in the Kantishna area, most wetlands are palustrine scrub shrub (PSS1/4). In these areas are also lesser numbers and area of palustrine emergent wetlands (PEM1B/C/F) and riverine wetlands and floodplains (R3US/UB), such as along the Nenana River, Riley Creek, and other rivers crossed by the Denali Park Road, and Moose Creek in Kantishna. Small areas of lacustrine (lakeside) wetlands (L1UBH) occur where human traffic and developments abut Wonder Lake.

3.8.2 GAAR Floodplains and Wetlands

The common dandelion, which occurred on the margins of Walker Lake, was either in upland or palustrine wetland area. The Middle Fork of the Koyukuk River follows the Dalton Highway for miles before it flows toward GAAR, which could serve as a route for white sweetclover and other invasive plants to make their way in to the park. This area and ATV trails in the park from Anaktuvuk Pass have not been mapped for wetlands; however, most wetlands here are probably palustrine moss-lichen (PML), scrub-shrub (PSS1), and emergent vegetation (PEM1) wetlands or riverine wetlands with various unconsolidated gravel bars and bottoms (R3US/UB).

3.8.3 GLBA Floodplains and Wetlands

Invasive plants in GLBA occur where a variety of wetland and floodplain types occur, such as near Bartlett Cove, shores of Glacier Bay proper, and in the Dry Bay area. Wetland types in affected areas of GLBA are either palustrine, estuarine, or riverine. Floodplain zones occur mostly near major rivers, such as the Alsek River, Bartlett River, and other rivers, deglaciated areas, and along coastal areas. Wetlands in GLBA are changing due to rapid uplift from isostatic rebound after deglaciation, which has been measured at rates approaching 25 mm per year (0.25 m per decade) in recent research (Larsen *et al.* 2004, 2005). Similar stream incision rates are thought to occur in order to accommodate this uplift and maintain stream base level. An increase in the elevation of stream-associated wetlands and floodplains would result in a decrease in groundwater elevation as streams maintain their base level. Declining groundwater elevations relative to soil surface elevations impose drier conditions for wetlands and changes in associated wetland vegetation communities over time. Shifts in vegetation community composition and distribution from wetland to drier (shrub) communities are evident in aerial photos dating back to 1948 or earlier to the present time.

Coastal estuarine areas are affected by massive storms from the North Gulf of Alaska, including wave surges and strong winds. Tsunamis from earthquakes, such as the 1964 Great Alaska Earthquake, have also affected coastal estuarine and floodplain areas. For example, the East Alsek and Doame Rivers coalesced into a common estuary during the early 1960s following the Lituya Bay earthquake and tidal wave.

Glaciers historically covered much of GLBA and the receding glaciers have exposed vast areas of barren ground where primary plant succession occurs. Some of these areas have naturally developed into palustrine, riverine, lacustrine, and estuarine wetlands. Recently, naturally exposed areas could be more at risk for invasive plant infestations than areas fully covered with native vegetation. Ice dams historically blocked the Alsek and Tatshenshini Rivers, which suddenly breached the dams and flooded the lowlands in the Dry Bay Preserve area.

OHV trails in the Dry Bay area of the Preserve traverse various vegetation and wetland vegetation types and provide access along the Alsek River, across estuarine areas, palustrine wetlands, and across riparian zones of the East Alsek River, Doame River, and other drainages. The NPS now has a draft land-cover map, which includes National Wetlands Inventory (NWI) mapping units. In summer 2005 NPS trail condition assessments provided some data on trail sustainability, generally depending on wetland status. An NPS team conducted ground-truth surveys of wetland classifications along ORV trails in the study area in July 2006. Survey methods followed those in the Corps of Engineers Wetlands Delineation Manual (USACE 1987.) Example images of palustrine, estuarine, and riverine wetlands are presented below in figures 3.11 to 3.14.

Figure 3.11 Broad-leaved palustrine scrub-shrub

Figure 3.12 Palustrine area with emergent (PSS1) vegetation (PEM1)

Figure 3.13 Palustrine area with unconsolidated bottom sediments (PUB1/2)

Figure 3.14 Perennially flooded riverine area (R2US/UB)

3.8.4 KEFJ Floodplains and Wetlands

Wetlands near the Exit Glacier Road are mostly perennial, seasonally flooded riverine wetlands with unconsolidated shores (R3USC) or temporarily flooded palustrine wetlands with emergent vegetation surrounded with scrub-shrub wetlands (PSS1/EM1) such as beaver ponds surrounded with willows. Permanently flooded riverine wetlands with unconsolidated bottoms occur along Resurrection River (R3UBH). Similar palustrine and riverine wetlands occur along the outer coast areas and estuarine and lacustrine wetlands.

3.8.5 KLGO Floodplains and Wetlands

Wetlands along the White Pass segment of the park are mostly broad-leaved palustrine scrub-shrub areas (PSS1). Near Dyea, the wetlands are largely irregularly flooded intertidal estuarine areas with unconsolidated shores or emergent vegetation (E2USP/EM1P). Farther up the Taiya River are seasonally flooded riverine wetlands with unconsolidated shores and bottoms (R1US/UB) and yet farther are temporarily flooded palustrine scrub-shrub wetlands with deciduous broad-leaved plants (PSS1).

3.8.6 LACL Floodplains and Wetlands

Wetlands in the Port Alsworth area are mostly seasonally flooded palustrine scrub-shrub or emergent vegetation areas (PSS1/EM1). Some riverine wetlands occur along the Tanalian River with unconsolidated bottoms and shores (R3UB/US). The Silver Salmon Creek area has mostly estuarine wetlands with emergent vegetation (E2EM) or palustrine wetlands with emergent vegetation (PEM) farther upstream beyond the tidal reach. The Twin Lakes area has mostly scattered polygons of palustrine wetlands with emergent vegetation or broad-leaved scrub-shrub vegetation forms (PEM1/SS1). Along the margins of the lakes and rivers there are lacustrine wetlands with gravelly shores (L1UB) or riverine wetlands with unconsolidated shores and bottoms (R3US/UB).

3.8.7 SITK Floodplains and Wetlands

Adjacent to this park's coast and along Indian River are estuarine wetlands with unconsolidated regularly exposed shores or persistent emergent vegetation (E2EM/US).

3.8.8 WRST Floodplains and Wetlands

Most wetlands in WRST have not been mapped; however, some data exists for the Nabesna and Chitina areas. Most of the McCarthy Road corridor has not yet been mapped. Along the Nabesna Road most of the wetlands are either forested, scrub-shrub, or emergent palustrine areas, often underlain with permafrost, so seasonally flooded (PSS1/4 or PEM1). Adjacent to streams and rivers such as the Slana and Cooper River are perennial riverine wetlands with unconsolidated bottoms and shore (R2US/UB). Along the western portions of the McCarthy Road near Chitina are also scattered polygons of scrub-shrub, forested, and emergent palustrine wetlands (PSS1/4 or PEM1). Large floodplains occur all along the major rivers such as the Copper River and Chitina River (R3UB/US).

3.8.9 YUCH Floodplains and Wetlands

Wetlands along Coal Creek, where most invasive plants occur in YUCH, are mostly excavated, flooded, and unconsolidated gravelly palustrine areas (PUBH/Fx), seasonally flooded broad-leaved palustrine areas with scrub-shrub or emergent vegetation (PEM1/SS1C), and saturated scrub-shrub/emergent palustrine areas farther upstream (PSS1/EM1B). Along the Yukon River wetlands are mostly broad-leaved scrub-shrub palustrine areas (PSS1) and temporarily flooded riverine areas with unconsolidated shores (R2USA) or permanently flooded riverine areas with unconsolidated bottoms (R2UBH). Farther inland from Coal Creek and the Yukon River are saturated forested scrub-shrub palustrine wetlands (PSS4B), usually black spruce areas underlain by permafrost.

3.9 Wildlife and Habitat

Throughout the 16 Alaska Region National Park units 376 vertebrate species have been documented[1]. Depending on the size and location of park, the diversity of wildlife species varies from 154 species (Aniakchak) to 308 species (Glacier Bay). These species have been summarized in ten animal categories in Alaska for a total of 4 amphibians, 2 bats, 11 furbearers, 7 game birds, 11 large mammals, 29 raptors (hunting birds), 28 seabirds, 42 shorebirds, 33 small mammals, 158 songbirds, and 51 waterfowl. (Table 3.4). More information is provided for parks with more extensive invasive plant infestations and management issues. Complete species lists for these parks may be obtained through NPSpecies (http://science.nature.nps.gov/im/apps/npspp/index.cfm), and species-specific information is presented in Appendix D. Wildlife habitat and forage may be adversely impacted by invasive plant infestations, and wildlife can distribute invasive plant seeds through transport on their fur, feathers, feet and deposition of feces.

Table 3.4. Vertebrate Terrestrial Wildlife by Alaska National Park Unit and Animal Category

	NUMBER OF SPECIES BY TERRESTRIAL ANIMAL CATEGORY											
	Amphi-bian	Bat	Fur-bearer	Large Mammal	Small Mammal	Upland Game Birds	Raptorial Birds	Sea-birds	Shore-birds	Song-birds	Water-fowl	**TOTALS**
ALAG		1	10	3	17	3	18	1	13	61	27	**154**
ANIA			8	3	14	2	12	17	20	55	28	**159**
BELA			10	4	14	2	16	12	22	65	33	**178**
CAKR			10	5	17	3	17	9	21	63	29	**174**
DENA	1	1	10	6	22	5	22	1	21	84	32	**205**
GAAR	1		11	7	20	3	22		16	65	24	**169**
GLBA	4	1	9	7	19	4	28	22	36	127	51	**308**
KATM	1	1	10	5	19	4	21	16	22	78	34	**211**
KEFJ		1	8	6	11	4	20	11	25	75	25	**186**
KLGO	2	2	9	7	18	6	21	4	18	100	31	**218**
KOVA	1		11	7	19	3	21		16	61	23	**162**
LACL	1	1	10	6	20	4	22	9	27	72	34	**206**
NOAT	1		10	7	18	3	21		20	67	24	**171**
SITK		1	4	2	7	1	14	5	29	78	33	**174**
WRST	2	1	9	8	21	6	25	22	30	104	40	**268**
YUCH	1		9	6	22	6	20		21	92	28	**205**
TOTAL Species	**4**	**2**	**11**	**11**	**32**	**7**	**29**	**28**	**42**	**142**	**51**	**358**

3.9.1 Denali National Park & Preserve

Wildlife and habitat may be more at risk from invasive plants and control methods in DENA than other parks because of the heavy visitation along transportation corridors like the George Parks Highway, the Denali Park Road, the Alaska Railroad, and numerous lodges and NPS facilities near the entrance area and Wonder Lake and Kantishna areas.

[1] Documented species are based on the National Park Service database "NPSpecies" and include those species that are known to occur in over 270 NPS units, and also those species listed as "probably present", i.e., thought to occur but lacking official verification in the form of observations or voucher specimens.

3.9.1.1 Denali Mammals

Moose are abundant throughout the year within and near the numerous drainages in Denali National Park and Preserve. Moose concentrations vary seasonally and, during winter, correlate with snow depth and timing (ADFG 1992b). Most calving takes place from late May through June. During calving, cows tend to seek areas within their home range that provide low predator densities (islands in rivers) or improved visibility (open muskeg areas) (ADFG 1996b). Post-calving moose generally move to higher elevations. Fall rutting and post-rutting concentrations occur in subalpine habitats, with moose moving down from these areas in winter as snow depths increase (ADFG 1992a). Riparian willow stands provide a large part of winter forage and upland coniferous forests provide thermal cover and shallower snow depths (ADNR 1991). Moose inhabit the entire vegetated areas in the park except the highest tundra communities. The area from the Park Headquarters to the Savage River supports a relatively high density of moose for Interior Alaska, which is the park area most at risk for invasive plant infestations.

Caribou are migratory herd animals that use varying habitats for wintering, calving (late May to early June), summer range, and rutting (September and October). Caribou are common along the park road and may be observed throughout the summer. The mountainous terrain throughout most of Denali National Park and Preserve provides habitat for Dall's sheep except for the south slopes of the range, which are prone to deep winter snow that excludes sheep. Sheep migrate annually between the Alaska Range and the Outer Range (Dalle-Molle and Van Horn 1991). Habitat for caribou and sheep are less likely to be adversely affected by invasive plants than moose habitat.

Brown bears range throughout the park and preserve, but generally prefer high-elevation tall shrub, low shrub, and alpine tundra communities. Bears are omnivorous, opportunistic feeders and move to areas when foods become seasonally available. Roots, sedges, early herbaceous plants, and overwintered berries constitute the bulk of their diet after they emerge from dens in late April (Stelmock 1981). Denali brown bears prefer peavine (*Hedysarum alpinum americanum*) roots, which grow on low slopes and valleys (Murie 1981), which could be displaced by white sweetclover. Bears also prey on moose and caribou calves. By mid-summer, brown bears turn from digging to grazing and feed on grasses and sedges growing on upper hillsides. In late July, brown bears turn to a diet of berries, especially soapberries (*Shepherdia canadensis*), that grow on floodplain gravel bars. This diet is supplemented by ground squirrels and, where available, salmon. They return to eating roots in the fall.

In contrast to brown bears, black bears prefer upland forest and floodplain forest communities below 2,000 feet in elevation (ADFG 1978a). Black bears den in all types of habitats in holes, brush piles, or simply under a blanket of snow (Smith et al. 1994). After emerging from their den in the spring, black bears seek new plant growth. They are opportunistic feeders and readily eat whatever food they encounter, including carrion. Salmon, where available, may be substituted for herbaceous vegetation. Berries are an important part of their diet in late summer and early autumn. Black bears are considered more tolerant of people than brown bears and have a high potential to be adversely affected by human activity (USDI NPS 1990).

Wolves occur throughout all areas of the park that support ungulate prey (i.e., areas less than

6,000 feet elevation). The wolf population is comprised of territorial packs that can include from 2-30 individual wolves (Mech et al. 1998). Though mostly carnivorous, wolves will forage berries when available. If large areas of ungulate habitat are adversely affected by invasive plants, then wolf populations could be indirectly affected.

Although much of the emphasis on Denali's wildlife focuses on larger mammals, Denali supports a large suite of smaller carnivores (coyote, red fox, lynx, river otter, wolverine, marten, ermine, least weasel and mink), rodents (hoary marmot, arctic ground squirrel, red squirrel, northern flying squirrel, beaver, muskrat, five species of voles, two species of lemmings, meadow jumping mouse, and porcupine), two lagomorphs (snowshoe hare and collared pika), six insectivores (shrews), and at least one species of bat (little brown bat). These species inhabit a variety of habitats across Denali and form integral links in Denali's food web. Many herbivores, including snowshoe hare and arctic ground squirrel, are important forces in browsing and dispersing vegetation across the landscape. Small mammals could be adversely affected by invasive plants species or they could transport their reproductive parts and seeds.

Lynx depend heavily on snowshoe hare as a prey source. The lynx is a "species of concern" under the Endangered Species Act. Low densities of lynx occur in forest communities in the northern areas of the park. Little is known about lynx on the south side of the park, although indications of lynx have been found in the southern development zone of Denali State Park (ADNR 1995). Red fox are common throughout the park and are very conspicuous along the Denali park road. Coyote occur but are not common. River otter and wolverine occur at relatively low densities. Marten, ermine, least weasel, and mink occur across the park, but little is documented about their abundance.

3.9.1.2 Denali Birds

All of the major groups of birds found in Interior Alaska are found in Denali. As of January 2008, 165 bird species have been documented in Denali. Of these, at least 106 species breed in Denali, including at least 25 resident species. Except for approximately 25 resident species, most birds are migratory and occur in Denali only during the breeding season (April to October). Migratory species include those wintering in North, Central and South America, Southeast Asia, Africa, and the southern Pacific Ocean.

Waterfowl

Except for a few species, waterfowl distribution on the south side is limited to the wetlands, lakes, and ponds along the southern park boundary. Lands south of the park boundary contain more waterfowl habitat. The Minchumina basin, in the northwestern portion of Denali, supports the highest densities of breeding waterfowl in Denali (McIntyre 2002). Of the 20 species of migratory waterfowl that breed in Denali, trumpeter swans, harlequin ducks, and Tule greater white-fronted geese are of particular interest on a nationwide basis. Additional species of interest include those used by subsistence users and those sensitive to human disturbance.

The Tule greater white-fronted goose, a subspecies of the greater white-fronted goose, is

considered "at risk" by the International Waterfowl Research Bureau, although it is not listed federally or by the state. They nest at very low densities from the Yenta River drainage to the Tokositna River drainage within and adjacent to Denali's boundaries (Ely and Dzubin 1994).

In autumn, tens of thousands of sandhill cranes, Canada geese, greater white-fronted geese, trumpeter and tundra swans, and other waterfowl migrate through the area, especially along the north side of the Alaska Range, the Wonder Lake and eastern Kantishna Hills area, and the northern additions. Many of these species also use wetlands and tundra areas for feeding and resting during migration. Trumpeter and tundra swans regularly use lakes and ponds in Denali during migration periods. In spring, migratory waterfowl are often forced to congregate in relatively small areas of open water. For instance, flocks of white-winged scoters numbering in the hundreds often stage at the south end of Wonder Lake in spring.

Raptors

As with predatory mammals, raptors could be indirectly affected where habitat for prey species is impacted by invasive plant infestations. Raptors are well represented in the avifauna of Denali, including eagles (bald and golden), falcons (gyrfalcons and peregrines), merlins and kestrels, accipiters (northern goshawk and sharp-shinned hawk), northern harriers, and owls (great gray, short-eared, northern hawk, boreal, great horned, and snowy). Until recently, most quantitative data on raptor abundance, distribution, and habitat preferences in Denali were restricted to studies on the north side of the park on a few species: golden eagles (McIntyre and Adams 1999; on-going studies), gyrfalcons, (McIntyre, unpublished data), merlins (Wilbor 1996), and northern hawk owls (Kertell 1986).

Known species of owls that breed in Denali include short-eared owl, great gray owl, great horned owl, northern hawk owl, and boreal owl. Great-gray owls and northern hawk owls occur at very low densities. Short-eared owls are the most common owl species breeding in the area and great-horned owl and boreal owls are the most common resident species in Denali (McIntyre, pers. comm.)

Alaska Department of Fish and Game staff reports an increasing number of ospreys observed south of Denali, with at least one pair nesting in the Trapper Creek area (ADFG 1996b). Osprey are occasionally seen in the Wonder Lake area, and abundance and distribution of this species is probably greater than currently reported based on the abundance of suitable habitat in the southern and western portions of Denali and increases in their breeding populations statewide. An active osprey nest was documented in the northwest additions to Denali National Park in 2007.

Species of Special Concern

The American peregrine falcon (*Falco peregrinus anatum*) was delisted in August 1999 (*Federal Register* 64: 46542-46558). Nesting peregrine falcons are relatively rare in Denali, but two pairs have been found nesting on the north side near the Toklat River and near Chilchukabena Lake (McIntyre, pers. comm.). Two other species of concern in DENA are the harlequin duck and

olive-sided flycatcher. Harlequin ducks occur in fast-moving clear streams and rivers in the Alaska Range, and Moose Creek in the Kantishna area and other clear water streams probably support breeding harlequin ducks. Olive-sided flycatchers nest in open coniferous forests with bog ponds and marshy streams, and in woodland/dwarf forest, usually in black spruce trees located near the drainages (Gabrielson and Lincoln 1959). This species has been recorded annually on point counts and Breeding Bird Surveys on the north and south sides of the Alaska Range. It has been found breeding on the north side near Moose Creek (Benson 1999), and they are an uncommon summer visitor to the Denali State Park along the south side of DENA (ADFG 1989).

In addition to federal species of concern, the State of Alaska maintains a list of "species of special concern," which includes American peregrine falcon, olive-sided flycatcher, gray-cheeked thrush, Townsend's warbler, and blackpoll warbler (ADFG 1996a). Except for Townsend's warbler, all of these bird species occur within the park and preserve boundaries in suitable habitats, although little is known about population abundance or distribution.

Other species

Ruffed and spruce grouse, and all three species of ptarmigan (willow, rock, and white-tailed), are residents in Denali. These species commonly gather grit along road sides or other disturbed sites where invasive plants and management actions may occur.

3.9.1.3 Denali Amphibians

One species of amphibian, the wood frog, occurs in Denali. The wood frog spends its life in the woodlands and vegetated wetlands across Alaska and occurs in Denali at lower elevations (Travis 2000). The wood frog hibernates through the winter in shallow depressions in the upper layer of the previous year's dead vegetation.

3.9.2 Glacier Bay National Park & Preserve

The wildlife habitat and species most likely to be affected (those areas most likely to receive invasive plant management plan activities, including the possible use of herbicides in exotic plant control) include the Bartlett Cove developed area, Strawberry Island, and the developed areas of Dry Bay in the Preserve (Fig. 2.2, 2.3, and 2.4).

3.9.2.1 Wildlife of Bartlett Cove and Strawberry Island

Bartlett Cove is the major developed area within Glacier Bay National Park with ground transportation that supports administrative and maintenance operations, the Glacier Bay Lodge concession, park visitor support services, and also provides access for local recreational activity. Strawberry Island was the site of an historic fox farm operation. A diverse array of wildlife species use the development zone because several of the habitats found there occur in few other places in the park. Parts of coastal Strawberry Island have been overtaken by perennial sowthistle.

Two plant community types provide important habitat for wildlife in Bartlett Cove area: mature spruce/hemlock forest and rich supratidal meadows. The dynamic boundary between these two communities is perhaps the most productive vegetative zone in Bartlett Cove. The coastal rainforest at Bartlett Cove has developed over the last two centuries, following the retreat of glacial ice. Even-aged Sitka spruce are being replaced by a diverse productive understory with western hemlock emerging as the dominant tree species.

While the closed-canopy forest was poor habitat for most wildlife, increased diversity and improved food sources are benefiting birds such as woodpeckers, flycatchers, wrens, golden-crowned kinglets and Townsend's warblers. Nuthatches and creepers, birds of the old-growth forest, should become more common over time. Dead trees provide an important food source for insect-eating birds and nesting habitat for cavity-nesters such as woodpeckers, chickadees and goldeneye ducks. The Bartlett Cove forest may also be important nesting habitat for marbled murrelets; which should increase in importance as the forest matures. Rich berry crops benefit bears and small mammals as well as birds, and the forest's proximity to the coast greatly increases its value as wildlife habitat.

Bartlett Cove's supratidal meadows consist primarily of fireweed, cow parsnip, lupine and beach pea, with salt-tolerant beach rye occupying a lower band reached by the very highest tides. The meadows are constantly migrating seaward as they are invaded by forest from the upland side and themselves invade intertidal meadows at the seaward side as the land rises (approximately 1.5"/year) due to glacial rebound. These meadows provide exceedingly rich wildlife habitat and also are very attractive for human use. They are at risk from invasion by reed canary grass, which could turn the habitat into a monoculture.

In addition to the avian groups described above, Bartlett Cove hosts a variety of birds such as bald eagles and other raptors (several hawks and falcons), corvids, several owl species, kingfishers, hummingbirds, swallows, thrushes, sparrows, juncos, finches, waterfowl, and shorebirds. Blue grouse and great blue herons are signature Bartlett Cove birds. A wide variety of seabirds occupies the adjacent marine waters, some of which nest onshore and on islands.

Besides the birds, several other terrestrial vertebrates occupy Bartlett Cove habitats: western toads, moose, wolves, coyotes, black and brown bears, river otters, marten, mink, porcupines, red squirrels, flying squirrels, and microtines. Black bear have been observed foraging dandelions in Glacier Bay (Rapp 2008).

3.9.2.2 Wildlife of Dry Bay

The Dry Bay habitat is dynamic with an active commercial fishery and network of off-road vehicle (ORV) trails and roads to fishing camps. Human activities here are known to have introduced several invasive plants species. The Dry Bay area is a part of the Yakutat Forelands complex of mostly pristine tidal mudflats, sand beaches and dunes, deciduous shrublands, spruce forests, streams and freshwater wetlands, muskeg, and river estuaries. Following the retreat of massive coastal glaciers, the land is rapidly uplifting at rates measured to 2.5 centimeters (1 inch) per year or 0.25 meters (10 inches) per decade (Larsen et al., 2004, 2005), thereby causing some wetland areas to shift to drier shrub communities. These diverse and dynamic ecosystems

support many species of migratory and resident wildlife. Some highly mobile wide-ranging species use Preserve habitats while others are restricted to a specific type of vegetation or terrain. Wildlife habitats in Dry Bay are divided into four subareas: the Alsek River Corridor, uplands, dunes and plains, and East Alsek River estuary complex. More detail of these vegetation zones are available in the NPS Dry Bay ORV EA (USDI NPS 2007a). Pertinent information regarding invasive plants and wildlife habitat are presented here.

Alsek and East Alsek River Corridors and Estuary/delta

The Alsek River supports significant salmon runs and also provides one of the few movement corridors for mammals and birds traveling from the interior to the coastal plain through the Saint Elias Mountains. Reed canary grass can ruin salmonid habitat and has been recently observed in the East Alsek area.

ORV traffic and wildlife may distribute and spread invasive plants species in the area. Most ORV trails here provide movement corridors for large animals and allow more light exposure for small flowering plants and grasses, including nonnative invasive species. Scat and tracks of bear, moose, and wolf are very common; evidence that they use the trail network frequently (Eichenlaub, pers. comm.). Individual bears, especially males, may use roads or trails, particularly if they lead to human habitations, burn pits, fish processing and net sites (Gibeau et al. 2002). Flower buds, fruits, seeds and succulent non-woody plants provide a diverse foraging area at trail edges for smaller upland mammals and birds; however, this habitat diversity could be diminished by invasive species monocultures. Raptors preying on birds such as sharp-shinned hawk may hunt upland trail corridors more frequently compared to areas without trails. Thrushes, fox sparrow, and dark-eyed junco are commonly seen foraging in the trail tread and at trail edges. Ponded trail sections produce or attract insects which in turn attract foraging bats, insectivorous birds and toads.

Along with the Copper –Bering River Delta the Yakutat Forelands including Dry Bay is the most extensive estuarine/wetland habitat on the eastern Gulf of Alaska coastline (Andres and Browne, 1998). The estuaries and marine shore provide significant stopover areas for migratory shorebirds including dunlin, black-bellied, Pacific golden plover, and semi-palmated plover, greater and lesser yellowlegs, western and least sandpiper, red and black turnstones, short-billed and long-billed dowitchers, and common snipe. Common nesting species of waterfowl include northern pintail, Vancouver Canada geese, American widgeon, Barrow's goldeneye, and trumpeter swan. Surveys in 1996 and 1997 estimated over 350,000 shorebirds using Forelands habitats qualifying it as a site of international significance. The peak of the spring migration occurs in the first 10 days of May (Andres and Browne 1998 and Petersen et al. 1981).

Harvest records for seventeen species of migratory waterfowl exist for Dry Bay including Canada, snow, and white-fronted geese, Barrow's goldeneye, green-winged teal, mallard, red-breasted merganser, sandhill crane, northern pintail, American widgeon, and gadwall. In particular, the estuarine habitat at the mouth of the East Alsek River provides important feeding areas for migratory waterbirds (Petersen et Al. 1981). Trumpeter swans winter in the estuaries (Capra pers. comm.).

Salmon and eulachon spawning runs in the Alsek and East Alsek Rivers attract and concentrate many predatory and scavenger species from other parts of the Preserve including bald eagle, brown bear, raven, river otter, mink, and wolverine. Fish runs provide critical high calorie foods for predators building winter fat reserves. In particular, brown bear are observed feeding in the Doame River delta. Steller sea lion and harbor seal occasionally pursue spawning salmon up into the East Alsek estuary (Eichenlaub pers. comm.). There are no records of sea lion or seal haul outs along the Dry Bay beachfront. The Doame River delta is particularly important for bears (Soiseth pers. comm.). Because of the wildlife abundance and reliance on habitat in this area, protection from invasive plant infestations and monocultures is important.

Uplands, Dunes and Plains

Bear, moose, and other mammals commonly use ORV trails and tracks and scat are seen very frequently. Trails used by ORVs regularly provide a network of movement corridors for terrestrial wildlife especially in areas where thick alder and willow brush has become established. ORV trails here provide movement corridors for large animals and allow more light exposure for small flowering plants and grasses including nonnative invasive species. Yellow-rumped warbler and ground foraging thrushes are very commonly heard and seen along ORV trails especially after young birds have fledged. Soiseth (pers. comm.) observed a great number of juvenile thrushes along trails in 2006. Willow ptarmigan have nested in some open grassland areas but are becoming rare due to habitat changes. Breeding pairs of spruce grouse have been observed since 2004 (Capra pers. comm.). Again, the diverse native habitat in these areas is important to protect in face of the growing invasive plant infestations in the area.

Figure 3.15. Migratory shorebirds in the East Alsek River estuary.

Wetlands are extremely important for moose in spring and summer providing high quality foods and some security from predators. Beaver have colonized riparian and some wetland habitats around the Doame River. Waterfowl such as mallard, green-winged teal, Barrow's goldeneye, American widgeon, and gadwall commonly nest and raise broods in riparian wetlands. Reed canarygrass could reduce available foods for waterfowl.

3.9.3 Kenai Fjords National Park

Though invasive terrestrial plant species occur sporadically along the coastal strand, the greatest infestations occur in the Exit Glacier developed area, for which wildlife and habitat are described below in more detail.

3.9.3.1 Exit Glacier and Resurrection River Valley Habitat Overview

This valley provides the one of two ice-free access routes to inland forests from Resurrection Bay, and is a particularly unique area due to the presence of Exit Glacier, which discharges directly into the Resurrection River floodplain. This dynamic ecological zone lies immediately adjacent to the expansive Harding Icefield, and it contains an unusual combination of wildlife habitat, including needleleaf forests, broadleaf forests, alder and willow thickets, alpine meadows, newly exposed bedrock and bare soils, riparian lowlands, and wetlands.

More than half of all land bird species detected across the Park were observed in the Exit Glacier and Resurrection River area, including the western screech-owl, downy woodpecker, hairy woodpecker, northern shrike, violet-green swallow, black-capped chickadee, and Bohemian waxwing. Two species previously undocumented in KEFJ, Townsend's Solitaire and Western Screech-Owl, were both observed in this diverse area (Van Hemert et.al. 2006).

Wetlands and wetland edge habitats occur primarily in the Resurrection valley, and support breeding populations of Alder Flycatcher, Tree Swallow, and Violet-green Swallow. In addition to land bird habitat, these wetlands provide important resources for breeding shorebirds. Greater Yellowlegs, Spotted Sandpiper, and Semi-palmated Plover exhibiting territorial breeding behavior and two nests of Wilson's Snipe were recently documented in this area (Van Hemert et al. 2006).

3.9.3.2 Terrestrial Mammals of Exit Glacier

Habitats suitable for all or most of the terrestrial mammal species in the park are present within the Exit Glacier study area. Among these, mountain goat, moose, black bear, brown bear, hoary marmot, snowshoe hare, porcupine, ermine, red squirrel, and red-backed vole are the species most frequently encountered (AKNHP 2000, USDI NPS 2001b). Also present, but less frequently observed, are wolves, coyotes, lynx, wolverine, marten, flying squirrel beaver, river otter, little brown bats, and mink (AKNHP 2000, USDI NPS 2001b). The distribution and abundance of terrestrial mammal species in the Exit Glacier area are unknown. Most information regarding terrestrial species in this area has come from anecdotal reports by park staff and visitors and is supported by a small number of surveys focused on bats and microtines (Wright

2001), mountain goats (Tetreau 1989), moose (Everitt 2001) and a survey of furbearer occurrence and distribution (Martin 2001).

Mountain goats occupy nearly all of the steep and rocky high country around Exit Glacier. During summer, the goats spend most of their time above tree line in alpine habitats. In fall and winter, goats move to lower elevations at or below tree line in subalpine and forested habitats, and they occasionally cross the glacier and valley floor. Moose are present in the Exit Glacier and Resurrection River area year-round, but are most visible during winter. In fall and winter moose congregate between Exit Creek and Paradise Creek to browse on the concentrations of willow and take advantage of high quality winter habitat.

Black bears are common in the Exit Glacier area. In early May bears are often observed above tree line on the north side of the Exit Glacier valley foraging on emerging vegetation. There are a number of reports of black bears preying on newborn moose and goats, and they feed on berries, primarily salmonberry (French 2003), in spring and summer months. Brown bears are visitors to Exit Glacier, typically passing through the valley in the summer season.

Wolves are rarely observed in the Exit Glacier area, although tracks are occasionally observed in winter snow. A total of nine wolf observations are recorded in the park's wildlife observation database (USDI NPS 2002). Given the low frequency of sightings and the small group sizes typically observed, it is unlikely that wolves den in or near the study area. Coyotes are more frequently encountered than wolves in the Exit Glacier area with numerous observations recorded in the park's wildlife observation database (USDI NPS 2002). Coyotes prey on ptarmigan, marmots, snowshoe hare, and other small mammals, and also feed on carrion from wolf or winter killed moose and goats. No den sites have been identified in the study area, though an observation made in 1998 of a family group near the Exit Glacier Ranger Station (USDI NPS 2002) suggests that coyotes may den in the area.

Lynx are extremely rare in the Exit Glacier area. Only three track observations have been recorded in the wildlife observation database between 1980 and 2002 (USDI NPS 2002). Local trappers report that lynx are rare in the entire Resurrection River drainage (Martin 2002). An intensive track and baited photo station survey targeting mid-sized carnivores, including lynx, was initiated in the study area in 2001. This survey documented only one lynx observation from a set of tracks found in October 2001 (Martin 2002). Other furbearers include marten, wolverine, ermine, mink, and river otter. Marten and ermine are common in all habitats and likely den in the area (Martin 2002). Wolverines are less commonly encountered with track observations suggesting that they travel through the area searching for carrion and do not den in the area (Martin 2002).

3.9.3.3 Birds of Exit Glacier

About 143 bird species are expected to occur within the Exit Glacier area, with a smaller number likely nesting there. Sixty-two species have been positively identified in the area (USDI NPS 2002). A survey of the occurrence and distribution of bird species in the Exit Glacier study area was conducted in 2000 and 2001, documenting 32 species with associated habitat types (Wright 2001).

The species most commonly observed by Wright (2001) were Wilson's warbler, varied thrush, hermit thrush, fox sparrow, ruby-crowned kinglet and orange-crowned warbler. Other passerine (songbird) species commonly encountered included Steller's jay, black-billed magpie, northwestern crow, common raven, chestnut-backed chickadee, black-capped chickadee, common redpoll, snow bunting, white-winged cross bill, and dark-eyed junco. Raptor species included bald eagle, golden eagle, northern goshawk, sharp-shinned hawk, great horned owl, and northern saw-whet owl. Additionally, willow ptarmigan, rock ptarmigan, white-tailed ptarmigan, and spruce grouse inhabit the Exit Glacier area.

3.9.3.4 Species of Special Concern

Kittlitz's murrelet is a candidate species for listing under the Endangered Species Act. Several State of Alaska Species of Special Concern and Alaska Audubon Society watch list species are present in the Exit Glacier area. A State of Alaska Species of Special Concern is any species or subspecies of fish or wildlife or population native to Alaska that has entered a long-term decline in abundance or is vulnerable to a significant decline due to low numbers, restricted distribution, dependence on limited habitat resources, or sensitivity to environmental disturbance. Audubon's Watch List species are those facing population declines and/or threats such as habitat loss on their breeding and wintering grounds, or with limited geographic ranges.

Townsend's warblers, a State Species of Special Concern, have been sighted in the area during the breeding season (USDI NPS 2002) and conifer habitat suitable for nesting is available. Decreasing populations in Alaska for this species are thought to be due to habitat loss in neo-tropical wintering grounds.

Gray-cheeked thrush, also a State Species of Special Concern, have rarely been reported in the area during the breeding season (USDI NPS 2002) and suitable woodland nesting habitat is available. Decreasing population numbers for this species in Alaska are also thought to be due to habitat loss in neo-tropical wintering grounds.

Golden eagles, on the Audubon Watch List, are observed infrequently in the study area, primarily in the early spring. No known golden eagle nesting sites have been identified in Kenai Fjords National Park. Populations of golden eagle have been observed to be in decline in some areas; however, populations in Alaska appear to be stable.

Rusty blackbirds, on the Audubon Watch List, also occur in the park. They prefer muskegs and boreal forests and have experienced steep declines across their range.

3.9.4 Klondike Gold Rush National Historical Park

Species of management concern include the western toad, brown bear, black bear, mountain goat, golden eagle, wandering tattler, marbled murrelet, olive-sided flycatcher, and black-pole warbler.

The prominent large mammal species in the area are mountain goats and black bear. A small population of moose inhabits the White Pass unit on the upper Skagway River bottom, and moose are occasionally sighted in the Taiya River valley. Brown bears are regularly seen feeding on the salmon spawning in the Taiya and its tributaries beginning in late July. During June, both bear species are commonly observed by park visitors feeding on dandelions and exotic graminoid plants along the Dyea road. Wolves and caribou are rarely seen in the area.

Wolverine, lynx, marmot, porcupine, marten, coyote, and many other smaller animals are present to the degree that the habitat allows. Bald eagles and many other birds, mink, river otter and other predators, and a variety of small mammals are found along the areas influenced by saltwater. Western toads and Columbian spotted frogs are the only amphibian species known to occur in the park.

An active monitoring program at KLGO has demonstrated Western toads are declining in KLGO. Others report that western toads are declining throughout their range in North America. In Washington State, western toads are a candidate for listing under the Endangered Species Act. Several invasive plant species occur in proximity to western toad breeding ponds in KLGO. Western toads in KLGO have been confirmed as being infected with Chytrid fungus, an amphibian disease native to southern Africa that is impacting amphibians world wide. The effects of herbicides on western toads are the park's primary concern that needs to be addressed in the invasive plant control EA.

Blue, spruce and ruffed grouse and three species of native ptarmigan inhabit the park area. This area also contains the northernmost breeding habitat of the rufous hummingbird. White-tailed deer, an introduced species, were sighted in the park in 1990. The tide flats, stream banks and channels, and wetlands form important feeding and nesting areas for waterfowl and other birds. Five bird species on the Alaska Watch List are likely to breed in the park: Golden Eagle, Wandering Tattler, Marbled Murrelet, Olive-sided Flycatcher, and Blackpoll Warbler.

The Olive-sided Flycatcher is a Federal species of management concern and an Alaska State species of special concern. It is declining throughout its range for unknown reasons. It is hypothesized that the population decline is primary due to habitat loss in its winter range in the northern and central Andes. This song birds occurs in areas where invasive species control work is likely to occur in Dyea and along the Chilkoot trail.

The Black-pole Warbler, Townsends Warbler, and Grey-checked Thrush are Alaska State species of special concern. These song birds occur in proximity to areas where invasive species control work is likely to occur in Dyea and along the Chilkoot trail.

3.9.5 Sitka National Historical Park

The convergence of the Indian River, the coastal rainforest, and the Pacific Ocean provides a biologically rich environment for a variety of wildlife species. The river receives a massive influx of marine–derived nutrients as salmon return to spawn and die in the river providing food resources to many species of wildlife. The park's extensive intertidal zone and shoreline areas support a variety of migratory waterfowl and shore birds. American and European wigeons,

northern shovelers, northern pintails, green-winged teals, brants, white-fronted geese, Canada geese, black turnstones, black-bellied and Pacific golden-plovers, semipalmated plovers, lesser and greater yellowlegs, marbled godwits, least, Western, and spotted sandpipers, dunlins, wandering tattlers, whimbrels, and dowitchers are all common migrants. Resident birds that use the estuary, river, and tidal flats for foraging and protection include common mergansers, mallards, spotted sandpipers, and great blue herons. A variety of gulls, northwest crows, and common ravens scavenge along the tidal flats, beaches, and the river.

Bald eagles are abundant, especially during the spring herring spawn and fall salmon runs, when eagles feed on fish carcasses in the river and adjacent tidal flats. At least two bald eagle nests are present in the park. Northern goshawks and sharp-shin hawks are often seen patrolling the park for prey. Many passerine birds, including pine siskins, dark-eyed juncos, savannah sparrows, varied, hermit, and Swainson's thrushes, American robins, Townsend's warblers, ruby-crowned and golden-crowned kinglets, Pacific slope flycatchers, northern flickers, red-breasted sapsuckers, tree swallows, belted kingfishers, American dippers, and winter wrens, use the park for breeding, a wintering ground, or a migratory stopover. One hundred fifty birds have been recorded in and around the park, all of which have the potential to be impacted by invasive plants or controls methods.

Mammal species that inhabit the park include masked shrews, deer mice, tundra voles, little brown bats (seasonally), red squirrels, mink, least weasel, and river otters. Brown bears occupy the Indian River drainage and occasionally forage in the park, often during Indian River salmon runs. Sitka blacktail deer also browse in the park occasionally. Most of these species depend on forest or edge habitat and could be potentially impacted by the control methods for invasive plants, particularly stands of dandelion, Japanese knotweed, creeping buttercup, and European mountain ash that have been found in the park.

3.9.6 Wrangell-St. Elias National Park & Preserve

Wildlife habitat associated with areas potentially subject to invasive plant treatments includes: low elevation river corridors, roadways, airstrips, and ORV trails. WRST roadways include the 60-mile McCarthy Road in the south, and the 40-mile Nabesna Road in the north. Both are gravel roads owned and maintained by Alaska Department of Transportation and Public Facilities (ADOTPF) . Ninety-five maintained and unmaintained airstrips are found throughout WRST, from elevations at 500m (e.g. Jake's Bar) to 1400m (e.g. Skolai Pass). WRST contains numerous ORV trails, most branching from the McCarthy Road (e.g. Kotsina Road) and the Nabesna Road (e.g. Copper Lake Trail, Tanada Lake Trail, Suslota Lake Trail, and Caribou Creek Trail). This diversity of sites represents virtually all wildlife habitat types in WRST except for alpine areas.

WRST has documented 209 species of birds in the interior regions of the park (Danby 2003, WRST Park files). Breeding bird surveys along the McCarthy and Nabesna roads have recorded the following species: pacific loon, horned grebe, northern shoveler, American wigeon, green-winged teal, mallard, lesser scaup, bufflehead, trumpeter swan, white-winged scoter, Barrow's goldeneye, merlin, willow ptarmigan, common snipe, lesser yellowlegs, Bonaparte's gull, arctic tern, belted kingfisher, downy woodpecker, alder flycatcher, Say's phoebe, violet-green swallow,

common raven, black-billed magpie, black-capped chickadee, Swainson's thrush, American robin, varied thrush, blackpoll warbler, myrtle warbler, Wilson's warbler, savannah sparrow, white-crowned sparrow, dark-eyed junco, pine grosbeak, and pine siskin. Additional species include raptors (bald and golden eagle, gyrfalcon, peregrine falcon, sharp-shinned hawk, red tailed hawk, northern harrier, great gray owl, great horned owl, northern hawk owl, boreal owl, and short-eared owl), and galliformes (spruce, ruffed and sharp-tailed grouse; willow, rock, and white-tailed ptarmigan). The State of Alaska lists the gray-cheeked thrush, blackpoll warbler, and the olive-sided flycatcher as Species of Special Concern.

Fifty-one species of terrestrial mammals have been recorded in WRST, from the pygmy shrew to the plains bison (Cook and MacDonald 2003, Danby 2003, WRST Park files). Ungulates include moose, bison, caribou, Dall's sheep, and mountain goat. Mule deer have recently expanded into the Chisana area. Carnivores include black and brown bear, wolf, coyote, fox, mustelids (wolverine, marten, ermine, mink, and river otter), lynx, and possibly cougar. Rodents include a variety of voles, arctic ground and red tree squirrels, beaver, porcupine, and muskrat. Snowshoe hare are common throughout the lower elevations, and collared pika are found in alpine areas.

One amphibian, the wood frog, is found in the study area, and is common along the McCarthy Road. The boreal toad is found only in the coastal areas of WRST.

The primary wildlife habitat types associated with areas potentially subject to treatment include: low elevation river corridors; spruce-dominated boreal forests along roadways and low elevation airstrips; scrub-shrub vegetation along mid-elevation airstrips; and tussock/tundra vegetation along parts of the Nabesna Road and higher elevation airstrips. River corridors provide important foraging and breeding habitat for numerous passerine bird species, bald eagle, trumpeter swan, moose, bison, caribou, coyote, wolf, beaver, and black and brown bear. The boreal forests provide habitat for numerous passerines; ruffed, sharp-tailed and spruce grouse; moose; coyote; wolf; black and brown bear; wolverine; marten; snowshoe hare; lynx; microtine rodents (esp. red-backed vole); red squirrels, porcupine, and wood frogs. Road corridors and maintained airstrips in this habitat provide important grit sources for spruce, ruffed, and sharp-tailed grouse, which are commonly found along roadways ingesting grit for aid in digestion. Additionally, willows associated with disturbance along roadsides are sometimes heavily used by snowshoe hares. The scrub-shrub areas occur around timberline, and are comprised mostly of alder, birch and willow thickets. These provide habitat for moose (especially winter), black and brown bears, wolves, coyote, caribou, willow and rock ptarmigan and wolverine. The higher elevation tussock/tundra areas contain caribou, Dall's sheep, brown bear, wolf, wolverine, pika, willow and rock ptarmigan, and Arctic ground squirrel.

3.10 Wilderness

Alaska's national parks contain most of the largest areas of undeveloped wild lands in the United States of America. They encompass some of the best examples of the wide diversity of ecosystems in Alaska including mountain summits, rolling tundra, massive icefields, beaches, boreal forest and coastal rainforest on a scale not possible elsewhere in the USA. Their size and scope give them a national and international recognition as wilderness resources. They also

protect significant wildlife habitat, archeological resources, and opportunities for subsistence and recreational activities. The Wilderness Act of 1964 (P.L. 88-577) describes wilderness as an area "untrammeled by man…retaining its primeval character and influence, without permanent improvements of human habitation… [with] outstanding opportunities for solitude or a primitive and unconfined type of recreation." Most of the land within the boundaries of the national parks in Alaska meets the criteria for Wilderness.

3.10.1 Wilderness Status

The national parks in Alaska comprise approximately 55 million acres of land, 33 million of which were designated wilderness with the passage of the Alaska National Interest Lands Conservation Act (ANILCA). These lands are managed as wilderness under the Wilderness Act of 1964 and under the provisions of ANILCA. The NPS Alaska region manages 75% of the designated wilderness in the National Park system and 31% of the wilderness acreage in the entire National Wilderness Preservation system. Eight of the park units in Alaska have designated wilderness: DENA, GAAR, GLBA, KATM, KOVA LACL, NOAT, and WRST.

An additional 18 million acres are considered eligible for wilderness designation by the Congress based on the wilderness suitability reviews conducted in compliance with ANILCA section 1317(a) and included in the park General Management Plans published in the mid 1980's. The full wilderness review process required under ANILCA section 1317(b) has not yet been completed on those eligible lands. Although EISs were completed there was no final action taken in the Secretary of the Interior's office and no record of decision was published in the Federal Register. This leaves the entire Alaska eligible wilderness acreage managed under NPS policies that protect wilderness character until Congress can act.

All of the units with designated wilderness have additional eligible wilderness acreage as well. The remaining units with eligible wilderness are ANIA, BELA, CAKR, KEFJ, and YUCH. Though great tracts of land are set aside as designated wilderness or are eligible for wilderness designation, most of these area are now free of invasive plants. The invasive plants mostly occur in development zones; however, a few small areas in wilderness settings are known to have invasive plants such as coastal strands, lake sides, and river corridors. These areas are frequented by people in float planes, canoes, kayaks, motor boats, and on foot as hikers and pack packers. Example areas are shores in GLBA and KEFJ, Twin Lakes in LACL, Walker Lake in GAAR, and ORV trails in WRST.

See figure 3.16 for a map of designated and eligible wilderness areas in Alaska National Parks.

3.10.2 Wilderness Policies

By policy the term "wilderness" includes the categories of eligible, study, proposed, recommended, and potential as well as designated wilderness. In policy, "the NPS will take no action that would diminish the wilderness eligibility of an area possessing wilderness characteristics until the legislative process of wilderness designation has been completed." (NPS Mgt. Policies, Ch. 6.3.1, 2006). This includes use of the minimum requirements concept regardless of wilderness category.

Wilderness character is the fundamental concept in the Wilderness Act of 1964 and is broadly defined in Section 2(c) but is not further defined in NPS policies. Wilderness character is the overarching and supplemental park management goal for areas so delineated. The NPS manages wilderness areas to be protected and remain unimpaired for future enjoyment as wilderness. Any proposal having the potential to impact wilderness resources will be evaluated in accordance with NPS policy or implementing NEPA. In evaluating environmental impacts, the NPS will take into account: 1. wilderness characteristics and values, including the primeval character and influence of the wilderness; 2. the preservation of natural conditions…, and 3. assurance that there will be outstanding opportunities for solitude, that the public will be provided with a primitive and unconfined type of recreational experience, and that wilderness will be preserved and used in an unimpaired condition (NPS Mgt. Policies, Ch. 6.3.4.3, 2006).

The control of invasive species in wilderness is addressed in NPS Mgt. Policies at Ch. 6.3.7 where management actions aimed at controlling invasive alien species should be attempted only when the knowledge and tools exist to accomplish clearly articulated goals.

3.10.3 Wild or Natural

The Wilderness Act designated lands "…where the earth and its community of life are untrammeled by man" and defined wilderness as land "retaining its primeval character and influence…which is protected and managed so as to preserve its natural conditions." The meanings and implications of the words "untrammeled" and "natural" are the source of current discussion and debate in the context of wilderness management (Landres et al. 2000). Dictionary synonyms of the word untrammeled include unimpeded, unhampered uncontrolled, self-willed and free. The connotations of this definition are an area that is free from human control or manipulation, or *wild*. Synonyms of the word natural include native, aboriginal, indigenous, and endemic. From a biological perspective natural may simply be defined as the native biological species composition, spatial and temporal patterns, and processes of an area (Noss and Cooperrider 1994).

The concepts of *wild* and *natural* influence decisions made in wilderness management (Landres et al. 2000). Where human-caused impact has created unintended changes to naturalness, we have the capability to manipulate the environment to restore naturalness. The management dilemma suggested by authors (Cole 1996, 2000; Landres et al. 2000) is whether manipulation, especially large scale manipulation, should be undertaken thereby sacrificing wildness for naturalness. A proposal to eliminate invasive plants as a step in restoring or protecting native plant communities is one of the actions suggested as a dilemma for managers in wilderness areas. In small scale restorations there is less conflict or controversy between wildness and naturalness (Landres et al 2000).

Figure 3.16 Wilderness Areas in Alaska National Park System Lands