

Exotic Plant Survey of Glacier Bay National Park and Preserve: Summer 2004 Field Season Report

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Introduction

Summer 2004 marked the fourth year that baseline surveys for non-native plant species were carried out on National Park Service (NPS) lands in Alaska. These surveys serve as the first source of data to be used in formulating a long-term control and monitoring plan for these species in Alaska's NPS units. Exotic plant species are a concern to resource managers because they threaten the genetic integrity of native flora through hybridization (D'Antonio et. al 2001), can outcompete resident plant species for limited resources, and can change the structure and function of ecosystems through alterations of geochemical and geophysical processes (Ruesnik et. al 1995, Gordon 1998). By 1996, exotic plant species had infested an estimated 7 million acres of NPS lands, with 4,600 acres of new infestations occurring daily (NPS 1996).

In Alaska, NPS lands have been considered immune to the establishment of many pernicious exotic species found in the lower 48 states (Westbrooks 1998). Several factors have contributed to this immunity. The first is climate. Circumboreal plants are adapted to a wide range of climatic conditions that exotic plants cannot tolerate. In addition, many parklands in Alaska have remained relatively free of man-made disturbances such as livestock grazing, wildfire suppression, and altered hydrological regimes that encourage the introduction of exotic species, and the remote wilderness parks in Alaska still have all of the major floral and faunal ecosystem components (Densmore et. al 2001). Despite these protective factors, the threat of exotic plant invasion is increasing due to global warming and increases in human activity and development. Fortunately, the NPS has the opportunity to head off exotic plant introduction in Alaska before it becomes a problem, but research and active management must begin now (Spencer 2001).

Glacier Bay National Park and Preserve (GLBA) is unique among Alaska NPS units with respect to exotic plants for several reasons. Two factors make it vulnerable to invasion: GLBA protects a large land area in the most temperate region of the state, and the terrestrial landscape is undergoing transformation across a mosaic of successional stages through the ongoing colonization of areas recently exposed by glacial retreat. On the other hand, there are very limited avenues for the introduction of exotic plants to the park. Only the immediate frontcountry of GLBA is accessible by vehicles (which must be barged in), and most visitors never step ashore in the rest of the park. So far there are relatively few species present in Gustavus or the park, but the threat of exotic plant introduction is aided by the influx of summer visitors, the escape of planted ornamentals from Gustavus, and ongoing maintenance activities that disturb the soil and facilitate the establishment of exotic species. Fortunately, GLBA has fared well in its isolation and has a real opportunity to avoid the problems other parks are experiencing, but park managers must remain vigilant. The purpose of surveys in GLBA during the 2004 field season was to provide baseline information on the distribution, abundance, and species composition of exotic plants in four general areas: Bartlett Cove, Gustavus, Dry Bay, and backcountry Glacier Bay. This information will be used to develop a long-term monitoring and control strategy for the park, to coordinate efforts among all the parks in the Alaska Region, and to contribute to the statewide effort to document and address this rapidly growing problem.

Methods

The 2004 summer field season marked the first year that extensive surveys for exotic plants were conducted using highly accurate Trimble GeoXT GPS units. These units can achieve sub-meter accuracy and can be equipped with data dictionaries, enabling both precise mapping and standardized data collection. They were used to map both infested areas and areas without exotic plants with detail sufficient for annual monitoring of spread. The data were collected for entry into two distinct databases: APCAM – the nationwide NPS database for exotic plant data – and AKEPIC – a collaborative, web-based database for tracking Alaskan weeds. Attributes were designed to describe the size, diversity, and severity of exotic plant infestations in a given area (Table 1), as well as to satisfy database requirements. Digital photos were taken at most sites to augment the data recorded on the GPS units. If exotic species were found in sufficiently low numbers, they were removed by hand.

The method used to survey lands for exotic plants was opportunistic sampling, focused on areas of human development and frequent use as reported by park staff. The frontcountry of GLBA was exhaustively surveyed from the park boundary to Bartlett Cove, by vehicle along the road and by foot for all NPS and concessionaire housing, the water treatment plant, the Bartlett Cove campground, the NPS visitor center and surrounding parking area, the Glacier Bay Lodge, NPS headquarters, and all developed trails. The roads of Gustavus were also surveyed by vehicle with attention to major infestations and unique (i.e. high priority) species. The Dry Bay airstrip and major trails were surveyed by off-highway vehicle (OHV). The West Arm of Glacier Bay was surveyed on a single day by motorized vessel, with stops at six heavily used sites (Table 3). The East Arm of the bay was surveyed more thoroughly by kayak over six days, with stops at heavily used sites and additional good landing sites. ArcGIS (ESRI 2002) software was used to generate a shapefile that includes all GPS records, from which maps of survey results were generated (Figures 1-4). The number of data fields collected renders tabular display unwieldy, and so the GIS shapefile (GLBA_EPMT_2004) or associated datafile (.dbf) should be used for data viewing and analysis.

Results

A total of 15 exotic plant species were documented through our surveys of GLBA and Gustavus. Results are addressed below by site.

Glacier Bay Frontcountry

Along the GLBA park road from the park entrance to the Bartlett Cove boat dock, several common exotics were present (Figure 1). These included common dandelion (*Taraxacum officinale officinale*), common plantain (*Plantago major*), white clover (*Trifolium repens*), and red clover (*Trifolium pratense*). Less common exotics included

mouse-ear chickweed (*Cerastium fontanum*), common timothy (*Phleum pratense*), and common wheat (*Triticum aestivum*). Wheat was purposefully seeded along the park road within the last two years. This species is a sterile hybrid that did not appear to be spreading and is contributing little cover in areas where it is growing. However, in the fall of 2004, fertilized seeds of common wheat have germinated and started growing (Whitney Rapp, personal communication).

The exotic perennial ryegrass (*Lolium perenne*) was abundant along the edge of the parking lot at the Bartlett Cove dock. It appears as if this species was purposely seeded in the area, although resource management staff at GLBA were unaware of when this took place. Other exotics found growing in this area included dandelion, plantain, and white clover. The trail to the Bartlett Cove campground and the campground area itself were also surveyed, and only dandelion and plantain were observed in this area. The heavy canopy cover is most likely limiting the growth of exotic species here. Surveys of trails to Bartlett River, Bartlett Lake and the Forest Loop trail yielded no exotics. As with the trail to the Bartlett Cove campground, heavy forest canopy cover is limiting the number of available sites for exotic plant establishment.

The areas around NPS and ARA employee housing as well as the GLBA park headquarters had all of the most common exotic species as well as a healthy population of oxeye daisy (*Leucanthemum vulgare*). This is the only area within GLBA park boundaries where this species was found. It was limited to a small area and can be controlled through hand pulling.

The Glacier Bay Lodge had several species of exotic grasses growing around the edge of the lodge parking lot. These included perennial ryegrass, common timothy, and reed canarygrass (*Phalaris arundinacea*). Most of these species could be controlled and potentially eradicated through hand pulling.

Gustavus

A few exotic species were found growing on roadsides in the greater Gustavus area that were not present within GLBA. Smooth brome grass (*Bromus inermis*) was common along Gustavus Road from the airport to the junction of Mountain View Road and the Good River Road (Figure 2). This species was found in large numbers and was most likely seeded along the roadside for erosion control. At an abandoned homestead site on Same Old Road, several specimens of maltesecross (*Lynchis chalconica*) were found growing on the road edge. This was a new exotic species for Alaska and is probably an escaped garden plant. This species was found nowhere else in Gustavus or GLBA. Along Gustavus Road within a mile of the airport, a large specimen of common tansy (*Tanacetum vulgare*) was growing in an abandoned fish processing plant. This is the first time this species has been encountered during Alaska NPS surveys.

Common exotic species found in Gustavus included dandelion, plantain, oxeye daisy, white clover, and red clover. All of these species were confined to roadsides or areas of major disturbance such as lawns or parking lots.

Dry Bay

Scattered populations of dandelion and plantain were growing along several of the OHV trails in the area and at the NPS field headquarters (Figure 3). The abandoned seafood processing plant at Dry Bay had four specimens of pineappleweed (*Matricaria discoidea*) and oxeye daisy (*Leucanthemum vulgare*) growing around the main processing building. A large population of oxeye daisy was also growing in a clearing just before the airstrip. Scattered populations of bigleaf lupine (*Lupinus polyphyllus*) were encountered along the trail from the NPS field headquarters to Alesk Lake.

Backcountry Glacier Bay

Scattered populations of common dandelion were found at coastal sites along the East and West Arms of Glacier Bay (Table 3, Figure 4), and no other exotic species was found, despite the fact that common timothy was reported in the past (Greg Streveler, personal communication). All dandelions found belonged to the exotic species, rather than the native dandelion that may also be present in the park. Dandelions were generally found growing in the coastal zone, between the beach ryegrass and forest, in a zone of similar plants including yarrow, strawberry, silverweed, and fireweed. Small populations were generally discovered in the immediate vicinity of old campsites.

Of the six sites visited in the partial survey of the West Arm of Glacier Bay, two had no dandelions, two had small populations, and two had abundant populations (Table 3), with the most vigorous infestation on the west shore of Reid Inlet. The two sites furthest up the West Arm had no exotics, suggesting that dandelions may be progressively colonizing their way up the bay.

In the more thorough survey of the East Arm, 21 sites had no exotics present, 7 had small populations of dandelions, and 8 had abundant populations (Table 3). Heavily infested sites included all offshore islands as well as sites along the southern portion of the East Arm. Stump and Nunatak Coves marked the northernmost extent of dandelions found, again suggesting that they may be colonizing the arm in the direction of glacial retreat. The smaller populations had as few as one dandelion present (in the case of the southeast cove on Sebree Island).

Discussion and Management Recommendations

Most of the exotic species found growing in the GLBA frontcountry do not currently pose a serious threat to the natural resources of the park because they are limited to areas of repeated anthropogenic disturbance and have not yet invaded native ecosystems. However, all of these species should be prevented from moving into the backcountry through frontcountry control efforts, and the most valuable measure would be to eradicate exotic plants in Gustavus before they reach the park. Therefore, it is critical that frontcountry GLBA and the town of Gustavus be regularly monitored for exotic plants to ensure that more pernicious species do not gain a foothold in the park.

There are several areas in the GLBA frontcountry with large amounts of bare ground and recent disturbance. This is especially true of areas alongside the park road. Although the supposedly sterile hybrid of wheat is persisting along the length of the road corridor, it is not contributing an appreciable amount of cover in areas where it has been seeded. An attempt should be made to revegetate the park roadside using native species.

Large areas of bare ground like those found along the road corridor are prime areas for the establishment and spread of exotic plants. Resource management staff should work closely with maintenance personnel to ensure that disturbances are minimized and that native species are used for revegetation purposes. The frontcountry Vegetation Management Plan should incorporate measures for the prevention and control of exotic plant infestations.

Several species deserve special attention as high priority invaders. Common dandelion, ubiquitous across most of the United States, appears to be rapidly colonizing sites in backcountry GLBA and is in the initial phase of establishment at many sites. With targeted control efforts and regular surveys of backcountry sites, its spread into remote areas of the park may be halted. In Bartlett Cove, there are certain areas with relatively scarce dandelions. In the vicinity of the lodge, visitor center, and campground, control efforts may reduce the ability of dandelion to disperse via visitors into the backcountry. Hand-pulling of this species can be moderately effective, while herbicides are likely to provide more effective treatment, especially where regular visits are not an option. With the use of minimum tool analysis and execution, impacts to native vegetation and the environment are likely to be minimal. Dandelion control must be timed in the spring, because they flower earlier than most other species in the area, and sites may have to be visited multiple times during a single summer season due to their aggressive behavior and ability to recover and flower again even after treatment.

Oxeye daisy is a species that is rapidly spreading in other parts of Alaska and can even outcompete dandelion in some cases. There are major infestations of this species in Gustavus, however there exist only two populations in the park itself: a small one at the NPS Administration building at Bartlett Cove, and a larger one near the old Sitka Sound Seafoods building in Dry Bay. These infestations should be controlled in early summer 2005 through hand-pulling, which can be effective for small populations, or herbicide application. It is also important to engage the local community in discussions about how to manage the oxeye daisy populations in Gustavus in addition to the unique species that were found there this year: common tansy and maltesecross.

In the Tongass National Forest, reed canarygrass has become a successful invader, and it has been ranked as one of the species of greatest threat to natural ecosystems in Alaska (Natural Heritage Program 2004). Common timothy has been reported from backcountry Glacier Bay before, and so it too should be considered a high priority for treatment. Small populations of reed canarygrass may be treated by pulling/digging for multiple years, while herbicides can be effective if applied in May or September. Timothy control options are unknown, for it has rarely been treated elsewhere.

Bigleaf lupine, similar to native lupines but with 10 leaflets per leaf (rather than 8) and pink flowers (rather than purple), has been reported to be an aggressive invader in Gustavus (Rusty Yerxa, personal communication). It has been cultivated there for years, and it has also established populations in Dry Bay along the trail from NPS Headquarters to Alsek Lake. Because of the extent of this infestation, control would be time-intensive, although the threat to this remote region of the park may warrant such effort. The populations at Dry Bay and in Gustavus should be monitored in 2005, to determine if the species is rapidly spreading or invading native ecosystems. All other species present at

Dry Bay should be considered for removal because their distribution and abundance are extremely limited and they are likely to spread.

If possible, all seven sites where plants were pulled in 2004 (Table 4) should be revisited in 2005 to monitor the effectiveness of these efforts and retreat the infestations if necessary. This includes five backcountry sites with small dandelion populations, the only two red clover records from inside the park (along the park road), and the maltesecross growing in Gustavus. In addition, the park road corridor and frontcountry facilities should be carefully monitored to detect new species and infestations. The Beardslee Islands were not surveyed in 2004 and should be inventoried for exotic species, working from nearby to distant islands, because of their frequent on-shore visitation. The GLBA backcountry should also be surveyed to whatever extent possible to better describe the distribution of dandelion around the bay and to detect the arrival of new exotic species.

Education

Education is the most critical element of the prevention and detection of new exotic plant infestations in GLBA. On the prevention side, park staff, visitors, and local residents alike should be informed about this potential threat to park resources and to land management in Gustavus. This should include the message that exotic plants are a growing problem in Alaska and new species are likely to appear in the area over coming years. Two primary vectors of invasion exist: seeds or plant material arriving on gear and clothing, and the importation of soil, gravel, nursery stock, or heavy equipment into the area. All backcountry visitors should be encouraged at the visitor's center to wash their gear (e.g. boots, tents, or backpacks) before departing on their trips. Soil, gravel, and nursery stock should be obtained from weed-free sources wherever possible, and sites should be carefully monitored for weed establishment after material has been deposited. Any heavy equipment as well as used cars and trucks should be washed before or upon arriving in Gustavus, with special attention to tires, undercarriage, and any stray clumps of dried material.

To ensure early detection of new infestations and/or species in GLBA and Gustavus, species already present and those that are likely to arrive in the future should be identified for the audiences cited above (see Selected Invasive Plants of Alaska field guide, 2004). A short training for all field employees could focus on what species to look for while performing other duties, how to record their locations using GPS technology, and how to report them to resource managers. Because dandelion is the only species found in the backcountry, it should receive special attention in this training, and visitors could be informed about its distribution. A small rackcard distinguishing the exotic from the native dandelion species and its current distribution in Glacier Bay could be distributed to field employees and backcountry visitors, with an emphasis on reporting to resource managers. Finally, because Dry Bay has few species with relatively minor infestations, anyone traveling to this part of the park should be requested to wash their gear and look out for new infestations, and the tires of NPS OHV's should be regularly washed to prevent spread of the species that are already there.

Table 1. Selected fields used in GPS data dictionary and GIS shapefile for exotic plant surveys, summer 2004.

LocationID	Location ID (bartlett_cove, gustavus, dry_bay, east_arm, or west_arm)
Dstrbncs	Disturbance Type (coastal, glacial, fill importation, trampling, mowing, or abandoned homesite)
LctnDscpt	Location Description
BufferM	Buffer distance (in meters) to convert points and lines to polygons
Taxon	Dominant exotic species
Phenology	Phenology of dominant exotic species (no_flower, full_flower, or in_seed)
CvrClsPer	Cover class percentage of dominant exotic species (1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, 100)
Action	Inventory or Treatment
Treatment	Treatment type (only PULL/DIG-MANUAL this year)
CntrlEffrt	Projected/actual control effort (low, medium, high)
Undetermined	Stem count of dominant exotic species
Remarks	Remarks
StartDate, StartTime	Date and time of site visit
AssocPark	Associated park (GLBA)
Recorder	Recorder (JAH = Jeff Heys, CPM = Chris McKee)
Taxon2, Taxon3...	Additional 8 fields for 8 other exotic taxa for each unique site
Spatial Accuracy Fields	Range of attributes to describe spatial information and precision
Acres	GIS-calculated acreage of each infested or uninfested area

Table 2. GLBA and Gustavus Exotic Plant List

Scientific Name	Common Name	Location Description
<i>Bromus inermis</i>	Smooth brome	Common on roadsides in Gustavus but not found in GLBA
<i>Cerastium fontanum</i>	Mouse-ear chickweed	Found on park roadside
<i>Leucanthemum vulgare</i>	Oxeye daisy	Growing on Rink Creek Road, Mountain View Road and in NPS park headquarters area, as well as Dry Bay
<i>Lolium perenne</i>	Perennial ryegrass	Growing around perimeter of GLBA visitor center parking lot
<i>Lupinus polyphyllus</i>	Bigleaf lupine	Trailsides in Dry Bay
<i>Lychnis chalconica</i>	Maltesecross	Growing on abandoned homestead on Same Old Road in Gustavus
<i>Matricaria discoidea</i>	Pineappleweed	Around perimeter of old fish processing plant in Dry Bay
<i>Phalaris arundinacea</i>	Reed canarygrass	Glacier Bay Lodge
<i>Phleum pratense</i>	Common timothy	Glacier Bay Lodge and GLBA park road
<i>Plantago major</i>	Common plantain	Common throughout Gustavus and GLBA frontcountry, also in Dry Bay
<i>Tanacetum vulgare</i>	Common tansy	Found next to Gustavus Road near airport
<i>Taraxacum officinale officinale</i>	Common dandelion	Common throughout Gustavus and GLBA frontcountry, also scattered populations in backcountry and Dry Bay
<i>Triticum aestivum</i>	Common wheat	Hydro-seeded on GLBA park road
<i>Trifolium pratense</i>	Red clover	Found on State Dock Road and Mountain View Road
<i>Trifolium repens</i>	White clover	Common throughout Gustavus and GLBA frontcountry

Table 3. 2004 GLBA Backcountry Dandelion Survey Results

Site	Common Dandelion Abundance			General Location
	None	Small Population	Abundant (>100)	
Tidal Inlet			xxx	West Arm
east outlet of Vivid Lake		xxx		West Arm
west shore of Reid Inlet			xxx	West Arm
Mary's Beach, just east of Lamplugh Glacier	xxx			West Arm
Russell Outfan	xxx			West Arm
Blue Mouse Cove		xxx		West Arm
Mt. Wright	xxx			East Arm
south tip of Garforth Island			xxx	East Arm
north tip of Garforth Island			xxx	East Arm
southeast cove on Sebree Island		xxx		East Arm
stream mouth between East and West Arms			xxx	East Arm
southwest cove on Sebree Island	xxx			East Arm
Caroline Point	xxx			East Arm
Ice Valley			xxx	East Arm
small stream mouth between Ice and Morse Valleys		xxx		East Arm
south side of Morse River mouth	xxx			East Arm
north side of Morse River mouth		xxx		East Arm
Hunter Cove		xxx		East Arm
small cove on north side of Hunter Cove	xxx			East Arm
Rowlee Point	xxx			East Arm
stream mouth on north side of Curtis Hills	xxx			East Arm
Stump Cove		xxx		East Arm
Wolf River mouth	xxx			East Arm
north spit of McBride Glacier outflow	xxx			East Arm
south spit of McBride Glacier outflow	xxx			East Arm
Moraine overlooking Riggs and McBride confluence	xxx			East Arm
stream mouth on south side of McConnel Ridge	xxx			East Arm
small cove south of McBride Glacier outflow	xxx			East Arm
large stream mouth between Van Horn Ridge and the Nunatak	xxx			East Arm
main Nunatak Cove	xxx			East Arm
southwest shore of Nunatak Cove			xxx	East Arm
beach across from Sealers Island	xxx			East Arm
Sealers Island			xxx	East Arm
Goose Cove	xxx			East Arm
stream mouth just south of USGS Moraine marker	xxx			East Arm
stream mouth on north side of Klotz Hills		xxx		East Arm
Point George			xxx	East Arm
small cove on southeast side of Klotz Hills, Adams Inlet		xxx		East Arm
draw separating an island from mainland at high tide, Adams Inlet	xxx			East Arm
lagoon on south side of Adams Inlet	xxx			East Arm
island off Dirt Glacier rivermouth			xxx	East Arm
Dirt Glacier rivermouth	xxx			East Arm
Total number of sites	23	9	10	

Table 4. Control sites for exotic plants in 2004

General Location	Location Description	Species	Phenology	Stem Count	Remarks	Date Controlled
West Arm	east outlet of vivid lake, end of vegetated strip	Dandelion	no flower	1	growing at edge of coastal vegetation in gravel	7/6/2004
Adams Inlet	small cove on southeast side of klotz hills	Dandelion	no flower	40	finite distribution, beginning of an infestation	7/12/2004
East Arm	stream mouth on north side of klotz hills	Dandelion	no flower	30	finite distribution	7/11/2004
East Arm	southeast cove on sebree island, tucked away	Dandelion	no flower	1	single individual in suitable area for dandelion; already seeded this year	7/8/2004
East Arm	northeast end of stump cove	Dandelion	no flower	30	very isolated patch - return next year	7/9/2004
Park Road	glba park road	Red clover	full flower	1	plant pulled out easily to roots	7/17/2004
Park Road	glba park road	Red clover	full flower	1	plant pulled out easily	7/17/2004
Gustavus	same old road	Maltesecross	full flower	10	maltesecross possibly escaped from cultivation; looks to be growing on an old homestead site	7/19/2004

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