National Park Service
U.S. Department of the Interior

Alaska Region

Alaska Region
Invasive Plant Management Plan
Environmental Assessment

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Alaska Regional Office
Anchorage, Alaska

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ACRONYMS

ABO	Alaska Bird Observatory
AD	After Death
ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ADOTPF	Alaska Department of Transportation and Public Facilities
AKEPIC	Alaska Exotic Plant Information Clearinghouse
ALACC	Alaska Lands Act Coordination Committee
ALAG	Alagnak National Wild River
ANIA	Aniakchak National Monument and Preserve
ANILCA	Alaska National Interest Lands Conservation Act of 1980
ATV	all terrain vehicle
BELA	Bering Land Bridge National Preserve
BLM	Bureau of Land Management
BP	before present
BMP	best management practice
CAKR	Cape Krusenstern National Monument
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulation
CNIPM	Committee for Noxious and Invasive Plant Management
DENA	Denali National Park and Preserve
DMTS	Delong Mountain Transportation System
DO	Director's Orders
EA	environmental assessment
EIS	environmental impact statement
EO	Executive Order
EPA	Environmental Protection Agency
EPMT	exotic plant management team
FAA	Federal Aviation Administration
GAAR	Gates of the Arctic National Park and Preserve
GIS	geographical information system
GLBA	Glacier Bay National Park and Preserve
GMP	general management plan
GPS	global positioning satellite
IPM	integrated pest management
IPMP	invasive plant management plan
JHA	job hazard analysis
KATM	Katmai National Park and Preserve
KEFJ	Kenai Fjords National Park
KLGO	Klondike Gold Rush National Historic Park
KOVA	Kobuk Valley National Park
LACL	Lake Clark National Park and Preserve
MHW	mean high water
MSDS	material safety data sheet

MSU	Montana State University
NANA	Northwest Alaska Native Association
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Act
NHPA	National Historic Protection Act
NOAT	Noatak River National Preserve
NPS	National Park Service or National Park System
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
OHV	off-highway vehicle
ORV	off-road vehicle
OSHA	Occupational Safety and Health Act
PEPC	Planning Environment and Public Comment
PIF	Partners in Flight
PL	public law
PPE	personal protective equipment
RAVE	Relative Aquifer Vulnerability Evaluation
SDWA	Safe Drinking Water Act
SITK	Sitka National Historic Park
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WRST	Wrangell-Saint Elias National Park and Preserve
YUCH	Yukon-Charley Rivers National Preserve

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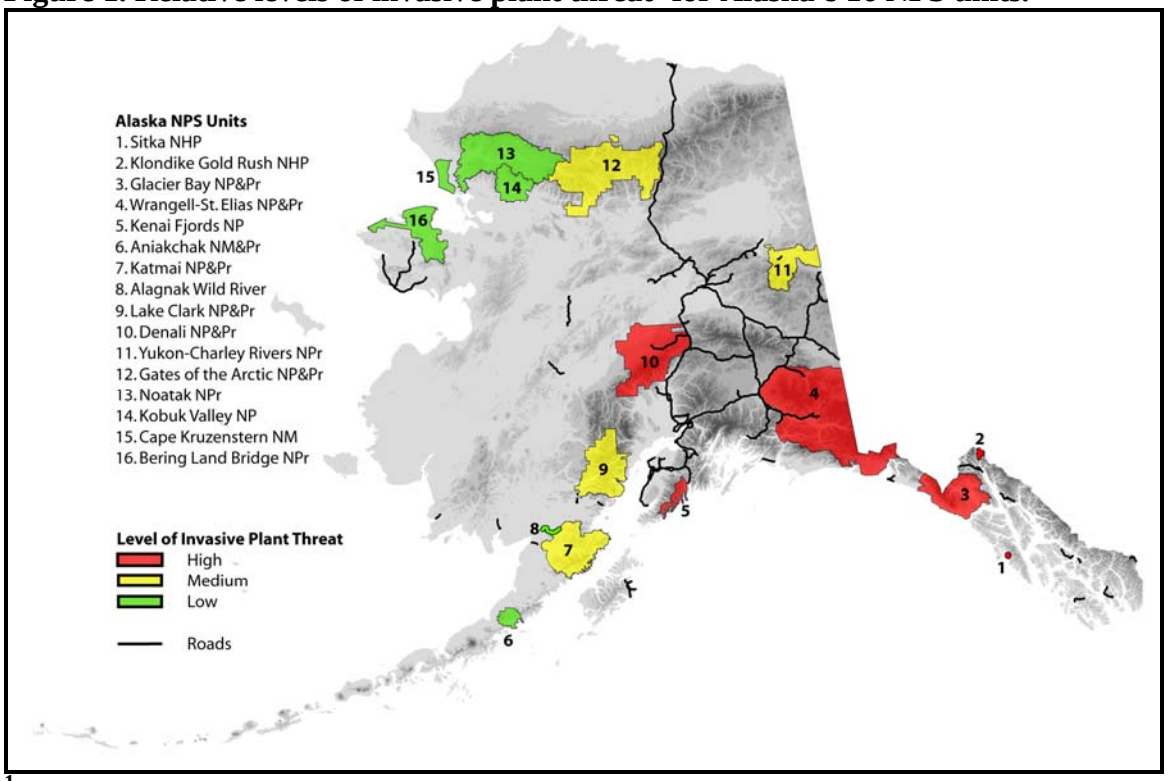
1.0 Purpose and Need

1.1 Purpose of and Need for Action

The National Park Service (NPS) is considering an Invasive Plant Management Plan (IPMP) to address invasive plant infestations in National Park System units throughout the Alaska Region. Invasive plants are defined as non-native plant species whose introduction does or is likely to cause economic or environmental harm or harm to human health. The IPMP uses a decision flow chart to select appropriate plant control methods, including physical (pulling, digging, burial, mowing, cutting, burning, and other heat treatments) and chemical (herbicide) treatments to eradicate or contain invasive plant infestations.

The purpose of the plan is to evaluate alternatives for managing invasive plants in Alaska National Park System units. The NPS goal is to manage invasive plants in a manner to prevent adverse impacts to park resources and values while minimizing adverse impacts of the management efforts. The NPS needs a long-term management strategy to avoid invasive plant establishment and expansion on local or landscape levels as seen elsewhere in the nation. Figure 1 shows National Park System units in Alaska with the relative threat of invasive plants in these units. Detailed maps of invasive plant infestations in some parks are provided in Chapter 3, existing conditions in the affected environment.

Figure 1. Relative levels of invasive plant threat[1] for Alaska's 16 NPS units.



[1] Threat of invasive is not uniform across any one park. High threats are localized in high traffic areas.

Alaska is unique among the United States in retaining vast landscapes inhabited by only native species. The sixteen Alaska Region National Park System units are representative of this condition, but invasive plants are beginning to infest areas of high human use. Invasive plant species are becoming widespread in towns and along roadways throughout the state. Impacts of invasive plants to natural areas include displacement of native plant communities, degradation of fish and wildlife habitat, and alteration of ecosystem processes. Invasive plants can also affect visitor perceptions and recreational use as natural areas are degraded over time. While invasive plants have affected only small spatial areas in Alaska NPS units to date, the rapid spread of many invasive species across Alaska indicates that more serious problems are on the horizon. A proactive strategy providing consistency and direction to manage invasive plants will never be more cost-effective than now, when we can focus on prevention, early detection, and rapid response to remove small-scale infestations.

This environmental assessment (EA) analyzes the proposed Invasive Plant Management Plan and alternatives and their impacts on the environment. While chemical and biological control methods could prove more effective than physical means, these methods have greater associated risks. This EA is being prepared to evaluate the potential impacts of invasive plants and their control methods toward the goal of minimizing overall impacts to Alaska Region NPS units. The EA has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 and regulations of the Council on Environmental Quality (40 CFR 1508.9).

1.2 Background

Prior to the establishment of the Alaska Region Exotic Plant Management Team (EPMT) program in 2003, invasive plant management in Alaska parks was limited to preliminary surveys in about half of the parks and small-scale control efforts in several parks. Since 2003, the EPMT has coordinated efforts throughout the Region toward invasive plant prevention, survey, control, monitoring, and restoration. Field employees watch for new infestations, control and monitor existing infestations, and map and collect relevant data about each site.

Invasive plant control efforts in Alaska parks 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 youth or 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 detection of new infestations requires additional effort. Lately more aggressive invasive plants have become established in Alaska NPS units or are not contained with current control methods, which point to a need for more effective control methods.

Authorities to manage exotic plants in Alaska National Parks are derived from the 1916 NPS Organic Act, the 1980 Alaska National Interest Lands Conservation Act (ANILCA), the Noxious Weed Control & Eradication Act of 2004, the 1999 Executive Order 13112 – Invasive Species, and the 2006 NPS Management Policies. These are briefly described below.

1.2.1 NPS Organic Act

The Act creating the NPS states the NPS will "… conserve the scenery and the natural and historic objects and the wild life therein and … provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

The NPS Organic Act and the General Authorities Act prohibit impairment of park resources and values. The 2001 NPS Management Policies uses the terms "resources and values" to mean the full spectrum of tangible and intangible attributes for which the park is established and managed, including the Organic Act's fundamental purpose and any additional purposes as stated in the park's establishing legislation. The impairment of park resources and values may not be allowed unless directly and specifically provided by statute. The primary responsibility of the NPS is to ensure that park resources and values will continue to exist in a condition that will allow the American people to have present and future opportunities for enjoyment of them.

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

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

The National Park Service Omnibus Management Act of 1998 (P.L. 105-391, 112 Statute 3497) addresses resources inventory and management in Title II. Section 201 defines the purposes of this title to enhance and encourage scientific study in National Park System (NPS) units. Section 202 authorizes and directs the Secretary of the Interior to assure management is enhanced in NPS units by a broad program of high quality science and information, such as inventory and monitoring and exotic plant management programs.

1.2.2 Alaska National Interest Lands Conservation Act (ANILCA)

Title 1 of ANILCA broadly defines the purpose of the Act. Section 101 states the units are established to "… preserve for the benefit, use, education, and inspiration of present

and future generations certain lands and waters in the State of Alaska that contain nationally significant natural, scenic, historic, archeological, scientific, wilderness, cultural, recreational, and wildlife values." Furthermore, this section emphasizes preserving scenic and geological values of *natural landscapes and habitat for wildlife in their natural state and maintaining undisturbed ecosystems*, among other values.

1.2.3 Federal Noxious Weed Act (Public Law 93-629)

Enacted January 3, 1975, the Act established a Federal program to control the spread of noxious weeds. P.L. 101-624, the 1990 Farm Bill, enacted November 28, 1990 (104 Stat 3611) amended the Act by requiring each Federal land-managing agency to:

(1) Designate an office or person adequately trained in the management of undesirable plant species to develop and coordinate an undesirable plants management program for control of undesirable plants on Federal lands under the agency's jurisdiction;

(2) Establish and adequately fund an undesirable plants management program through the agency's budgetary process;

(3) Complete and implement cooperative agreements with State agencies regarding the management of undesirable plant species on Federal lands under the agency's jurisdiction; and

(4) Establish integrated management systems to control or contain undesirable plant species targeted under cooperative agreements.

In General, Federal agencies, as appropriate, shall enter into cooperative agreements with State agencies to coordinate the management of undesirable plant species on Federal lands. The contents of a plan pursuant to a cooperative agreement shall:

(A) Prioritize and target undesirable plant species or group of species to be controlled or contained within a specific geographic area;

(B) Describe the integrated management system to be used to control or contain the targeted undesirable plant species or group of species; and

(C) Detail the means of implementing the integrated management system, define the duties of the Federal agency and the State agency in prosecuting that method, and establish a timeframe for the initiation and completion of the tasks specified in the integrated management system.

(D) Exception: A Federal agency is not required under this section to carry out programs on Federal lands unless similar programs are being implemented generally on State or private lands in the same area.

1.2.4 Executive Order 13112 - Invasive Species:

Section 2 of Executive Order (EO) 13112 addresses federal agency duties with regards to management of invasive species. Each Federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law:

1. identify such actions;
2. subject to the availability of appropriations, and within Administration budgetary limits, use relevant programs and authorities to: (i) prevent the introduction of invasive species; (ii) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; (iii) monitor invasive species populations accurately and reliably; (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded; (v) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; (vi) promote public education on invasive species and the means to address then; and
3. not authorize, fund, or carry out action that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.

1.2.5 NPS Management Policies of 2006:

Policy 4.4.4 Management of Exotic Species

Exotic species will not be allowed to displace native species if displacement can be prevented.

Policy 4.4.4.1 Introduction or Maintenance of Exotic Species

“In general, new exotic species will not be introduced into parks. In rare situations, an exotic species may be introduced or maintained to meet specific, identified management needs when all feasible and prudent measures to minimize the risk of harm have been taken.”

For historic properties, an exotic species would be maintained in NPS units only if, “It is needed to meet the desired condition of a historic resource, but only where it is noninvasive and is prevented from being invasive by such means as cultivating (for plants), or tethering, herding, or pasturing (for animals). In such cases, the exotic species used must be known to be historically significant, to have existed in the park during the park’s period of historical significance, to be a contributing element to a cultural landscape, or to have been commonly used in the local area at that time.”

Policy 4.4.4.2 Removal of Exotic Species Already Present

"All exotic plant and animal species that are not maintained to meet an identified park purpose will be managed—up to and including eradication—if:

1) control is prudent and feasible;
2) the exotic species:
    - Interferes with natural processes and the perpetuation of natural features, native species or natural habitats; or
    - Disrupts the genetic integrity of native species; or
    - Disrupts the accurate presentation of a cultural landscape; or
    - Damages cultural resources; or
    - Significantly hampers the management of park or adjacent lands; or
    - Poses a public health hazard as advised by the U.S. Public Health Service (which includes the Centers for Disease Control and the NPS Public Health Program); or
    - Creates a hazard to public safety.

High priority will be given to managing exotic species that have, or potentially could have, a substantial impact on park resources, and that can reasonably be expected to be successfully controllable. Lower priority will be given to exotic species that have almost no impact on park resources or that probably cannot be successfully controlled. Where an exotic species cannot be successfully eliminated, managers will seek to contain the exotic species to prevent further spread or resource damage.

The decision to initiate management should be based on a determination that the species is exotic. For species determined to be exotic and where management appears to be feasible and effective, superintendents should:

1) evaluate the species' current or potential impact on park resources;
2) develop and implement exotic species management plans according to established planning procedures;
3) consult, as appropriate, with federal and state agencies; and
4) invite public review and comment, where appropriate. Programs to manage exotic species will be designed to avoid causing significant damage to native species, natural ecological communities, natural ecological processes, cultural resources, and human health and safety."

Policy 4.4.5.2 Integrated Pest Management Program

"The Service conducts an integrated pest management (IPM) program to reduce risks to the public, park resources, and the environment from pests and pest-related management strategies. IPM is a decision-making process that coordinates knowledge of pest biology, the environment, and available technology to prevent unacceptable levels of pest damage, by cost-effective means, while posing the least possible risk to people, resources, and the environment.

The Service, and each park unit, will use an IPM approach to address pest issues. Proposed pest management activities must be conducted according to the IPM process prescribed in Director's Order #77-7: Integrated Pest Management. Pest issues will be reviewed on a case-by-case basis. Controversial issues, or those that have potential to negatively impact the environment, must be addressed through established planning procedures and be included in an approved park management or IPM plan. IPM procedures will be used to determine when to implement pest management actions, and which combination of strategies will be most effective for each pest situation. Under the Service's IPM program, all pesticide use on lands managed or regulated by the Service, whether that use was authorized or unauthorized, must be reported annually."

1.3 Issues

To focus the environmental assessment, the NPS selected specific issues for further analysis and eliminated others from evaluation. Issues were identified in two internal NPS scoping meetings in spring of 2006, from three public meetings in September, 2006, (Juneau, Fairbanks, and Anchorage). Public input was also received through the NPS PEPC planning website, from personal correspondence, and through direct contact with likely stakeholders (e.g. Alaska Lands Act Coordination Committee on October 10, 2006, and the Committee for Noxious and Invasive Plant Management [CNIPM] meeting October 25 and 26, 2006). Over 200 scoping newsletters were sent to stakeholders in Alaska and abroad on or about September 1, 2006. See Chapter 5 for more details on public scoping, consultation, and coordination.

1.3.1 Issues Selected for Detailed Analysis

Based on scoping, the NPS identified the following issues for evaluation in this EA.

1.3.1.1 Aquatic Resources and Fish

Invasive plant species could have negative effects on native aquatic biota and fish habitat and populations. Invasive plant expansion or use of herbicides may have detrimental effects on aquatic species such as salmon, including eggs, fry, migrations, adult tissues, reproductive capacity, and essential fish habitat.

Improper applications of herbicides could result in negative impacts to fish and other aquatic life forms. The accumulation and contamination of streams, rivers, wells, and sediments from EPA approved herbicides may adversely affect aquatic resources.

1.3.1.2 Cultural Resources

Archeological resources could be adversely impacted from the various invasive plant control methods. Digging, some chemicals, steam, and fire could adversely affect archeological or historical resources.

Some non-native plants were introduced during the Klondike Gold Rush era and other human events with historical significance. Though some of these species may be spreading invasives, most are not and are part of the historical landscape. The assessment should address potential effects on historically important plants.

1.3.1.3 Floodplain Management and Wetlands Protection

Invasive plant infestations and various control methods could adversely affect floodplain and wetland functions such as: obstruction of natural flows, changes in water retention, changes in availability of water to organisms other than the invasive plants, changes in erosion rates, or displacement of vegetation used by wildlife or fish.

1.3.1.4 Human Health and Safety

General public and employee health and safety could be adversely affected from exposure to chemical herbicides and the use of other control methods such as fire, steam, cutting, and mowing.

1.3.1.5 Soils

Invasive plant infestations can alter natural soil chemistry, soil physics, and productivity. Conversely, single or repeated applications of herbicides could alter soil chemistry and adversely affect soil invertebrates and soil productivity. Soil moisture, particle sizes, and soil temperatures may affect herbicide movement through soil, so soil moisture regimes, particle sizes, and temperatures need to be considered.

1.3.1.6 Subsistence Resources/Uses

Uncontrolled invasive plant infestations may lure pollinators away from native plants resulting in reduced berry crops and otherwise adversely affect habitat for fish and wildlife used for subsistence, thereby changing subsistence use patterns.

Herbicide uses could adversely affect food safety, palatability, and perceptions of foods used in subsistence activities. Appendix A contains the ANILCA Section 810 summary evaluation and finding of effects to subsistence.

1.3.1.7 Vegetation

Invasive plant infestations could result in reduced biodiversity of natural plant communities and the displacement or replacement of native species and natural plant communities. Invasive plant infestations could adversely affect the natural evolution of plant communities, increase land disturbances, and accelerate with climate change effects.

Herbicides could adversely affect non-target species of native vegetation in treatment areas.

1.3.1.8 Wilderness Resources/Scenic Quality

Invasive plant infestations and some control methods in Alaska National Park System units could affect the scenic quality of the parks and the wilderness resources of the areas. Appropriate methods are needed to detect and manage invasive plants in the vast, remote wilderness areas in Alaska National Park System units.

1.3.1.9 Wildlife/Habitat

Invasive plant infestations could result in adverse and toxic effects on wildlife and their habitat in Alaskan NPS units.

The use of herbicides or uncontrolled expansion of invasive plants could result in damaging effects on insect life used by birds, small mammals, and larger animals. Herbicides and bioaccumulation in tissues of higher trophic level animals could result in sub-lethal effects to wildlife. Keeping wildlife from feeding in chemically treated areas or avoiding chemical treatments in sensitive wildlife habitat are important considerations.

1.3.2 Issues Dismissed From Detailed Analysis

Issues dismissed from detailed analysis will not be addressed further in the EA.

1.3.2.1 Air Quality

The proposed invasive plant control alternatives would not consider aerial spraying or otherwise measurably affect air quality in national parks in Alaska.

1.3.2.2 Environmental Justice

None of the invasive plant control alternatives are expected to have a disproportionate adverse effect on any economically disadvantaged human populations in or near the Alaska National Park areas, including subsistence communities.

1.3.2.3 Noise

No measurable change in human-caused noises would occur as a result of any of the invasive plant control alternatives.

1.3.2.4 Recreation and Visitor Use

The effects on park recreation and visitor use from herbicide treatment of invasive plants would be minimal. Herbicide treatment areas would be small in size and considerable acreage is available for park visitors to pursue alternate recreational venues in parks. In addition, park visitors would be displaced from treatment areas for a short period of time to protect their health and safety.

The potential for the introduction of invasive plants to NPS areas from recreational uses, equipment, and livestock would be addressed through preventative mitigating measures to 1) educate the public about invasive plants and 2) require weed-free feed, straw, and recreational equipment. See also section 2.5 on mitigating measures.

1.4 Permits and Approvals Needed to Implement Project

An Alaska Department of Environmental Conservation Pesticide Application permit would be needed for any application greater than one acre on a state right-of-way. Because only small-scale and spot applications are considered, no permits are anticipated. All NPS applicators would be licensed by the appropriate Federal or State agencies to address proper labeling, storage, use, and disposal of herbicides.

2.0 Description of the Alternatives

2.1 Introduction

This chapter describes a range of reasonable alternatives, namely the no action alternative (status quo - physical methods to control invasive plants) and the proposed action alternative (use a decision tree for adaptive management to supplement physical control methods with herbicide use where necessary, safe, and effective). This chapter also describes those alternatives and actions that will not be considered further (i.e., those not analyzed in Chapter 4).

Refer to Chapter 3, section 3.1 for an inventory or known invasive plant infestations in Alaska NPS units and to chapter 5 for a description of the process used and participants consulted during the development of the alternatives.

Tables 2.7 and 2.8 at the end of this chapter provide a comparative summary of the alternatives and their environmental impacts, respectively.

2.2 Elements Common to Both Alternatives

2.2.1 Survey, Monitoring, and Data Management

Surveying new areas and monitoring areas already surveyed or treated are critical for finding new infestations, measuring changes in a given population, and evaluating control effectiveness. Field technicians will continue to use a standard data collection protocol (Hayes and Rapp 2008) for precise global positioning system (GPS) units to enable population size analysis, planning using distribution maps, and relocation of infestations.

Data management is important because it is only through proper maintenance of the data that the existing knowledge base will be valuable for years to come. All data collected will be stored in a geographic information system (GIS) database that contains data collected since 2003. This database is accessible to all NPS employees, can be provided to others on demand, and would serve as the information source for the decision tree process under Alternative 2. Data are collected in accordance with North America Weed Management Association standards and are annually submitted to the online Alaska Exotic Plant Information Clearinghouse database (http://akweeds.uaa.alaska.edu) as points rather than the original polygons.

2.2.2 Physical Control Methods

Physical control methods would continue in Alaska NPS units, including manual, mechanical, and thermal methods.

Manual and mechanical techniques such as pulling, digging, cutting, or otherwise damaging plants are effective for controlling some invasive plant species, particularly small populations of species without substantial root reserves and lacking the capacity for

vegetative reproduction. These methods are labor and time intensive, and treatments must generally be administered multiple times each growing season for multiple years.

All Alaska parks with documented invasive plant infestations currently use manual or mechanical treatments to control them and would continue to do so for the majority of infestations under either alternative. Manual treatment involves the use of small hand tools to complement hand-pulling, while mechanical treatment tools include shovels, clippers, pulaskis, weed wrenches™, brush trimmers, mowers, and chainsaws (Tu et al. 2001). Both manual and mechanical treatments remove aboveground plant biomass and prevent dispersal by seed.

2.2.3 Thermal Treatments

Thermal control methods, including burning, steaming, and application of hot foam, are expensive and relatively untested options in Alaska. Where manual and mechanical control methods are ineffective in controlling particular infestations, thermal treatments could control larger areas, allow for thorough coverage, and control seeds and shallow roots. For plants with substantial root reserves, however, thermal treatments are unlikely to be effective in eliminating a population.

2.3 Alternative 1. No Action (Status Quo)

Under Alternative 1, the NPS would continue to treat invasive plant infestations in Alaska National Park System units with manual or mechanical control methods where feasible, as determined on a case-by-case basis. Table 2.1 provides the acres treated with physical control methods between 2005 and 2007 and estimates of acres to be treated with those methods until 2018. We project fewer than 1,200 acres would be treated out of about 40,000,000 acres of vegetated lands in Alaska NPS units. Where multiple years of control are ineffective, alternative methods would be used experimentally, including thermal and additional mechanical treatments but not chemical and biological methods. Where all other methods fail, further NEPA analysis would be necessary for the latter methods. Increasing labor and funding would be needed under alternative 1 due to the persistence of existing infestations and the establishment of new ones.

2.4 Alternative 2. Proposed Invasive Plant Management Plan with Decision Tree (*NPS Preferred Alternative)*

An adaptive management approach would use a decision tree to determine how to control invasive plant infestations in Alaska National Parks most effectively while posing the least possible risk to people, resources, and the environment. Spot herbicide application would be allowed in specified circumstances using best management practices (appendix H) where physical control methods would be ineffective. Acres treated since 2005 and projected through 2018 under Alternative 2 are shown in Table 2.2. We project fewer than 600 acres would be treated out of about 40,000,000 acres of vegetated lands in Alaska NPS units. A conservative projection of herbicide use under this alternative would be up to 1 acre per year in smaller treatments and 1 acre per year for unanticipated

treatments. An upper estimate of herbicide use across Alaska NPS units under Alternative 2, if many new populations of high-risk species were found, would be 10 acres per year.

Table 2.1 Actual and Projected Acres Treated and Retreated across Alaska NPS Units in 2005 through 2018 (* indicates estimated projections) under Alternative 1.

Year	Acres Treated for the First Time	Acres Retreated	Total Acres Treated
2005	17	6	23
2006	46	20	66
2007	28	22	50
2008	20*	25*	45*
2009	22*	29*	51*
2010	24*	34*	58*
2011	26*	40*	66*
2012	28*	47*	75*
2013	30*	55*	85*
2014	32*	64*	96*
2015	34*	74*	108*
2016	36*	85*	121*
2017	38*	97*	135*
2018	40*	110*	150*
Totals	421*	708*	1129*

Table 2.2 Actual and Projected Acres Treated and Retreated across Alaska NPS Units in 2005 through 2018 (* indicates estimated projections) under Alternative 2.

Year	Acres Treated for the First Time	Acres Retreated	Acres Treated with Herbicide	Total Acres Treated
2005	17	6	0	23
2006	46	20	0	66
2007	28	22	0	50
2008	20*	25*	0	45*
2009	22*	29*	6*	51*
2010	21*	27*	4*	48*
2011	20*	25*	3*	45*
2012	19*	23*	2*	42*
2013	18*	21*	2*	39*
2014	17*	19*	2*	36*
2015	16*	17*	2*	33*
2016	15*	15*	2*	30*
2017	14*	13*	2*	27*
2018	13*	11*	2*	24*
Totals	286*	273*	27*	559*

2.4.1 Integrated Pest Management Decision Tree

The Decision Tree (Figure 2.1 with definitions in Table 2.4) determines whether a given infestation meets specific criteria that indicate herbicide use would be necessary, safe, and effective. There are three situations that warrant consideration of herbicide use:

1) a population is larger than a "threshold" size beyond which physical control methods are ineffective (Table 2.3);
2) a small population has been repeatedly controlled using physical control methods, but the population persists; and
3) herbicide use for a small population in a remote area would control existing plants as well as plants that germinate later in the growing season when no one is present.

If herbicide use should be considered due to one of these three conditions being satisfied, there are four conditions that would rule out the use of herbicide:

1) the population is not an isolated population but instead is part of a larger population;
2) the species is considered low-risk;
3) the species is of medium-risk but park-wide eradication is infeasible; or
4) the use of herbicide would result in risks to human or wildlife health or water contamination.

Threshold population sizes for effective physical control of particular invasive plant species, as shown in Table 2.3, were developed on the basis of their biology and control results in Alaska. The species listed are those currently being managed on NPS lands in Alaska or likely to arrive in the near future. Thresholds for additional species would be developed as needed from literature for high-risk species and following multiple years of physical control for medium-risk species. Thresholds would be adapted if consistent results demonstrate that larger populations of a particular species can be eliminated by physical methods or that the listed threshold population size cannot be eliminated by physical methods.

Table 2.3. Thresholds for physical control of invasive plants on NPS lands in Alaska.

Low Control Difficulty	**Medium Control Difficulty**	**High Control Difficulty**
5,000 individuals or 1.00 acre	**1,000 individuals or 0.25 acres**	**100 individuals or 0.10 acres**
alsike clover	common tansy	bird vetch
black bindweed	common timothy	Canada thistle
common dandelion	foxglove	creeping buttercup
common sheep sorrel	orchardgrass	European mountain-ash
red clover	oxeye daisy	Japanese knotweed
tall buttercup	quackgrass	orange hawkweed
	smooth brome grass	perennial sowthistle
	white clover	Siberian peashrub
	white/yellow sweetclover	reed canarygrass
	yellow toadflax	

Figure 2.1. Integrated Pest Management Decision Tree

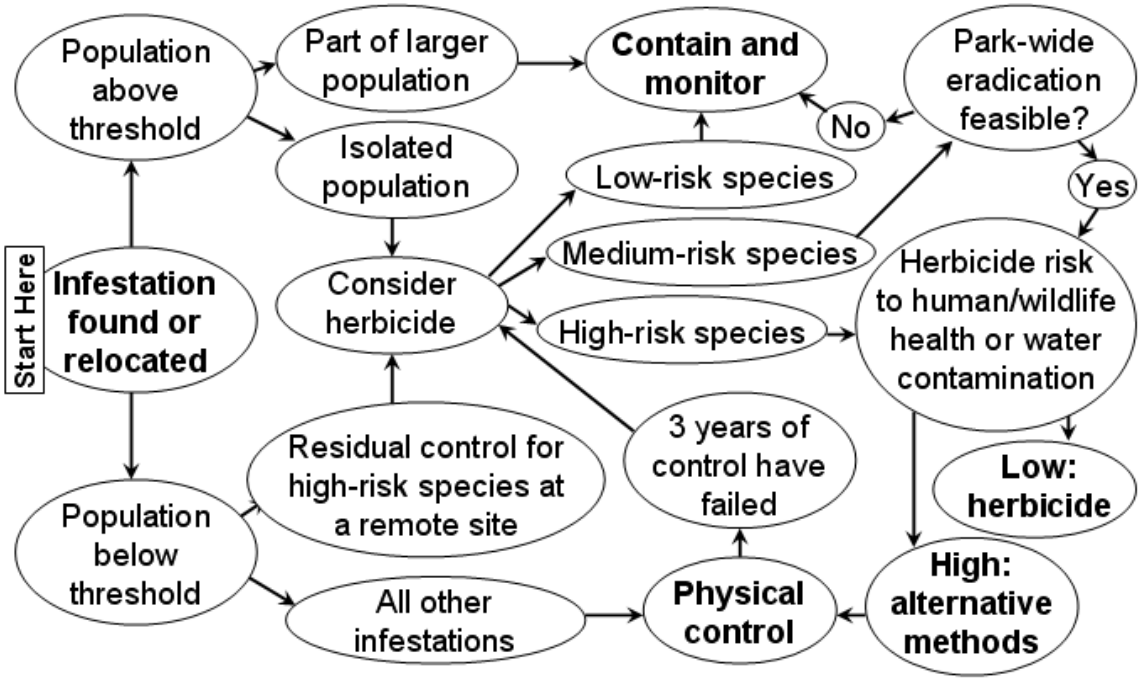


Table 2.4. Definition of terms used in Decision Tree.

Term	Definition
Threshold	Measured in number of individuals or gross acreage, represents the population size beyond which physical control would not provide 50% control after 3 years of treatment or 75% control after five years.
Residual control for high-risk species in a remote site	Herbicide residue in the soil would control seedlings of high-risk species likely to germinate at a site that cannot be revisited later in the growing season.
3 years of control have failed	Three years of well-timed and thoroughly executed control efforts have not reduced the population level to 50% of its initial size; or five years have not reduced the population level to 25% of its initial size.
Isolated population	Evaluated independently by species, any population less than 5 acres in size for which there is no other population above the threshold size for physical control within 500 meters on NPS lands.
Part of larger population	There is another population of this species greater than the threshold size for physical control within 500 meters of the population under consideration, or the population is greater than 5 acres in gross size.
High-risk species	Ranked 60 or higher by the Alaska Natural Heritage Program (http://akweeds.uaa.alaska.edu/).
Medium-risk species	Ranked 50 to 59 by the Alaska Natural Heritage Program.
Low-risk species	Ranked less than 50 by the Alaska Natural Heritage Program.
Park-wide	Considered feasible only if populations of a species in a given

eradication feasible?	park total less than 25 acres.
Contain and monitor	Physical control methods would be used to contain the infestation to its current distribution, without the stipulation that the population be controlled in 3 to 5 years as described above.
Herbicide risk to human or wildlife health or water contamination	Analyzed on the basis of Risk Assessments prepared for the Forest Service (http://www.fs.fed.us/foresthealth/pesticide/risk.shtml), human or wildlife risk evaluation considers exposure and toxicity to determine if humans or animals would likely come into contact with significant quantities of a toxic substance, primarily via consumption of subsistence resources or forage. Water contamination potential considers herbicide properties and likelihood of transport into surface water or groundwater and effects therein.
Low: herbicide	The least risk and most effective herbicide for a given species and context would be allowed.
High: alternative methods	Return to the physical control mode with an emphasis on experimentation with alternative methods. If the 3- or 5-year conditions are not met, use of the least-risk herbicide would be allowed.

2.4.2 Herbicide Use

Only species considered to be moderately to highly invasive by the Invasive Plant Ranking System would be considered for herbicide use under Alternative 2. Because of the variety of these species and the nature of integrated pest management, a range of herbicides would need to be considered in order to provide effective and site-specific control. The herbicide active ingredients commonly used for invasive plant control in natural areas in other states that are registered for use in Alaska are those that would be authorized for use under Alternative 2 (Table 2.5)**.** Common trade names are listed in the table as examples; under the preferred alternative, any registered herbicide trade name that contains the active ingredients listed in Table 2.6 may be used. In addition, newly developed herbicides in the future would be authorized if they are registered by the Environmental Protection Agency and the Alaska Department of Environmental Conservation, if a risk assessment has been prepared that takes Alaska's climate into account, and if their properties (as presented in Chapter 4) fall within the range of values of herbicides specifically authorized here. Herbicide selection for a particular infestation would be based on the target species biology, presence of non-target species, soil type, depth and distance to water, and weather, and each selection would have to be approved by the NPS Regional or National Integrated Pest Management Coordinator.

Under Alternative 2, herbicides would only be applied according to their labels and using spot spray via boom, backpack, or handheld spray mechanisms or direct contact via wicks, brushes, sponges, or injection. Particular infestations may require repeated herbicide applications for effective control. A wide range of best management practices would be required to ensure legal, safe, and responsible herbicide use (Appendix H).

Table 2.5. Proposed herbicides and their characteristics.

Active Ingredients	Target Plants	Mode of Action	Method of Application
2, 4-D (Aqua-Kleen, Barrage, Weedone, Esteron ® brand 99)	Broadleaf plants, woody plants, aquatic invasive plants, and non-flowering plants	Plant-growth regulator that stimulates nucleic acid and protein synthesis and affects enzyme activity, respiration, and cell division. It is absorbed by plant leaves, stems, and roots and moves throughout the plant. It accumulates in growing tips.	Ground spraying, lawn spreaders, cut stump treatments, foliar spray, basal bark spray, injection.
Aminopyralid (Milestone VM)	Broadleaf plants	Disturbs plant growth. It is absorbed by green bark, leaves and roots and moves throughout the plant. Accumulates in the meristem (growth region) of the plant.	Ground spraying, hand-held sprayer.
Chlorsulfuron (Telar)	Broadleaf plants and some annual grasses.	Absorbed by the leaves and roots and moves rapidly through the plan. Prevents the plant from producing an essential amino acid.	Ground spraying, hand-held sprayer.
Clopyralid (Curtail, Transline, Reclaim, Lontrel, Redeem)	Annual and perennial broadleaf herbs, especially knapweeds, thistles, and other members of the sunflower, legume, and knotweed families	Absorbed by the leaves and roots of the invasive plant and moves rapidly through the plant. It affects plant cell respiration and growth.	Ground spraying.
Glyphosate Products (Roundup Pro, Roundup Ultra, Rodeo, GlyPro, Accord, Glyphomax, Touchdown)	Grasses, herbaceous plants including deep-rooted perennial invasive plants, brush, some broadleaf trees and shrubs, and some conifers. Does not control all broadleaf woody plants.	Absorbed by leaves and rapidly moves through the plant. It acts by preventing the plant from producing an essential amino acid. This reduces the production of protein in the plant, and inhibits plant growth.	Ground spraying, hand-held sprayer, wipe application, frill treatment, cut stump treatment.
Imazapyr (Arsenal, Habitat)	Annual and perennial grass, broad-leaved weeds, brush, vines, and deciduous trees.	Absorbed by leaves and roots, moves rapidly through plants. Disrupts photosynthesis and interferes with cell growth and DNA synthesis.	Ground foliage spray, basal bark and stem treatment, cut stump treatment, tree injection.
Metsulfuron methyl (Escort)	Woody plants, annual and perennial broadleaf plants, and annual grassy invasive plants.	Absorbed through the roots and foliage and moves rapidly through the plants. It inhibits cell division in the roots and shoots, which stops growth.	Ground spraying, hand-held sprayer.
Triclopyr (Garlon products)	Woody plants and broadleaf plants.	Disturbs plant growth. It is absorbed by green bark, leaves and roots and moves throughout the plant. Accumulates in the meristem (growth region) of the plant.	Ground foliage spray, basal bark and stem treatment, cut surface treatment, tree injection.

In the future, additional plans to address specific invasive plant management issues may be prepared. Park-specific plans containing invasive plant treatments or having associated potential impacts that have not been considered in this analysis would require additional compliance with NEPA.

2.4.3 Infestations to be Treated Immediately Using Herbicides

Alternative 2 would result in four herbicide applications in the first year of treatment (Table 2.6). These infestations are shown on maps in Figures 2.2 through 2.5.

Table 2.6. Initial Herbicide Applications under Alternative 2.

Park	**Species**	**Location**	**Size**	**Herbicide**
GLBA	perennial sowthistle	south side of Strawberry Island in the Beardslees	2.4 acres	Milestone VM™
GLBA	reed canarygrass	slope backing the Maintenance Yard in Bartlett Cove	2.0 acres	Roundup Pro™
GLBA	reed canarygrass	four small populations in Bartlett Cove	0.1 acre total	Roundup Pro™
GLBA	oxeye daisy	fish processing plant near Dry Bay airstrip	0.9 acres	Milestone VM™
SITK	Japanese knotweed	near Indian River	0.1 acres	Habitat™

Figure 2.2. Reed canarygrass infestations warranting herbicide use in the Bartlett Cove area of GLBA.

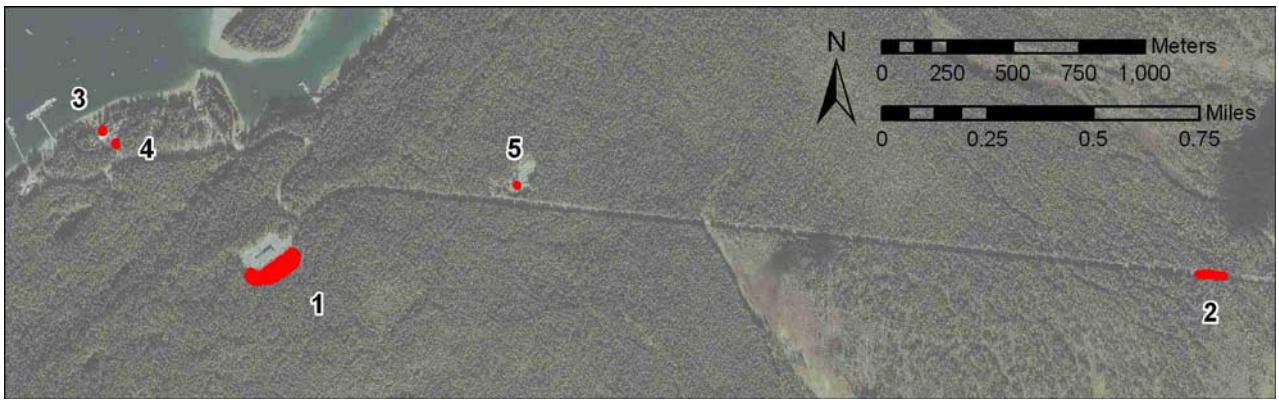


Figure 2.3. Perennial sowthistle infestation on Strawberry Island in Glacier Bay National Park and Preserve (GLBA).

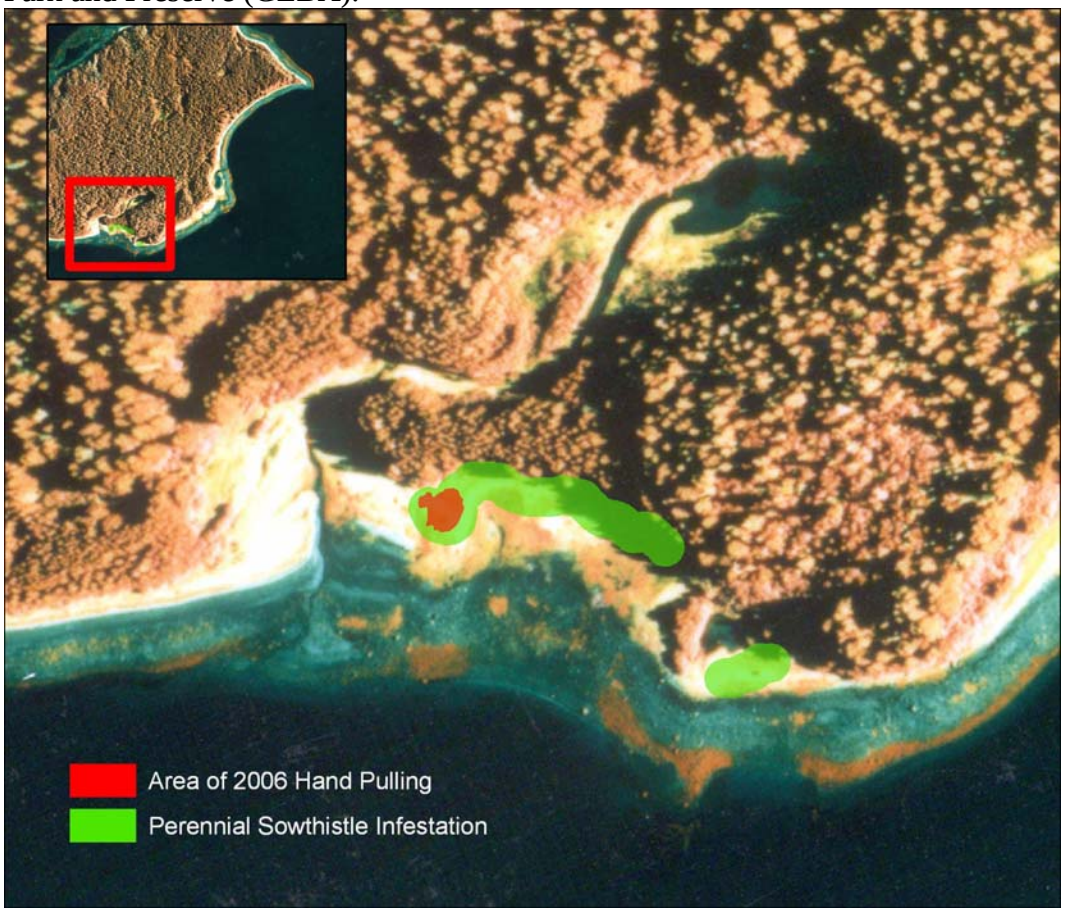


Figure 2.4. Oxeye daisy infestation warranting herbicide use in the Dry Bay area of GLBA.

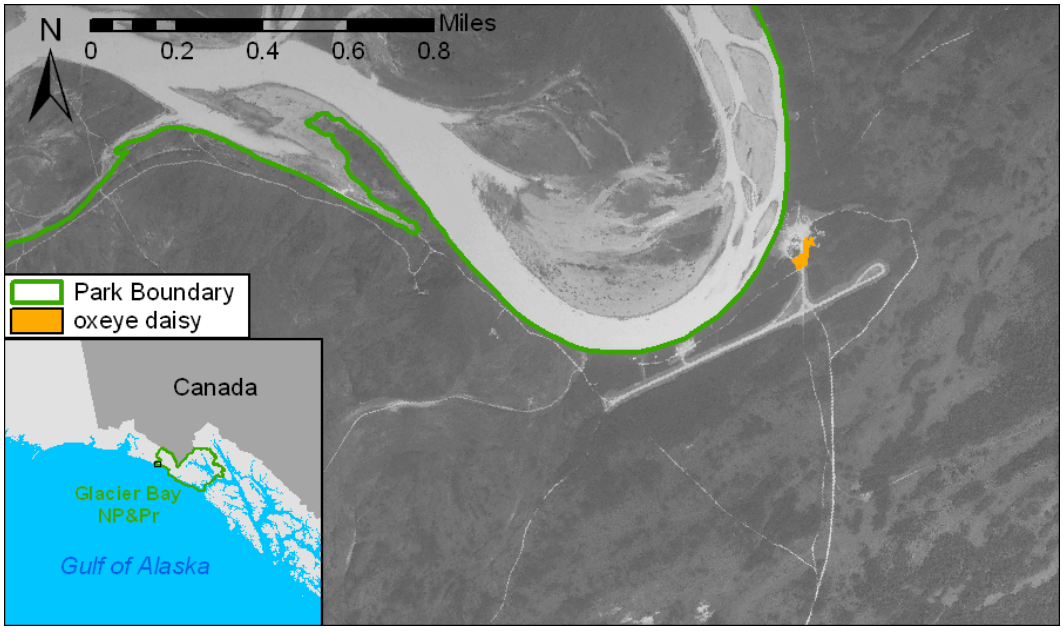
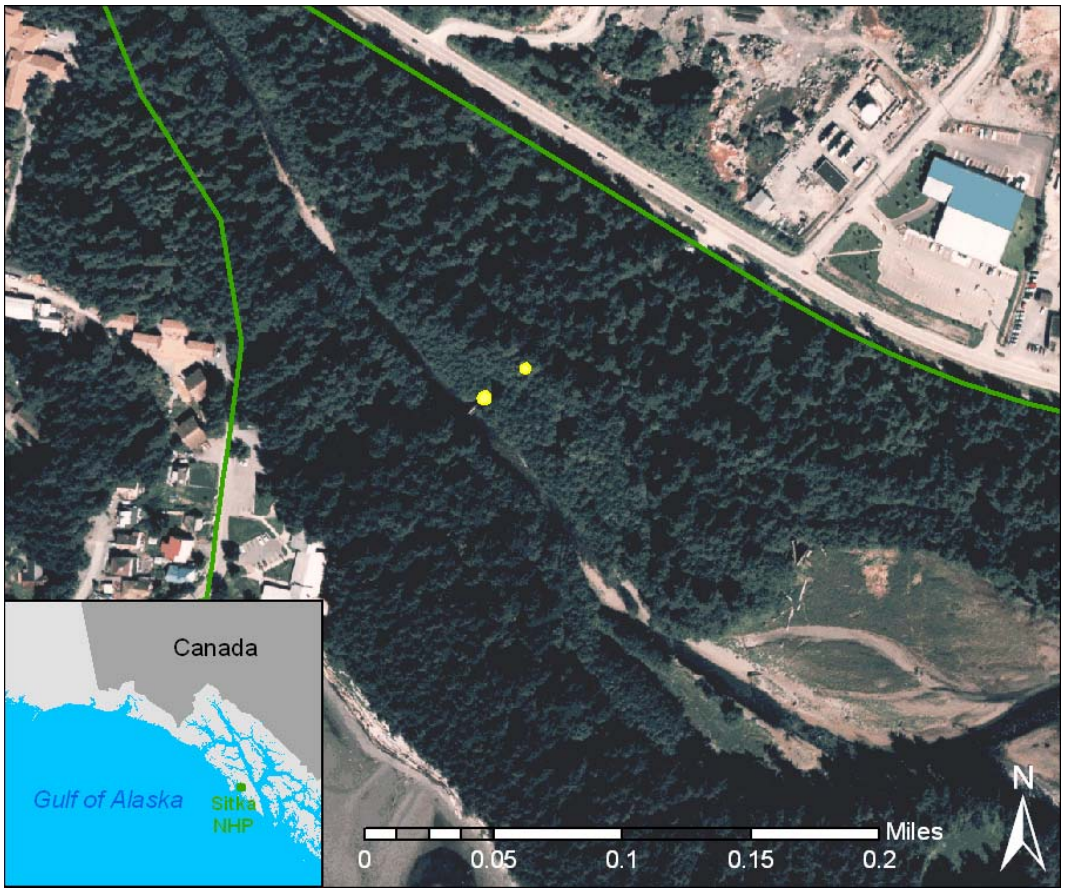


Figure 2.5. Japanese knotweed infestations in Sitka National Historical Park.



2.5 Mitigation Measures

Mitigation measures to reduce the impacts of invasive plant control efforts in Alaska NPS units include prevention measures, education, collaboration, best management practices for herbicide use, restoration, and protection of historic properties.

2.5.1 Prevention Measures

The following best management practices will be used for ground-disturbing operations conducted in Alaska parks:

- Equipment and clothing will be thoroughly cleaned of soil, mud, and debris and inspected by park personnel prior to entry into the park.
- Sources of fill materials, including gravel, crushed rock, and topsoil, and stockpiled project materials must be verified as free of invasive plants by park personnel or a reputable third party. Contaminated materials may only be used if they are thoroughly decontaminated using physical or thermal methods.

- Any hay or straw used by the NPS, by visitors, or residents must be Certified Weed-free Forage based on Alaska standards.
- Care will be taken to avoid working in or moving equipment through infested areas. Where unavoidable, cleaning of equipment will be required before leaving the area.
- Ground-disturbing projects will be closely monitored for five years after project completion to ensure that colonizing invasive plants are rapidly found and addressed. See the Restoration section (2.5.5) for post-project revegetation measures to minimize colonization success.

2.5.2 Education

Educational programs are ongoing and critical for protecting the parks in the future from the threat of invasive plants. There are three general audiences to inform about the issue: park employees, local residents, and visitors.

Park employees are both the most likely parties to spread invasive plants during the course of their duties and also the most likely parties to assist with invasive plant management. The NPS educational program will provide educational presentations and materials to all employees annually to ensure that they remain aware of the problem, how to prevent infestations, and how to assist with the park's documentation, reporting, control, and educational efforts.

For local residents, education programs and publications will be developed and disseminated to convey that certain garden plants will spread beyond the originally planted area and eventually become a nuisance to others. In addition, the NPS will educate both local residents and other visitors about the problems caused by invasive plants and how an individual can avoid contributing to these problems and instead help with solutions.

2.5.3 Collaboration

The NPS will continue to work with other agencies to promote and coordinate invasive plant management across Alaska through the Alaska Committee for Noxious and Invasive Plants Management (CNIPM). This organization provides many opportunities for collaboration in the areas of information-sharing, cooperative educational, research, and management projects, and identification of needs and recommendations for adequately addressing invasive plants in Alaska. The NPS will continue to be an active participant in this organization and will work to engage landowners and land managers adjacent to each park unit in partnerships to address local and regional problems with invasive plants. Individual park units will become or remain involved in Cooperative Weed Management Areas across the state, groups dedicated to working across boundaries to prevent the widespread establishment of invasive plants in Alaska.

The NPS has recently gained the authority to enter into cooperative agreements to assist adjacent landowners with invasive plant management, on the basis that nearby invasive

plant infestations threaten park resources over the long-term. The NPS will enter into such agreements in Alaska as funding permits where high-risk plants occur near park units.

2.5.4 Herbicide Use Best Management Practices

A wide range of best management practices would be required to ensure legal, safe, and responsible herbicide use (Appendix H). These practices include specific prescriptions for applications, regulations and record-keeping, notification, and evaluation of and adaptation to groundwater vulnerability.

2.5.5 Restoration

Where large infestations (> 0.1 acre) are controlled, the NPS will restore the site with healthy native vegetation to ensure longer-term protection against repeated invasion. Smaller controlled areas would not be restored unless invasive plants persist nearby or a substantial seedbank of invasive plants exists at the site. Seeds of pioneer native plant species will be collected in each park unit with large infestations, processed, and sown following the example of ongoing restoration work in Denali National Park and Preserve.

2.5.6 Historic Properties Protection Measures

When there is a specific site and consideration of removal methods, then the park superintendent in consultation with appropriate staff (including a cultural resource specialist) need to carefully evaluate the area of potential effect to determine if an exotic or invasive species may be a historic component of a cultural resources property. Once a specific plant eradication site has been identified and appropriate removal techniques have been determined, the park superintendent in consultation with cultural staff needs to carefully evaluate whether or not an exotic or invasive species is a contributing historic component of a cultural resources property.

In accordance with the Advisory Council on Historic Preservation's regulations implementing section 106 (36 CFR Part 800, "Protection of Historic Properties"), impacts to cultural resources will need to be identified and evaluated by (1) determining the area of potential effects; (2) identifying cultural resources present in the area of potential effects that are either listed on or eligible to be listed on the National Register of Historic Places; (3) applying the criteria of adverse effect to affected cultural resources either listed in or eligible to be listed on the National Register; and (4) considering ways to avoid, minimize, or mitigate adverse effects.

2.6 Alternatives Considered but Eliminated from Further Analysis

2.6.1 Alternative 3 - Stop all invasive plant management activities within each park.
This alternative was eliminated from detailed study because stopping all invasive plant management and control activities within parks is inconsistent with the Purpose and Need for this Environmental Assessment, the Alaska National Interest Lands Conservation Act, E.O. 13112 on Invasive Species, the Federal Noxious Weed Control Act, and NPS Management Policies.

2.6.2 Alternative 4 – Consider the full range of treatment options, including broadcast herbicide application and the release of biological control agents.
This alternative was eliminated from detailed study because these methods are not yet necessary in Alaska Region parks and the Alaska public has expressed concern over their impacts. If the State of Alaska were to develop an active biological control program for invasive plants, this treatment method would be reevaluated for use in parks.

2.7 Environmentally Preferred Alternative

As stated in Section 2.7 (D) of the NPS DO-12 Handbook, "The environmentally preferred alternative is the alternative that will best promote the national environmental policy expressed in NEPA (Section 101(b))." The environmentally preferred alternative is the alternative that not only results in the least damage to the biological and physical environment, but that also best protects, preserves, and enhances historic, cultural, and natural resources. Alternative 2 is the environmentally preferred alternative because it would result overall in the fewest adverse impacts to the physical and biological environments in Alaska NPS units from less physical disturbance to remove invasive plants and the greatest beneficial effects from more effective control of persistent invasive plants.

Table 2.7 Comparison of the Alternatives

Category	Alternative 1 – Status quo	Alternative 2 – IPMP
Acres Treated	The number of acres treated would continue to increase due to the treatment of new infestations and repeated treatments. About 1,000 acres would likely be treated over the next 10 years.	The number of acres treated would increase slightly in the first few years and then decrease as existing infestations are eradicated. Less than 500 acres would likely be treated over the next 10 years.
Control Methods	Only physical control methods, including manual, mechanical, and thermal treatments, would be used for invasive plant management.	Physical control methods would be complemented by spot herbicide application as directed by an Integrated Pest Management Decision Tree that determines where its use is necessary, safe, and effective.

		Herbicides would likely be used for 20 to 50 acres of control over the next 10 years.
Effectiveness	Effectiveness would be low for infestations of species that are difficult to control. As a result, repeated treatments are likely to double the acreage of initial treatments over the next 10 years.	Effectiveness would be relatively high for species that are difficult to control. Repeated treatments are likely to approximately equal the acreage of initial treatments over the next 10 years.

Table 2.8 Summary Impacts of the Alternatives

Alternatives / Resources	Alternative 1 - Status Quo Control of Invasive Plants	Alternative 2 - IPMP with Potential Targeted Use of Herbicides
Aquatic Resources & Fish	The impacts to aquatic resources, including fish and water quality, would be minor and on balance beneficial, but this alternative would not be effective in controlling the establishment of invasive plants along aquatic habitats over the long term.	The impacts to aquatic resources, including fish and water quality, would be minor and on balance beneficial, provided that appropriate measures are taken when herbicides are applied near streams and lakes.
Cultural Resources	Because of the small physical treatment areas and NHPA Section 106 compliance reviews, no more than minor effects to cultural resources would occur.	Because of the small physical and chemical treatment areas and NHPA Section 106 compliance reviews, no more than minor effects to cultural resources would occur.
Human Health & Safety	Removing exotic invasive plants by the use of manual and motorized activities and soil solarization have easily recognized hazards that can be predicted and easily controlled. The	As with alternative 1, removing exotic plants by the use of manual and motorized activities and soil solarization have easily recognized hazards that can be predicted and easily controlled.

	overall risk of human injury would be low and the impacts to human health and safety are judged to be overall minor.	Removing exotic plants by the use of the identified herbicides and application methods have recognized hazards that can also be predicted and easily controlled. The overall risk of employee injury should be low and the impacts to human health and safety are judged to be overall minor.
Soils	Small, localized adverse effects on park soils would occur where EPMTs compact soil surfaces or dig up plant infestations. At large, high- density sites with difficult to control invasive plants, attempted mechanical control could result in major long- term impacts to soil from compaction and disturbance to organic layers and the soil profile. Invasive plant species not effectively removed by physical methods may change soils for long time periods through the addition of nitrogen or allelo- chemicals, changes in microbial and mycorrhizal populations, and changes to nutrient cycling and fire frequency. The overall impacts to park soils and	The effects of non- native plants on soils are unknown, but suspected to be of minor to major significance depending on plant species, density, and soil susceptibility. The effects of manual control methods on soil can be considerable due to trampling and depend on the amount of trampling and soil susceptibility. The effects of compaction can last long periods. The effects of herbicides on soils should be minor and short- lived due to the small number of acres involved and the herbicides being proposed. The overall impacts to park soils and function would be minor over the next decade or two.

	function would be minor over the next decade or two.	
Subsistence	Physical control methods would result in minor impacts to subsistence resources and uses. Should these methods fail to contain infestations resulting in greater habitat losses of important subsistence resources, then the level of impact could increase to moderate.	Use of a decision tree to decide the best method to control invasive plant infestations in Alaska NPS units, including physical and chemical (herbicide) control methods where appropriate, would result in minor impacts to subsistence resources and uses. Long term beneficial effects could accrue from the prevention of rapidly spreading invasive plants and the resultant loss of subsistence resources and use areas.
Vegetation	The overall success of invasive plant management under Alternative 1 would vary from park to park. The overall impacts on native vegetation resources from physical methods to control invasive plants would be beneficial, site-specific, short- to long-term, and up to moderate. For invasive plants species difficult to control with physical methods, impacts to natural vegetation would be major over the long – term.	The combination of physical and chemical control methods would help parks achieve the desired condition to maintain native vegetation as parts of their natural ecosystems. By effectively controlling invasive plants, native plant communities at all 16 parks would be rehabilitated - thus benefiting native plant species and ecosystem integrity. The minor short- term adverse impacts would be outweighed by the long-term benefits to vegetation.

Wetlands & Floodplains	The impacts to wetlands and floodplains from the physical controls of invasive plants would be minor.	The impacts to wetlands and floodplains from the combination of physical and chemical control methods to control invasive plants would be minor and beneficial.
Wilderness	The impacts to wilderness from would be minor and overall beneficial to the wilderness resources.	The impacts to wilderness would be minor and overall beneficial to the wilderness resources.
Wildlife & Habitat	The impacts of invasive plant management activities on wildlife habitat and populations would be minor overall in the short term. In parks where early detection and rapid control of invasive plants are feasible and achievable, physical methods would prevent invasive establishment and spread and preserve native wildlife habitat. Some known invasive plant infestations can be effectively controlled with herbicides. In the long term Alternative 1 methods would ultimately fail to contain current or future invasive plant infestations to protect natural wildlife habitat and their populations.	This alternative would result in minor beneficial effects to wildlife and habitat in the short- term because physical and chemical control methods would contain the majority of current or future invasive plant infestations. Invasive plant management success and beneficial effects to wildlife habitat would vary from park to park. Where early detection and rapid control are feasible and achievable, physical methods available would be sufficient to prevent establishment and spread. Spot treatment with herbicides where needed could reduce or eliminate impacts to wildlife and habitats.

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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.

Table 3.1 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							
Bird vetch	S	N				X			N	N
Canada thistle			N							
Common dandelion	X	X	X	X	X		X	X	X	X
Common sheepsorrel				N						
Common timothy	S		X		X					
Creeping buttercup			X					X		
European mountain ash								X		
Japanese knotweed								X		
Lambs-quarters										
Narrow-leaf hawksbeard	X			X	X	X			S	X
Orange hawkweed			N				N			
Oxeye daisy		N	X	N	X	X	N		X	
Perennial sowthistle			X							
(Purple) foxglove								X		
Red clover			X							
Reed canarygrass			X							
Siberian peashrub									X	
Smooth brome (grass)	S									X
White sweetclover	X	N	N			X		X	N	N
Yellow alfalfa					N					
Yellow toadflax	S		N		X	X			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

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.

Table 3.2. Gross acreages of management activities for medium- to high-risk invasive plant species by park unit, 2004-2006.

Park	Inventoried	Treated	Monitored	Retreated
ALAG	0	0	0	0
ANIA	0	0	0	0
BELA	0	0	0	0
CAKR	0	0	0	0
DENA	28.04	11.19	16.38	14.019**
GAAR	0.10	0.10	0	0
GLBA	1148.507*	6.93	2.28	2.28
KATM	7.56	0.01	0	0
KEFJ	7.00	4.56	5.45	1.51
KLGO	83.912*	11.33	7.80	4.18
KOVA	0	0	0	0
LACL	11.94	1.11	0	0
NOAT	0	0	0	0
SITK	16.13	2.55	0.13	0.13
WRST	245.723*	5.27	3.90	1.27
YUCH	17.13	0.11	0	0
* magnitude accounted for by common dandelion (GLBA, KLGO, WRST) and bigleaf lupine (GLBA)				
** greater retreated acres than treated acres due to documentation of Dandelion Pull efforts not measured in previous years				

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 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.

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.

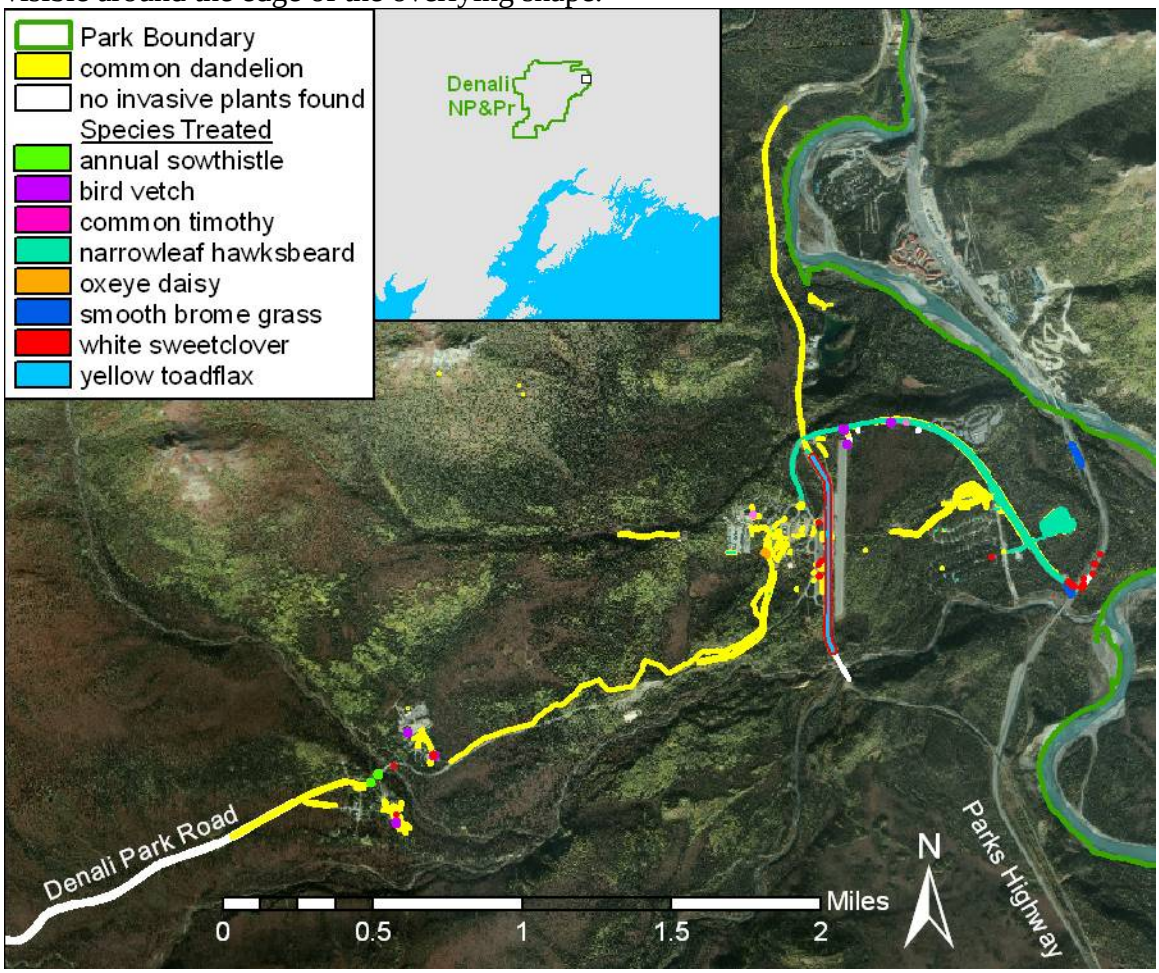
3.1.6 Gates of the Arctic National Park and Preserve (GAAR)

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.

3.1.7 Glacier Bay National Park and Preserve (GLBA)

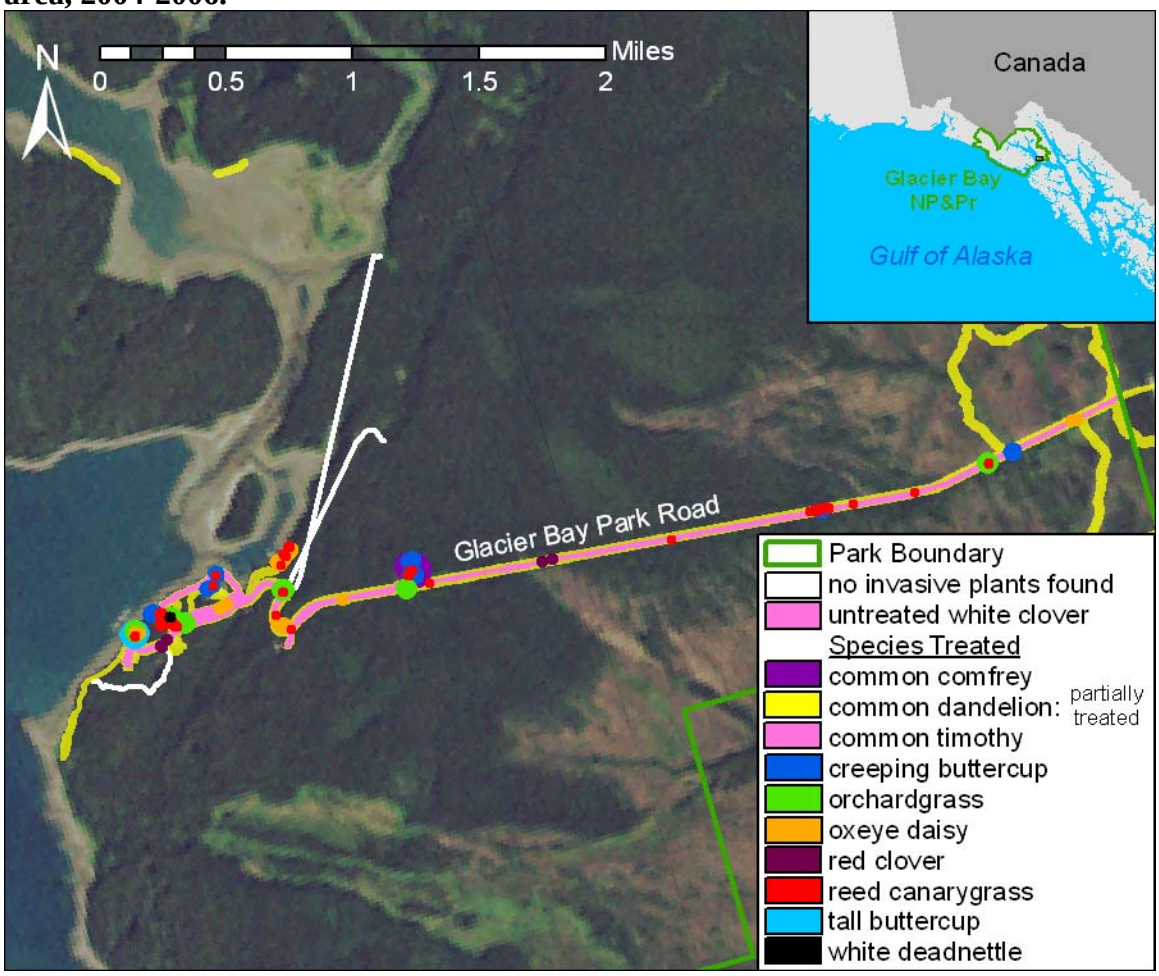
Numerous invasive plant species are found in Glacier Bay National Park and Preserve, as documented by the past three summers of survey and control efforts. In Bartlett Cove,

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.



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 and 2006 but without sufficient resources or effectiveness for success. Oxeye daisies are also found in Dry Bay and Reid Inlet, common dandelions are scattered 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 white sweetclover. 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.



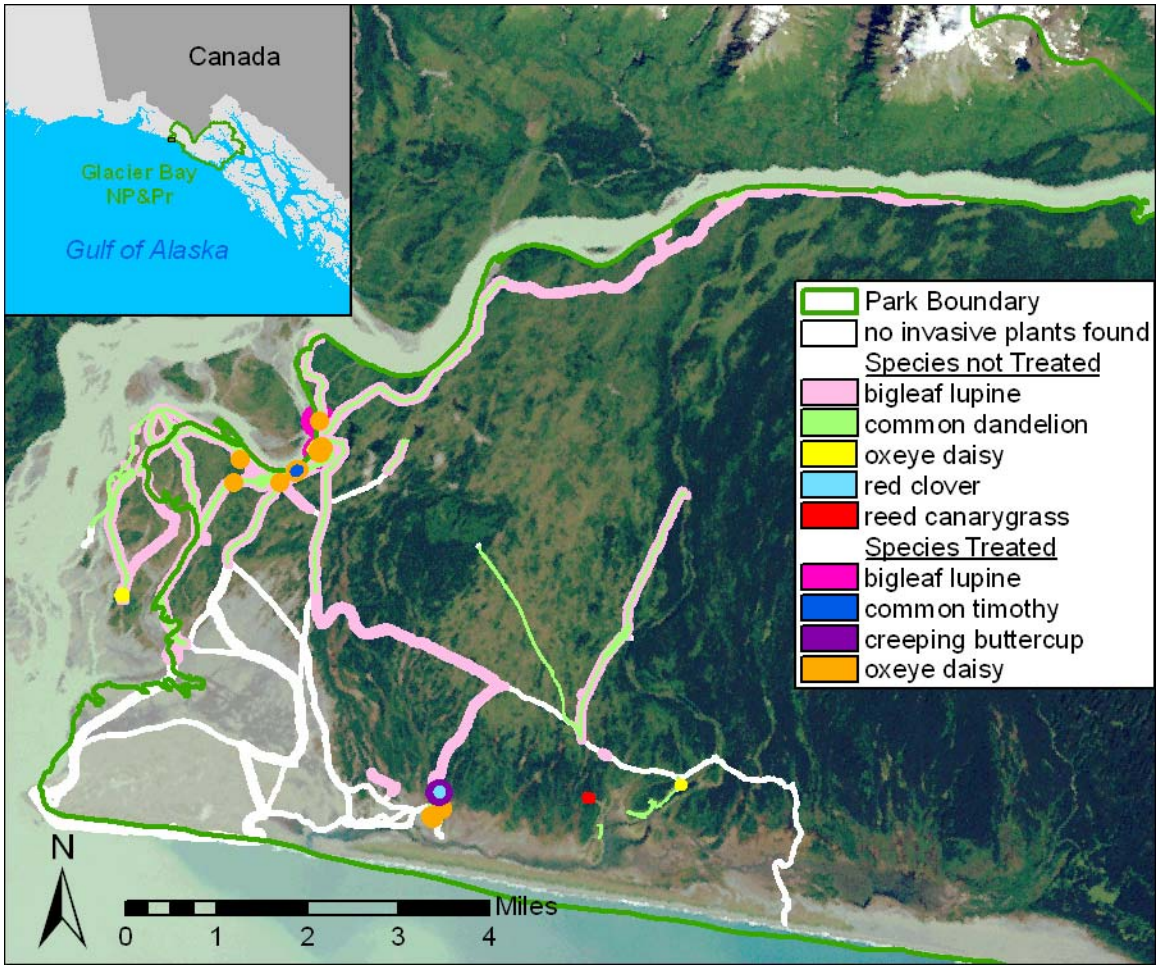
3.1.8 Katmai National Park and Preserve (KATM)

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.

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

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

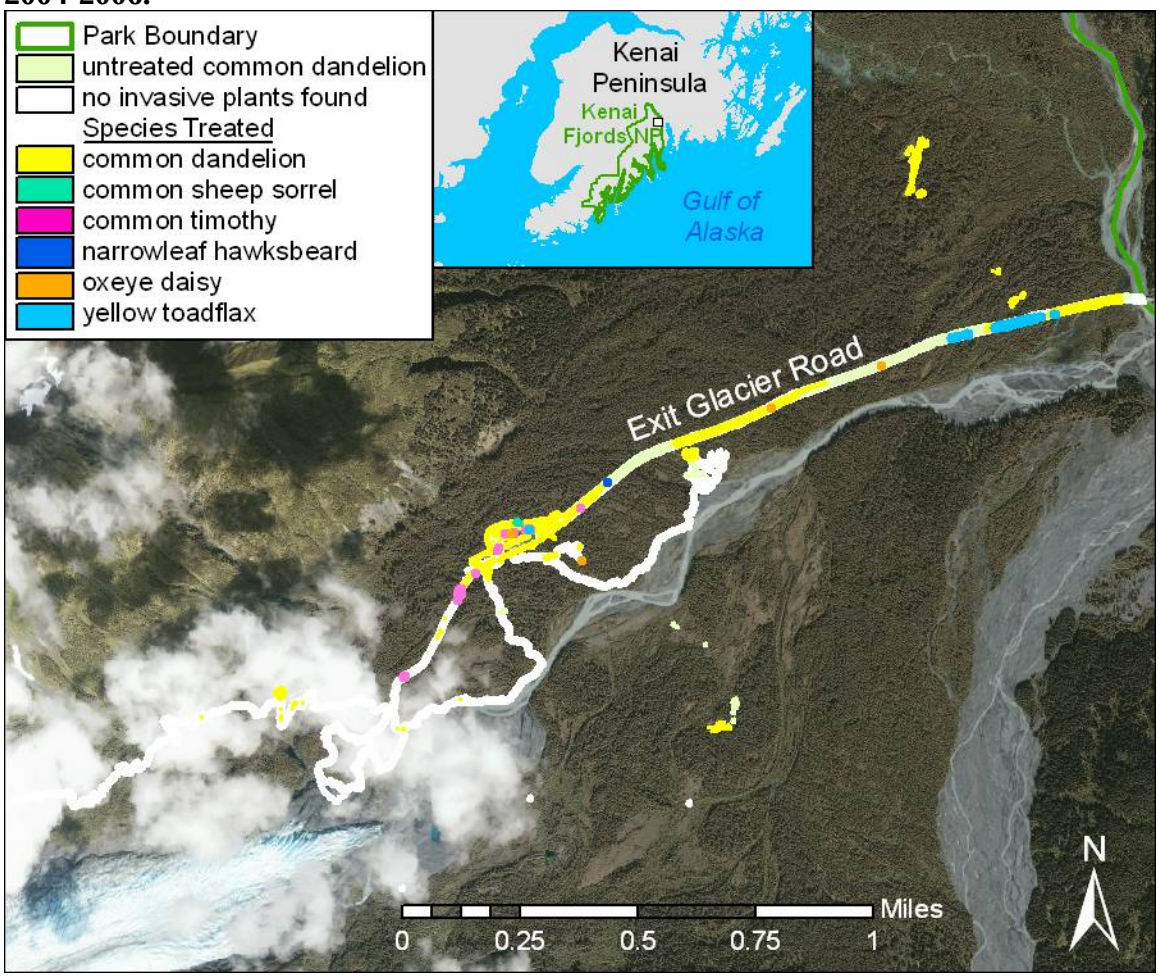


dandelion, timothy, yellow toadflax, narrowleaf hawksbeard, and oxeye daisy in this area, while yellow alfalfa thrives outside the park along Exit Glacier Road. See figure 3.4 for a summary of invasive plants near Exit Glacier in the park.

3.1.10 Klondike Gold Rush National Historic Park (KLGO)

Invasive plant management over the past three 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.

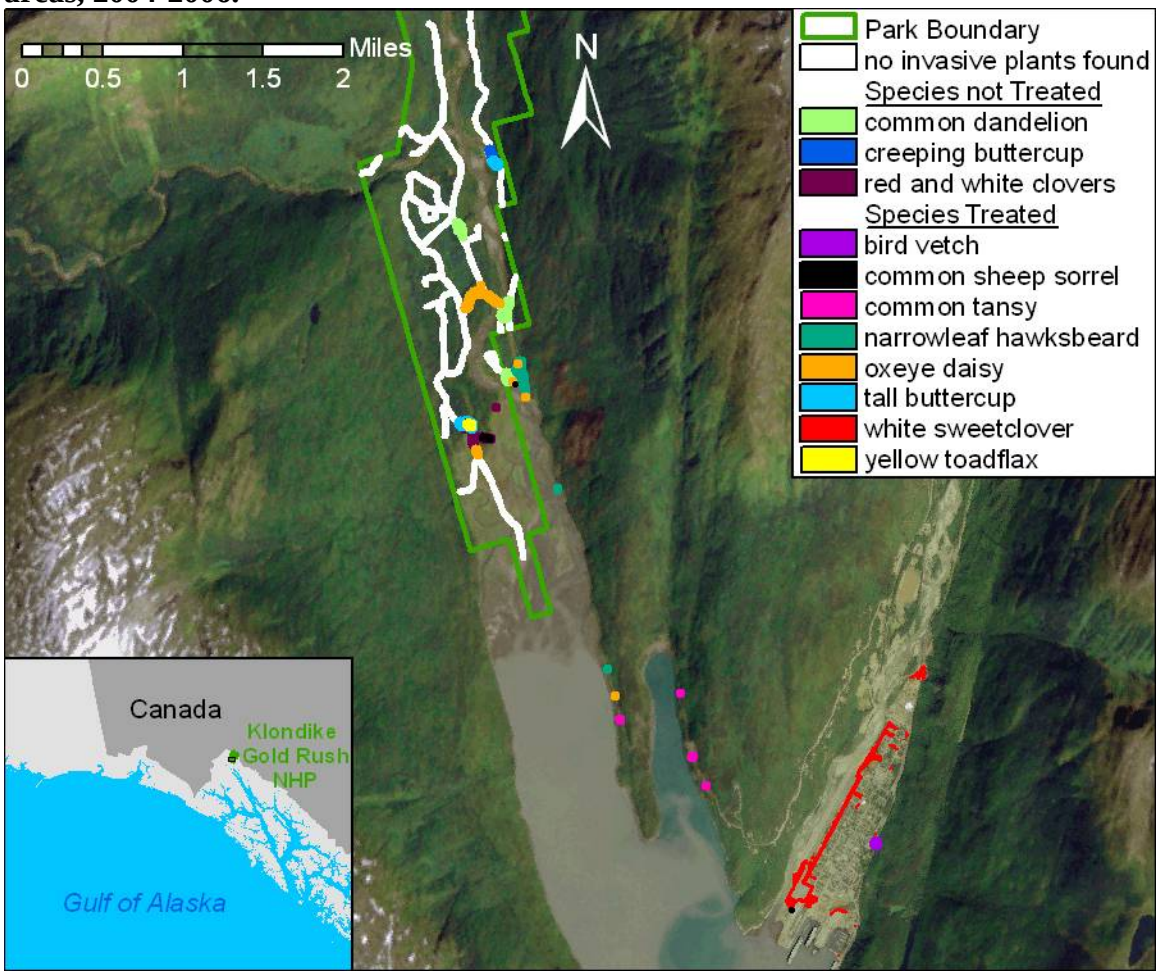
3.1.12 Lake Clark National Park and Preserve (LACL)

The only 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. Both orange hawkweed and oxeye daisy are present 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 five consecutive summers but grows back each year. Creeping buttercup is well established in the forest understory, and European mountain-ash has overtaken approximately 3 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.

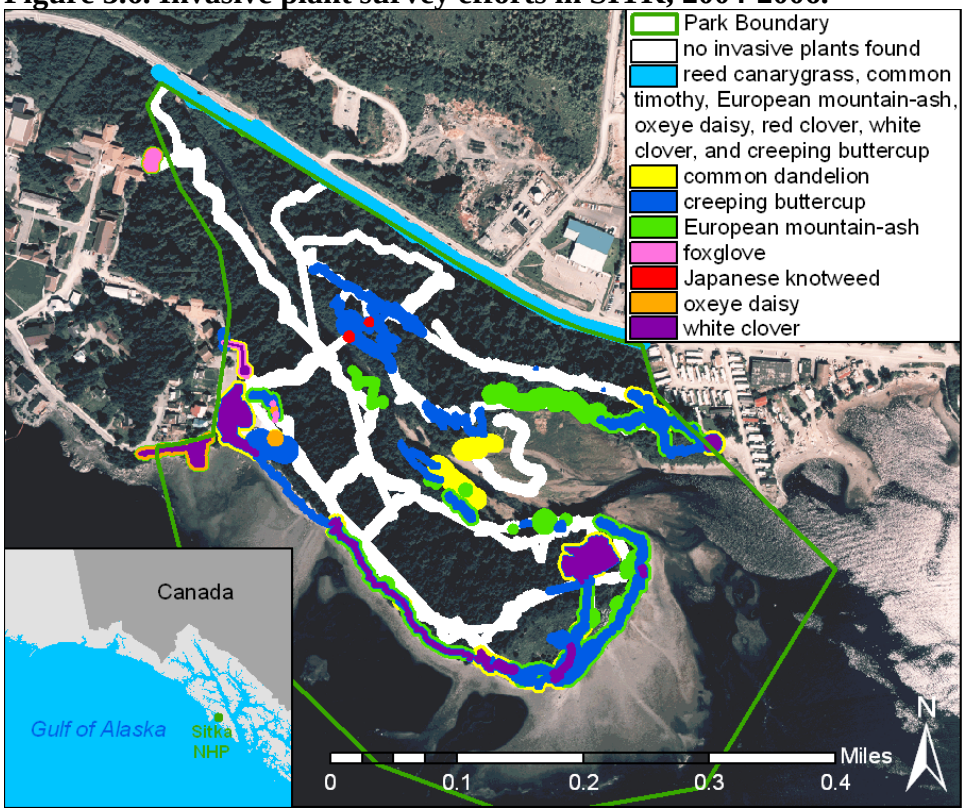
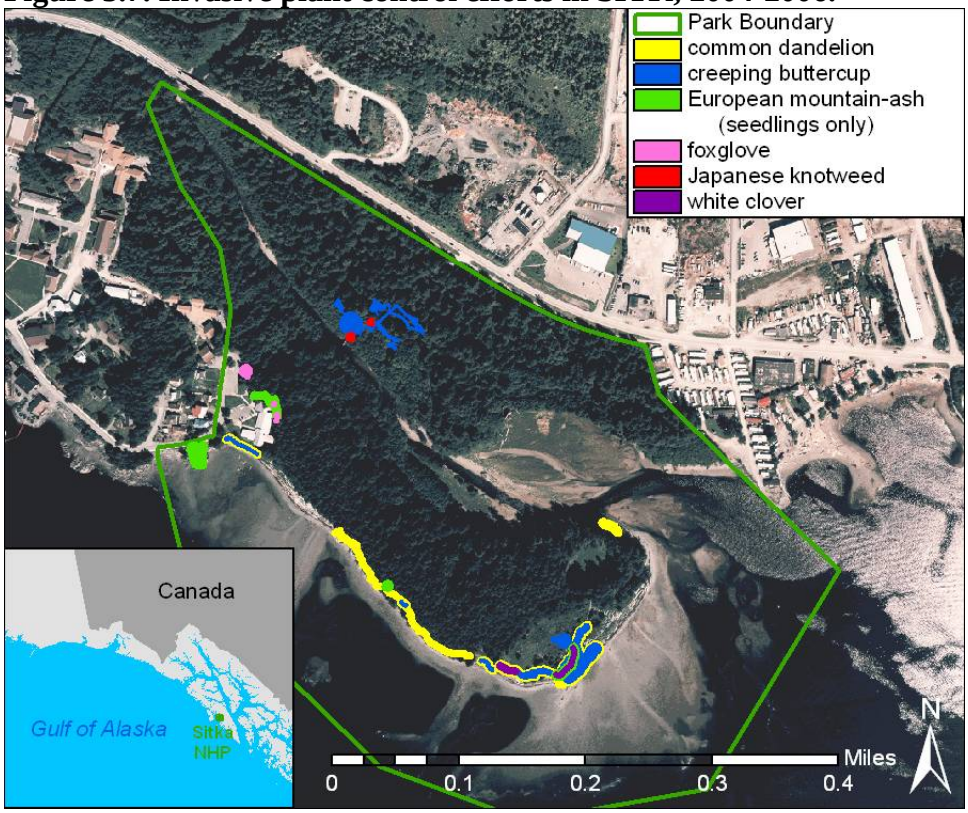


Figure 3.7. Invasive plant control efforts in SITK, 2004-2006.



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.

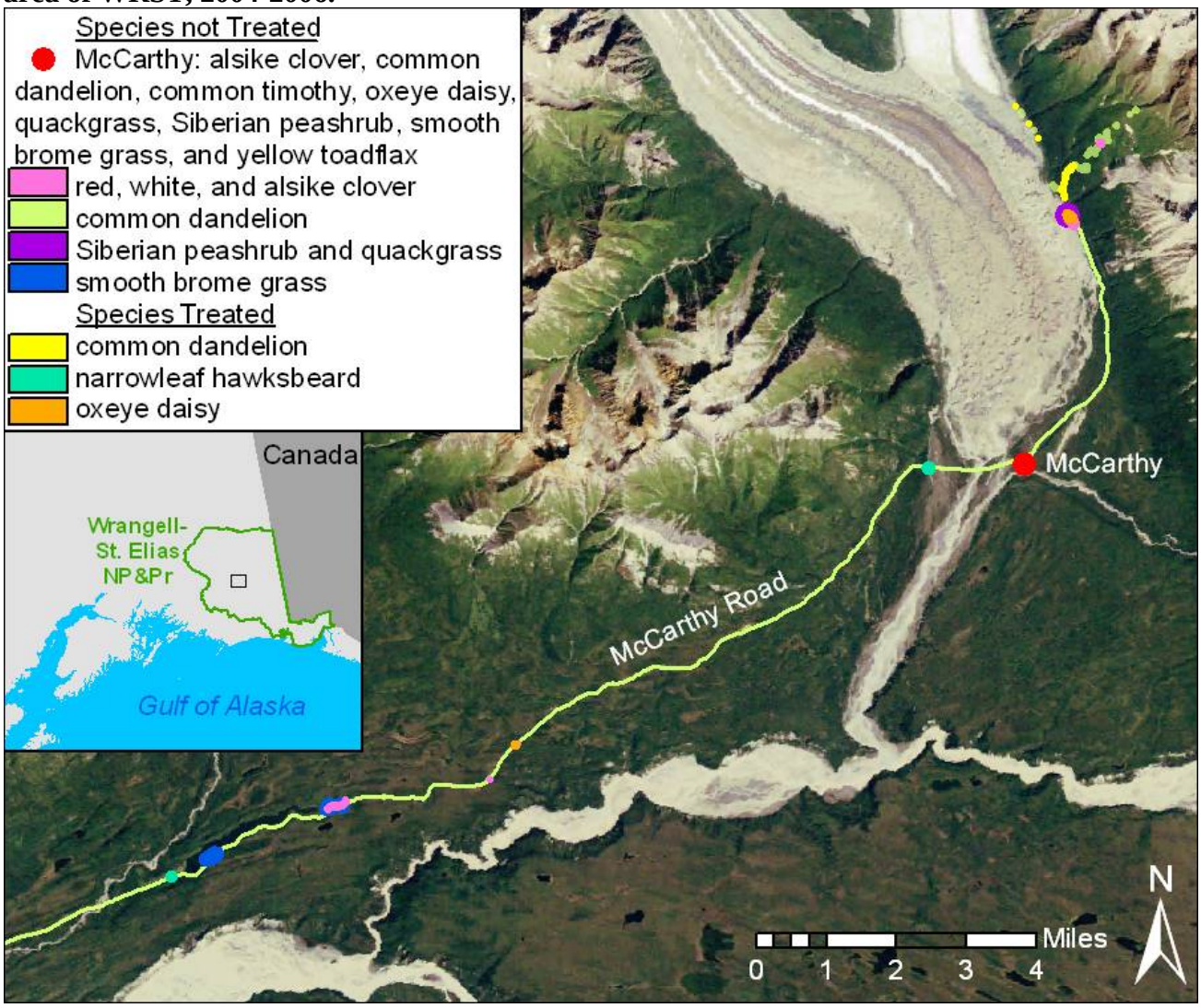
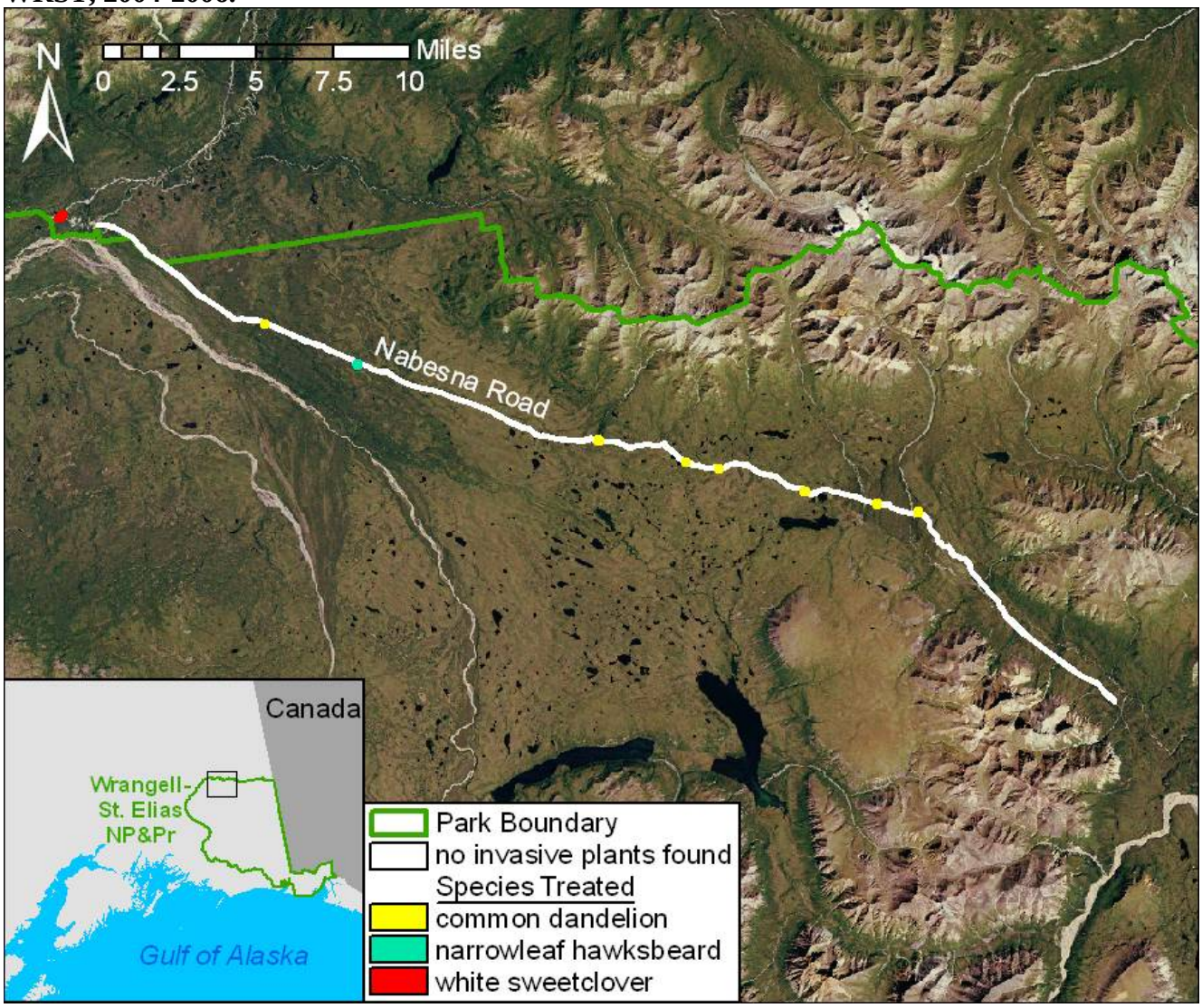


Figure 3.9. Invasive plant survey and control efforts along the Nabesna Road in WRST, 2004-2006.



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 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.

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 sweet clover from river bars and road sides in the front country of DENA. This area includes the catchments of several small streams, 3 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 Reid Inlet 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 and 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 ecosystems 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 indicates aquatic invasive species and contaminants are a concern for these areas (USDI-NPS 2006).

3.2.9. WRST Aquatic Resources

NPS EPMT crews have so far successfully removed white sweet clover 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 flowing 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 areas 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 1985).

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 data base 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.

This brief overview generalizes the process by which Alaska was populated during the historic period. 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 Sitka National Historical Park with the Tlingit fort and

battlefield site and the Russian Bishop's House. The colony attracted adventurers from several other countries as well; several inland voyages were undertaken; and the resident Native population made significant responses to the ongoing colonization. Longstanding trade patterns, for example, were modified to accommodate European needs. The Chilkoot Trail, famous during the Gold Rush Era of the 1890s, had served for hundreds of years as a major trade route which the coastal Tlingit used in their penetrations of the Athabaskan interior, and Tlingit traders gained new influence due to their ability to provide goods to the Russians.

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. Defined in its narrowing sense, the so-called mining frontier was felt most strongly in the Skagway and Dyea areas, now part of the Klondike Gold Rush National Historical Park, 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 Yukon-Charley Rivers National Park and Preserve. Supplying these camps, however, demanded trails, roads, wood camps, roadhouses, gear caches, supply stations, Army forts, telegraph lines, and a host of other support facilities. In addition to the better-known towns and camps, prospectors fanned out and explored remote ledges, rock faces, and other possible mineral sites, some of which may not have been visited in more recent years. Thousands of small prospects and test pits bear silent witness to their past activities.

In the late 1870s the commercial fishing and packing industry began. Beginning in 1878 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 moved to sites adjacent to the canneries to take advantage of work opportunities, and 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 Glacier Bay National Park and Preserve, Katmai National Park and Preserve and Lake Clark National Park and Preserve.

A few large scale ventures drew people to Alaska, including the Kennecott Copper Mine complex and company town, now part of Wrangell-St. Elias National Park and Preserve. 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 facilities as well as support facilities, such as roads and airfields.

Because of the many economic activities that have taken place in Alaska, particularly 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 information involves site age, function, community structure and organization, cultural identity, material culture, relationships with sites in other geographic areas, mode of abandonment and preservation status. The common feature of archeological sites is that many of the things that humans transported, modified, constructed or produced are preserved and available to be recovered and studied today. In some cases phenomena that can be seen or experienced by visitors such as rock art, ruins or landscape modifications are preserved at archeological sites, but in most cases the value of archeological sites is the information preserved within them. Archeological sites are not exclusive of historic sites or ethnographic sites. A building or industrial facility can deteriorate until only piles of debris or landscape modifications are visible on the surface, but subsurface objects, features (pits, fire places, graves, occupation surfaces), and human-produced sediments are preserved. An ethnographic site used by contemporary people to conduct traditional activities as part of their cultural system or way of life may include an archeological record of this activity in the past; or contemporary people may conduct traditional activities on an archeological site to which they have no direct lineal affiliation. Archeological sites can be contributing elements to Cultural Landscapes whether visible at the surface or not. Management of archeological sites requires balance between preservation of the information preserved in them, and making the knowledge within the site available to the public.

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. Archeological sites within a settlement pattern have differing functions. A single culture may produce villages, hunting camps, kill sites, graves, caves, territorial markers, and rock art which all differ in environmental setting, size, length of occupation and what is preserved at them. Archeological sites in Alaska include winter villages where populations gather at a permanent settlement that is strategically positioned for access to resources and travel routes such as Brooks Camp, Anaktuvuk Pass, Cape Krusenstern, and Harrison Lagoon to name a few. Winter settlements may be at the mouths or confluences of larger rivers, spits or points with access to marine mammals, protected in the heads of bays or at locations for intercepting migrating herds of animals. Because archeological sites are often occupied by people in modern times too, these sites could be at risk from invasive plant infestations.

Distributed around winter settlements are smaller sites used by individuals, clans and families for temporary camps such as fish camps and hunting camps. Deep round pits that served as caches for dried or smoked fish occur along salmon streams sometimes far from camps or settlements. Hunting camps may be ephemeral single term occupations that may be surrounded by smaller kill sites. The lack of Pleistocene kill sites that preserve the remains of mammoth or other extinct megafauna may be due to the difficulty of locating the sites in the vast landscape overlying permafrost. Pleistocene hunting camps with the remains of extinct species such as horse, wapiti and bison have been found in the Nenana valley and are probably related to sites such as Teklanika sites in Denali.

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. Occasionally stone rings or hearths are found with lithic scatters. Sometimes lithic scatters are found in the vicinity of hunting blinds and stone alignments related to caribou hunting. Organic materials are rarely present due to exposure to the elements meaning that no charcoal or bone is available for radiocarbon age determinations. Artifacts that are diagnostic of various cultures are sometimes found in lithic scatters, but more often they are enigmatic evidence of past land use. Often these sites are related to early (Paleoarctic) or mid (Northern Archaic) Holocene cultures either by the presence of diagnostic tool forms or judgments based on the experience and insight of the archeologist. Northern hunting cultures survived by intercepting migrating large mammal herds at predictable places and times. Prevailing interpretations of lithic scatters are that nomadic big game hunters occupied land forms positioned to have good views of migrating animal herds with wind exposure to provide relief from bugs. One interpretation is that the Northern Archaic traditions represent Athabaskan speaking people who successfully adapted to the high latitude environment. Archeology cannot prove or disprove this theory, but it is clear that all lithic scatters cannot be attributed to early big game hunters. 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.

From the Middle Holocene era the successive Arctic Small Tool tradition, Norton Tradition and late prehistoric Thule/Koniag traditions feature increases in numbers and sizes of sites leading up to the historic era and Russian contact in AD 1740. After contact Alaska Native sites including Aleut, Alutiiq, Chugach, Eyak, Tlingit, Tsimshian, Haida, Yupik, Dena'ina, Ahtna, Koyukon, Han, Kuchin and Inupiat societies began to include European items and occasional structures or buildings such as the Russian Churches at Kukak and Kaguyak on the coast of Shelikof strait. Site distributions began to show response to Russian settlements either abandonment of sites to avoid Russians, positioning of settlements to be near European churches, trading posts or job opportunities, or positioning of settlements and camps to be accessible to sources of marketable goods such as furs. Beginning with the Russian period and continuing after American possession of Alaska cultural disruption and disease caused depopulation and consolidation of Native populations resulting in abandonment of settlements such as Kijik. However some important Alaska Native centers such Wales, Barrow and Sitka became modern population centers.

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. Unique plant communities at archeological sites are most important for modern archeologists who use them as indicators of the presence of archeological sites.

Russian and American archeological sites tend to be fortifications, trading posts, trap line cabins and mining sites. Historic sites may include visible features such as buildings, other structures, earthworks, excavations, grounds, routes, graves, wreckage and scatters of artifacts and machinery. Historic sites have archeological components even if the surface features are no longer present. The archeological manifestations of buildings that have disappeared include foundations, buried structural debris artifacts and a suite of associated external features. Often enough is left in the ground to determine the type and function of former structures such as cabins, shops and storage facilities. Pits remaining from cellars, out houses, hearths, and wells sometimes contain well preserve artifact assemblages that yield important knowledge about the site. Often buried foundations remain from the earliest structures at historic sites and these allow study of the development of historic sites such as communities, administrative centers, military posts, mining operations, and canneries.

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 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

Ethnographic resources are traditional sites, structures, objects, landscapes, natural resources, and other material features associated with contemporary cultural systems or ways of life. While every park has ethnographic resources, not all parks have systematically surveyed or inventoried them. Documenting ethnographic resources in a service-wide database has been an important NPS performance management goal.

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 National Register of Historic Places, 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. Park staff and others charged with gathering this information should be trained in ethnographic methods and familiar with contemporary culture and lifeways of people associated with the park.

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).

3.6 Subsistence

ANILCA Section 101 (c) states an intent and 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 in applicable NPS units.

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

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.

Table 3.3. Summary of Alaska NPS Units with Subsistence

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 communities in the Bristol Bay and Iliamna Lake areas	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.
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	Motorboats, snowmachines, dog teams.

		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.	
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 native and nonnative people reside within the boundaries of the park and preserve.	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.

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 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 (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 (USNPS 2007). 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 m 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 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

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). Non-native species include sowthistle, common dandelions, and red

raspberry. The sowthistle and red raspberry were probably introduced when the area was a fox farm in the 1930s. Dandelions have been introduced more recently and are wider spread.

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 on 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 Skagway to Whitehorse 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 sow thistle, white sweet clover, oxeye daisy, and yellow toadflax. Perennial sow thistle may occur in lake or ocean shores, meadows, and along streams. White sweet clover 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 sow thistle, smooth brome or cheatgrass, reed canarygrass, Japanese knotweed, and yellow toadflax. Perrennial sow thistle 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 inhabit 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 toad flax 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 non-native 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 debark 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. This area and ATV trails in the park from Anaktuvuk Pass have not been mapped for wetlands; however, most 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.

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.

Figure 3-10 Broad-leaved palustrine scrub-shrub (PSS1)

Figure 3-11 Palustrine area with emergent vegetation (PEM1)

Figure 3-12 Palustrine area with unconsolidated bottom sediments (PUB1/2)

Figure 3-13 Perennially flooded riverine area (R2US/UB)

3.8.5 KLGO Floodplains and Wetlands

Wetlands along the White River 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 greater 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. More detail is provided for parks with more extensive invasive plant infestations.

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. During early autumn, large rutting congregations occur between mile 6 and mile 15 of the park road.

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. Caribou are usually visible during early morning and evening while they are foraging, or during midday while bedded. Most people observe caribou in open areas above tree line.

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, J. and Van Horn, J. 1991). The park road travels along several nursery areas on mountains near Toklat and Polychrome Pass where it is common to observe ewes with lambs.

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). They 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 (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 forge berries when available.

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.

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). In general, the potential for high lynx densities on the south side is thought to be low due to low hare densities during cyclic peaks (ADFG 1995a). 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.

One of the most common and most conspicuous smaller mammals in Denali is the arctic ground squirrel. These open-country squirrels inhabit many different vegetation communities in Denali, but are usually found in areas where they can build burrows that are protected from flooding. Arctic ground squirrels are obligate hibernators and spend nearly seven months hibernating in their burrows. Another common herbivore in Denali is the snowshoe hare. Snowshoe hare inhabit forested regions of Denali, but they often occur outside forested areas in years when their populations are high. Populations of snowshoe hare in Denali fluctuate on 8- to 11- year cycles.

Hoary marmots are usually found in family groups in loosely formed colonies in subalpine and alpine areas, often in proximity to talus slopes and boulder fields. Marmots are obligate hibernators and spend nearly eight months of the year in hibernation. Flying squirrels and red squirrels are usually found in spruce-dominated forests. Collared pika live in subalpine and alpine areas and are active year round. They depend on seeds and grass collected throughout the short summer season to survive throughout the year. Beavers and muskrat live in areas dominated by ponds, lakes, and streams. Beavers play a major role in diverting water and creating small to large ponds.

Voles, shrews, and lemmings occur in abundance across the park in a diversity of habitats. Populations of some species exhibit tremendous fluctuations between years. These animals are active year round and during winter they live under the snow. They form the prey base for many of Denali's carnivorous and omnivorous animals.

3.9.1.2 Denali Birds

Denali National Park and Preserve supports a diverse avian fauna. 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

Park-wide waterfowl surveys are conducted in coordination with the U.S. Fish and Wildlife Service. 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 included those used by subsistence users and those sensitive to human disturbance.

Breeding and staging trumpeter swans occur on the south side of the Alaska Range, particularly in the Yenta and Tokositna drainages, and in the Minchumina basin on the north side of the Alaska Range (McIntyre 2002). However, there is limited swan habitat within the boundaries of Denali on the south side of the Alaska Range.

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 et al. 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

Most raptor surveys in Denali have been limited to the mountainous regions and waterways within and adjacent to Denali. 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).

In 2000, Denali staff initiated a three-year study to quantify cliff-nesting raptor habitat and bald eagle habitat on the south side of the Alaska Range (McIntyre 2002). Denali staff is also developing habitat models to predict the occurrence of golden eagles throughout Denali and habitat models to predict occurrence of cliff nesting raptors and bald eagles on the south side of the Alaska Range (McIntyre 2002). Golden eagles and gyrfalcons occur in the mountainous regions of the park, with the highest densities in the northeastern portion of Denali. Bald eagles are numerous at lower elevations on the south side of the Alaska Range (McIntyre, unpublished data); the highest concentrations occur on lands adjacent to Denali. Surveys in 2001 found over 25 occupied bald eagle nesting areas in the Yenta, Kahiltna, Tokositna, Ruth, and Chulitna drainages (McIntyre, unpublished data).

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. Farther to the south at least three pairs were present in the Willow 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. However, ospreys were not located during bald eagle surveys on the south side of the Alaska Range in 2001 (McIntyre, unpublished data). 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.

The Boreal Partners in Flight Working Group (PIF) identified 19 bird species as "priority species" for Central Alaska, which includes Denali. The PIF system ranks each species of North American breeding birds based upon seven measures of conservation vulnerability. All but three of these species (sharp-tailed Grouse, Townsend's warbler, and Smith's longspur) occur in Denali. The Smith's longspur occurs infrequently in the Wonder Lake area and is expected to occur on the south side. Suitable habitats for sharp-tailed grouse and Townsend's Warblers (mature white-spruce forests) are limited in Denali; however, Townsend's warblers are seen occasionally.

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 (see figures 2.2 and 2.3).

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.

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.

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.

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.

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. 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 many Preserve habitats while others are restricted to a specific type of vegetation or terrain. Specific movement patterns, distribution, population sizes, and detailed habitat use for almost all species is largely anecdotal or unknown. Wildlife habitats in Dry Bay are divided into four subareas.

Alsek River Corridor

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. Migratory raptors including peregrine falcon, sharp-shinned hawk, and gyrfalcon have been recorded all along the Alsek River drainage (Capra, pers. comm.). The river drainage provides riparian migratory and breeding habitat for songbirds including Swainson’s, gray-cheeked, and varied thrush, yellow-rumped and yellow warbler, fox sparrow, horned lark, and rufus hummingbird.

Mobile, wide-ranging mammals include brown bear, black bear, wolf, wolverine, red fox, lynx, river otter, pine marten, mink, snowshoe hare, beaver, and moose. Bald eagles, ravens, and gulls can be found along most sections of the river depending on season, but they range over much of the Preserve feeding on carrion, salmon, and the occasional stranded marine mammal. Eagles will roost and nest in larger diameter cottonwood trees along the river corridor.

The only amphibian documented in Dry Bay is the boreal toad, which may have colonized from the interior into newly formed habitats along the river. Wood frogs have been documented along the Alsek River inland of the Preserve boundary (Soiseth, pers. comm.).

Most ORV trails here provide movement corridors for large animals and allow more light exposure for small flowering plants and grasses including non-native invasive species. Black bear have been observed foraging dandelions along the ORV trails (Rapp, pers. comm..). 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. 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. Fledgling birds are also common, and are sometimes hit by vehicles especially from late May until mid June (Soiseth, pers. comm.). Red-backed vole, deer mouse, boreal toad, and shrews are also found dead on the trail. Ponded trail sections produce or attract insects which in turn attract foraging bats, insectivorous birds and toads. Without soil compaction from ORV traffic, moist depressions holding rainwater may not persist long enough to produce as much invertebrate prey for small animals.

Uplands

Bear, moose, and other mammals commonly use ORV trails and tracks and scat are seen very frequently. Trails used by ORVs regularly may provide a network of movement corridors for terrestrial wildlife especially in areas where thick alder and willow brush has become established. Beaver have colonized riparian and some wetland habitats around the Doame River. Small mammal species include white-footed deer mouse, red-back and long-tailed voles, meadow jumping mouse, shrews, little brown bat, and red squirrel.

Passerine birds including Swainson's, varied, and gray-cheeked thrush, pine grosbeak, fox sparrow, yellow-rumped and yellow warbler, dark-eyed junco, and rufus hummingbird are common in upland woodlands (Eichenlaub, pers. comm.). 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. com).

Sitka black tailed deer were introduced to the Yakutat Bay islands in the 1930s, and have been slowly expanding. One winter-killed deer was found in the Preserve in 1995. Two individuals were sighted in the Preserve in 2004 and deer tracks are becoming more common (Capra, pers. comm.).

Wildlife species dependent on riparian and wetland habitats are affected by ORV activity to a higher degree in this region because ORVs are encountered more often throughout the year. 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.). Wetlands are extremely important for moose in spring and summer providing high quality foods and some security from predators.

As along the Alsek River, trail edges provide abundant flower buds, fruits, seeds and succulent non-woody plants for smaller upland mammals and birds. Raptors preying on birds hunt upland trail corridors more frequently compared to areas without trails, but northern harrier and short-eared owl hunting over open wetlands may be disturbed more frequently by ORV use in this subarea. Similar to the Alsek subarea, song birds are commonly seen foraging in the trail tread and at trail edges. Wetland and riparian habitats produce a large amount of invertebrate foods so passerine bird and boreal toad populations are probably higher along these trail segments. Common fledgling birds, red-backed vole, deer mouse, boreal toad, meadow jumping mouse, and shrews on trails may be hit and killed by vehicles. Ponded trail sections produce or attract insects which in turn attract foraging bats, insectivorous birds and toads. Beaver activity in the Doame River riparian area has affected water flows and the condition of trails there. Beaver are accessible to fur trappers from these trails.

Waterfowl such as mallard, green-winged teal, Barrow's goldeneye, American widgeon, and gadwall commonly nest and raise broods in riparian wetlands. ORV trails crossing wetlands are not likely to damage nests hidden in dense vegetation, but adults may be separated from young resulting in abandonment and predation. Stream sedimentation resulting from ORV crossings damages or kills aquatic vegetation and invertebrates and reduces available foods for waterfowl.

Dunes and Plains

Beach dunes provide resting areas for migratory sea and shorebirds that also feed in the estuaries. Birds present during breeding season include parasitic jaeger, arctic tern, whimbrel, and glaucous-winged gull (Petersen et. al. 1980). Short-eared owls and northern harrier range from open plains into the estuarine fringes foraging for small mammal prey. Moose may travel into the sand dune areas to calve (Capra, pers. comm.). Brown bears are often seen along the dunes and beach fringes searching for marine mammal and fish carcasses or digging for beach carrot and other favored tuberous plants.

Most of the Temporary Fish Camp Zone occurs in this subarea, where camp locations and access tracks are not restricted. Most ORV users stay on detectable routes however wildlife in the Temporary Camp Zone could encounter an ORV anywhere.

Estuary/Delta

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).

Figure 3-14. Migratory shorebirds in the East Alsek River estuary.

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.).

ORV use here is more widely dispersed and less predictable as riders navigate shifting tidal channels, silt, sand, and open water. Access to the Temporary Camp Zone, fishing and net sites, boat launches, and cabins occurs throughout this subarea of the Preserve. Three of the trails here have caused the most significant habitat damage in the estuary with large areas of braiding, deep ruts, and unstable wetland crossings.

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 landbird 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 landbird 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 2000a, NPS 2001g). Also present, but less frequently observed, are wolves, coyotes, lynx, wolverine, marten, flying squirrel beaver, river otter, little brown bats, and mink (AKNHP 2000a, NPS 2001g). 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 through 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 (NPS 2002c). 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 (NPS 2002c). 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 (NPS 2002c) 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 (NPS 2002c). 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 (NPS 2002c). 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 2001a).

The species most commonly observed by Wright (2001a) 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 (NPS 2002c) 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 (NPS 2002c) 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 butter cup, 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, 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 3.15 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 3.15 Wilderness Areas in Alaska National Park System Lands