



# Invasive Plant Management for Kenai Fjords National Park

## *2010 Summary Report*

Natural Resource Report NPS/KEFJ/NRDS—2010/109



**ON THE COVER**

Kenai Fjords National Park Exotic Plant Management Team and Southeast Alaska Guidance Association crew pull invasive plants on Exit Glacier Road at the park boundary.

Photograph courtesy of Kenai Fjords National Park

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## **Abbreviations**

AACD	Alaska Association of Conservation Districts
ABRS	Aialik Bay Ranger Station
AKDOT	Alaska Department of Transportation
AKNHP	Alaska Natural Heritage Program
ARRA	Alaska Recovery and Reinvestment Act
CWMA	Cooperative Weed Management Area
EDRR	Early Detection and Rapid Response
EPMT	Exotic Plant Management Team
GPS	Global Positioning System
HIT	Harding Icefield Trail
KEFJ	Kenai Fjords National Park
NPS	National Park Service
PUC	Public Use Cabin
RBCA	Resurrection Bay Conservation Alliance
SAGA	Southeast Alaska Guidance Association
SCA	Student Conservation Association
USFS	U.S. Forest Service
YCC	Youth Conservation Corps

## **Abstract**

This report describes the work performed by the Alaska Exotic Plant Management Team at Kenai Fjords National Park during the 2010 field season. This marks the seventh season that Kenai Fjords National Park has monitored and controlled for invasive plants according to the Alaska Exotic Plant Management Team protocol. This year's team included one biological technician, one Student Conservation Association intern and one Youth Conservation Corps intern with three weeks of assistance from a Southeast Alaska Guidance Association AmeriCorps crew. As with previous seasons, invasive plant management efforts were focused in the Exit Glacier area. Several locations along the coastal area of the park were also surveyed including Nuka Bay, McCarty Fjord, Two Arm Bay, Northwestern Lagoon, Aialik Bay, and beaches near Yalik and Bear Glaciers. Invasive plants were surveyed and mapped using a Trimble GeoXT Global Positioning System and treated with manual control efforts. A total of 2,617 pounds of invasive plants were pulled in the park this field season. 55.9 species acres of Kenai Fjords National Park managed lands and 5.9 species acres of lands outside the park boundaries were surveyed. 5.5 acres of invasive plant infestations were mapped. 3.4 acres of invasive plants were treated. Monitoring and control efforts should continue at Kenai Fjords National Park to prevent the further spread of existing and introduction of new invasive plant species and to keep native ecosystems intact.

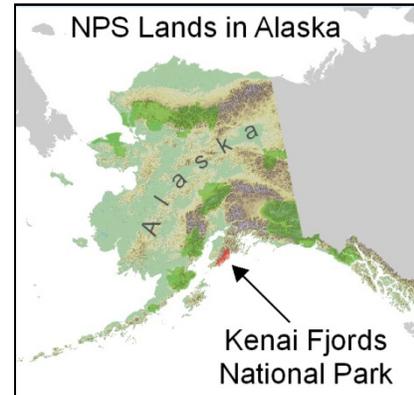
## **Acknowledgments**

The Kenai Fjords National Park Exotic Plant Management Team would like to thank all who helped pull invasive plants in and around the park this year including Student Conservation Association intern Greg Kolenda; Youth Conservation Corps intern Hayden Maxwell; the Southeast Alaska Guidance Association crew; the Kenai Peninsula Cooperative Weed Management Area Youth Crew; Resurrection Bay Conservation Alliance; Alaska Sea Life Center employees; the Alaska Association of Conservation Districts Invasive Plant Coordinator, Jen Kain; as well as Kenai Fjords National Park employees Shannon Kovac, Jason Flowers, Brooke McFarland, Amber Rethwisch, and Katy Lofton.

## Introduction

Kenai Fjords National Park (KEFJ), located in southcentral Alaska (fig. 1), is a dynamic landscape. Dominated by more than 500 square miles of the Harding Icefield, the park is rimmed by mountains and sculpted by active glaciers spilling from the icefield to waters of the Pacific Ocean. Natural processes such as avalanches, glacial recession and glacial outburst floods periodically disturb the landscape. These natural disturbances occur at varying time scales, offering researchers and naturalists the opportunity to study and understand the natural process of plant succession as it is reinitiated with each disturbance.

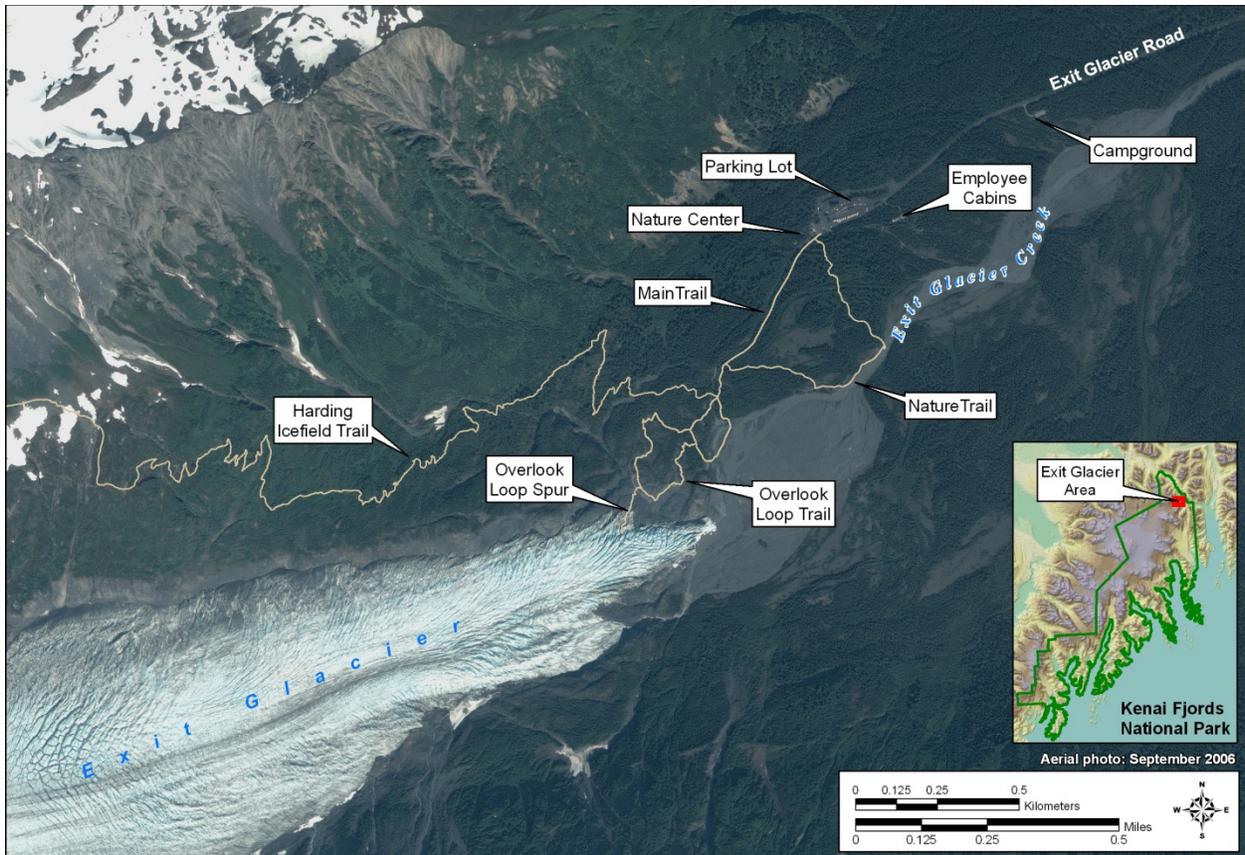
The introduction and spread of invasive plants is a concern to natural resource managers in KEFJ. Invasive plants can threaten natural ecosystems by interrupting normal plant succession; competing with native flora for resources such as light, water, and soil; and disrupting nutrient cycles and hydrologic regimes (Martin 2004). Glaciers throughout the park are in a cycle of melt and recession (Giffen et al. 2009). As glaciers recede they reveal newly disturbed, unvegetated terrain, providing an ideal environment for invasive plants to establish and create competition for early-succession plant species such as native fireweed (*Chamaenerion angustifolium*) and alder (*Alnus rubra*).



**Figure 1.** Location map of KEFJ in Alaska.

The Exit Glacier area, located in the northeast portion of KEFJ (fig. 2), is the only part of the park that can be accessed by road and has been developed to provide the most visitor services. More than 100,000 people visited the Exit Glacier area during the 2010 tourist season. 1.35 miles of Exit Glacier Road lead from the U.S. Forest Service (USFS) boundary to the visitor facilities. Visitor facilities include a 12-site, walk-in, tent campground; three primitive cabins (two for employee housing and one for public use); a paved parking lot; a visitor center/ bookstore referred to as the Nature Center; roughly 2.5 miles of trails along Exit Glacier Creek and the terminus of Exit Glacier; and 4.1 miles of the Harding Icefield Trail (HIT). Several trail building and improvement projects have been completed in the past five years around the Nature Center at Exit Glacier. These new trails and construction projects are monitored as potential vectors for the spread of existing invasive plant species and introduction of new ones in the park.

Interference with natural plant succession is a major concern in the developed Exit Glacier area where Exit Glacier continues to recede and create an outwash plain of naturally disturbed soil. The outwash plain provides an ideal environment for invasive plants to establish. Seeds can be carried unknowingly on visitors' clothes and footwear. The maintained trails in this area offer vectors for transport from the developed area further into the naturally disturbed areas around the glacier, nearby active river valleys, and surrounding mountains.



**Figure 2.** Developed sites in the Exit Glacier area.

The coastal area of KEFJ is formed of rugged, glacier-carved fjords. Most visitors in this area of the park arrive via tour boats and never set foot on land. Some visitors access the coast with local kayak guiding companies while other independent adventurers travel into the coastal backcountry via water taxi, private boat or kayaks to explore the numerous beaches. Although the coastal areas are still relatively free of invasive plants, increased visitor use at camping beaches, public use cabins (PUC) and new commercial development at Pederson Lagoon may also contribute to the spread of invasive plants along the coast, reinforcing the need for annual monitoring of these areas.

Prior to the establishment of the Alaska Exotic Plant Management Team (EPMT), KEFJ initiated its own invasive plant management involving surveys, monitoring, and community weed pulls (Bryden 2002; Densmore 2001; Martin 2004). In 2003, a National Park Service (NPS) Alaska EPMT was formed. This regional program provides standards for consistent documentation of invasive plant infestations and assistance with invasive plant management decisions. 2010 marks the seventh consecutive year of systematic inventory, monitoring, and manual control of invasive plants in KEFJ following protocol developed by the Alaska EPMT (Million and Rapp, 2010). All data from the Alaska EPMT is uploaded into two databases: the Alien Plant Control and Monitoring database, a national NPS database, and the Alaska Exotic Plant Information Clearinghouse, a statewide, interagency database that tracks all invasive plant infestations in Alaska.

## Methods

The primary objectives of the KEFJ EPMT are to prevent the introduction of invasive plants, survey for established invasive plants, monitor existing invasive plant infestations and work to contain, reduce and, ultimately, eradicate invasive plants on KEFJ lands.

Methods for invasive plant management at KEFJ were outlined in the Alaska EPMT 2010 field protocols (Million and Rapp, 2010). Surveying and mapping were conducted primarily with a Trimble GeoExplorer 2008 Series GeoXT Global Positioning System (GPS) as well as a Trimble GeoExplorer 2003 Series GeoXT GPS. Each unit was loaded with legacy invasive plant data to locate and monitor previous infestations. The legacy data that was used was collected by the park in previous seasons and compiled and distributed by the regional Alaska EPMT office. In addition to the legacy data, the Alaska EPMT data was used to collect all attribute data for precise and standardized data collection for monitoring or documenting new infestations. GPS data was post-processed and edited by KEFJ field staff using GPS Pathfinder Office before being uploaded to the regional Alaska EPMT office.

Removal methods to date have been restricted to hand-pulling using small handheld tools and flower removal to prevent seed dispersal.

The 2010 field season lasted from June through early September and was organized by a NPS biological science technician working out of Seward, Alaska. This was the first year that a Student Conservation Association (SCA) intern assisted with field work and data entry. One Youth Conservation Corps (YCC) intern also assisted with field work during the peak of the field season (early June through mid August). This core crew monitored and documented infestation sites, mapped new infestations, and coordinated manual control efforts in high-priority areas. A volunteer crew of Southeast Alaska Guidance Association (SAGA) AmeriCorps members, funded by the American Recovery and Reinvestment Act of 2009 (ARRA), assisted KEFJ EPMT for two weeks in early June and one week in mid August.

### **Distribution of Invasive Plants**

Control and monitoring efforts are primarily focused on the Exit Glacier area which contains the most extensive invasive plant infestations in the park. Coastal monitoring is also conducted for early detection of new introductions. In 2010 KEFJ EPMT surveying and monitoring sites were well distributed across the vegetated areas of the park around Exit Glacier and on the coast.

#### ***Exit Glacier Area***

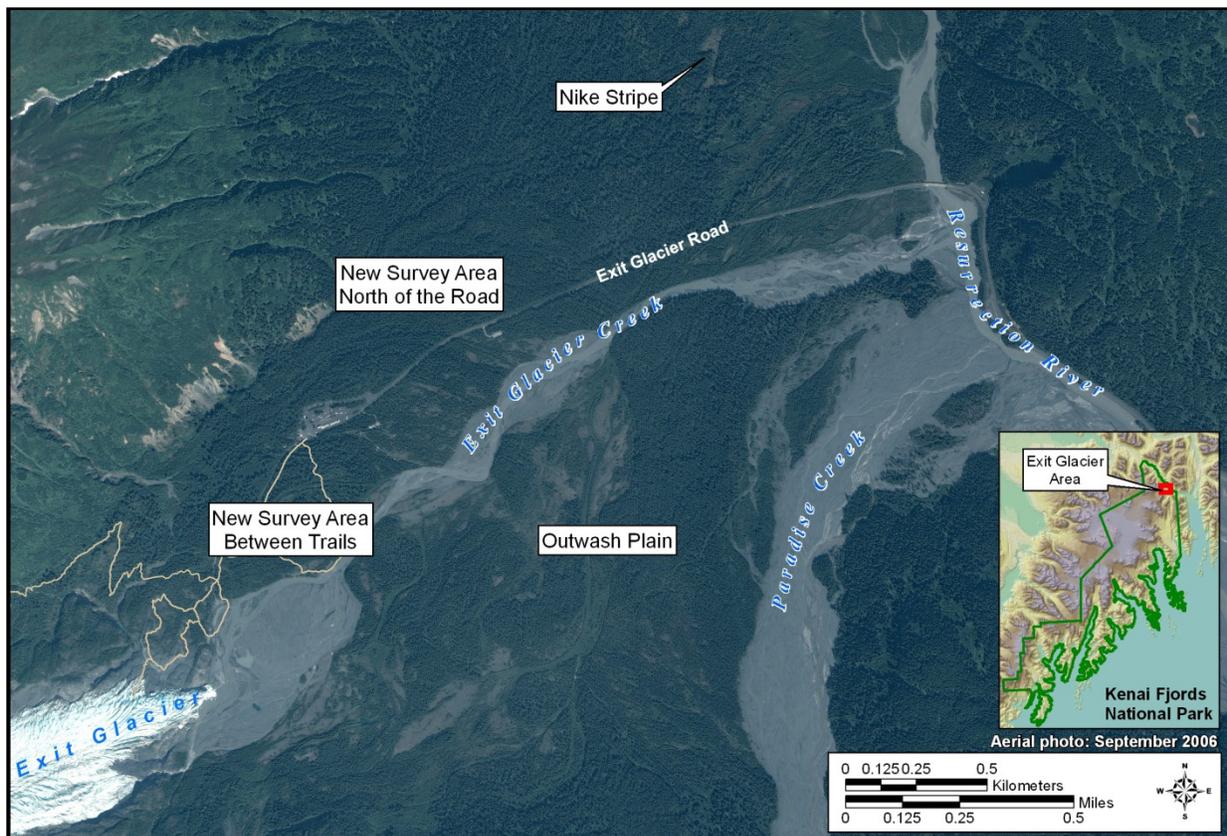
The road-side, trail-side, and parking lot areas of Exit Glacier are the most easily accessible and most visited areas in KEFJ and serve as the main human-use corridors. As a result, they contain the greatest extent and diversity of invasive plants in the park. All known locations of invasive plants in the Exit Glacier area were revisited in 2010. Monitoring and control work were performed in the Exit Glacier area weekly throughout the field season.

Two known backcountry locations of common dandelions (*Taraxacum officinale*) were monitored in the Exit Glacier area. One site, locally referred to as the “Nike Stripe” (due to its resemblance of the logo of a popular sport clothing company on an aerial photo) is a small infestation of dandelions north of the road near the park boundary. The second, larger and less

accessible site is a large infestation of common dandelions on the outwash plain south of Exit Creek. To access this site, crews must ford the glacial waters of Exit Creek. It is typical for high water levels to impede access to the old glacial moraines and outwash plain on the other side of the creek. Water levels on this creek can change day-to-day as they are affected by the rate of glacial melt, which is related to diurnal temperature and rainfall. Often there is only a small window of time during the early season when dandelions have emerged enough for accurate monitoring and mapping yet the creek is still low enough to safely cross on foot.

In 2010 KEFJ EPMT focused on mapping the entire extent of the common dandelion infestation on the south side of Exit Creek in early June while the SAGA crew was working in KEFJ. Crews crossed the creek on two different days. Due to a greater focus on mapping the infestation this year, little time was spent removing plants, although a few bagfuls were pulled. By spreading out the crew and having two people operating GPS units, KEFJ EPMT were able to survey and map most of the outwash plain for thorough documentation of the extent of this infestation. Although the outwash plain on the south side of Exit Glacier Creek was fully mapped, it is possible that there are dandelions spreading even further south into Paradise Creek and up into Paradise Valley.

In addition to revisiting all areas that had been surveyed in the past at Exit Glacier, two new areas were inventoried: an off-trail area located in-between the Main Trail and the Glacier View Trail and the area north of the road between the parking lot and campground. No invasive plants were observed in either of these locations (fig. 3).



**Figure 3.** Backcountry locations of invasive plant survey sites in the Exit Glacier area.

### Coastal Areas

KEFJ EPMT staff surveyed and monitored coastal areas of the park on three occasions including one trip to Aialik Bay and two separate trips involving visits to multiple bays and fjords. Visitor areas in Aialik Bay were surveyed and monitored for four days in late June. These areas included the beaches around the KEFJ Aialik Bay Ranger Station (ABRS), Aialik and Holgate PUCs and camping beaches, and a camping easement on Port Graham Native Corporation land at Pedersen Lagoon. This was the second season that Kenai Fjords Wilderness Lodge, operated by Alaska Wildland Adventures, was operating in the Pedersen Lagoon area. KEFJ EPMT surveyed recently deglaciated areas on NPS lands in front of Pedersen Glacier which are accessible by visitors staying at the lodge.

KEFJ EPMT staff had two more trips to the coastal areas of the park aboard the KEFJ vessel, M/V Serac. One trip in late July allowed EPMT staff to survey and monitor remote coastal locations that are used by people including the beach in front of Yalik Glacier, the James Lagoon outer beach, known campsites in McCarty Fjord, Taroka and Paguna Arms of Two Arm Bay, abandoned mining areas at the head of Beauty Bay, and the known sites of common dandelion located near Dinglestadt Glacier in McCarty Fjord. A second trip was made in late August. Based on the M/V Serac, EMPT staff monitored or surveyed locations in Yalik Bay, Beauty Bay, Surprise Bay, McCarty Fjords, Harris Bay, and the ridge near McArthur Pass (fig. 4).

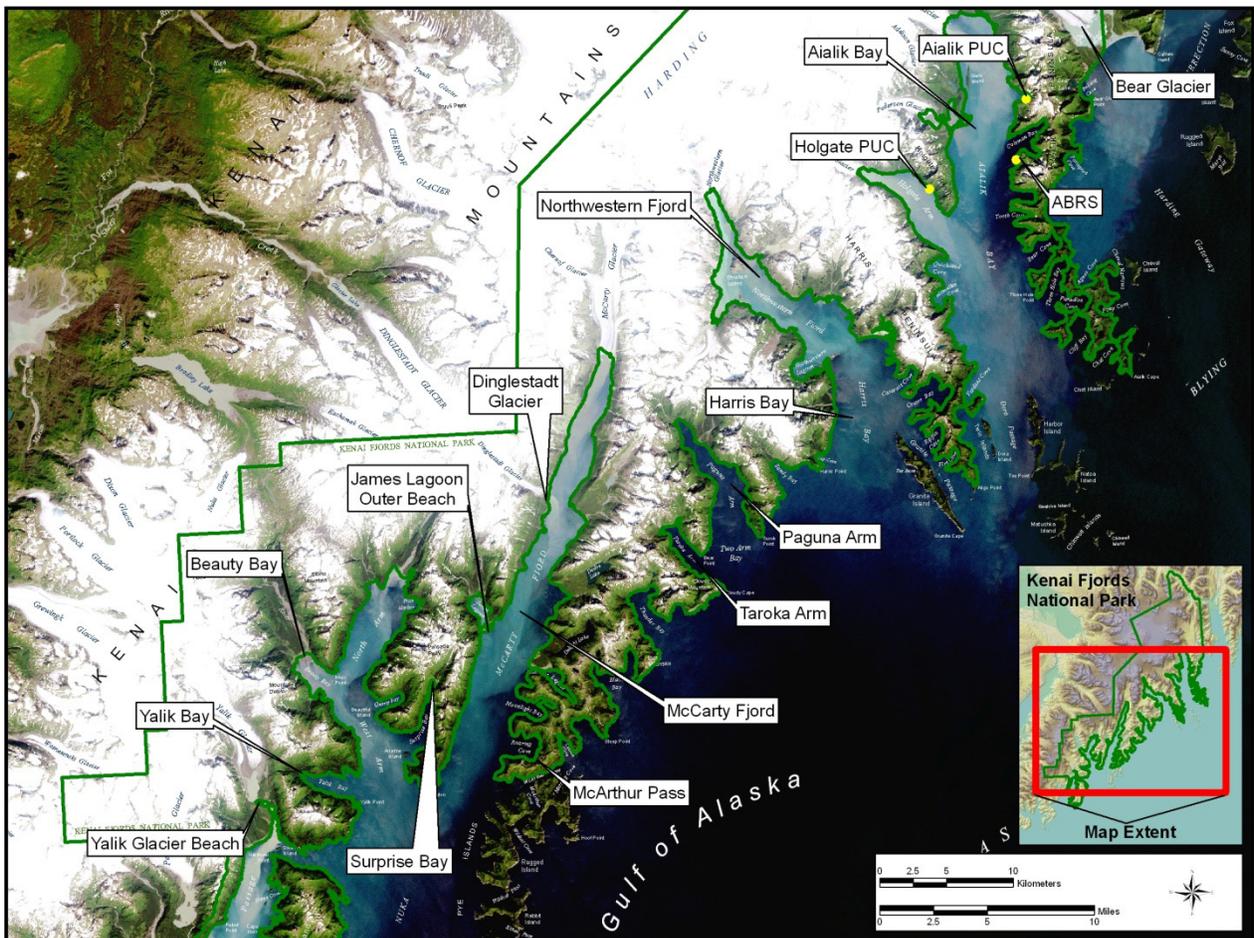


Figure 4. Backcountry locations of invasive plant survey sites in coastal areas of KEFJ.



# Results

## Overview

The number of species acres surveyed more than doubled in 2010 compared to 2009 (Table 1). This is a result of additional surveying that was conducted on the outwash plain south of Exit Creek as well as on the outer coast. The increased surveys lead to the discovery of more invasive species infestations, resulting in the doubling of species acres infested from 2009 to 2010. With the extra assistance of an SCA intern and three full weeks of SAGA crew help, 2010 also saw an increase in the number of acres treated in KEFJ.

KEFJ EPMT identified 13 invasive plant species growing in KEFJ in 2010 (Table 2). The most abundant invasive plant species in KEFJ is the common dandelion. 4.9 acres of this species were mapped in 2010. Most of the common dandelion infestations located in KEFJ are found in the Exit Glacier area. A few small infestations are located near Dinglestadt Glacier in McCarty Fjord.

**Table 1.** Summary of Kenai Fjords National Park Exotic Plant Management.

Year	Invasive GPS Data NPS Lands (non-NPS lands)		
	Species Acres Surveyed	Species Acres Infested*	Acres Treated
2004	2.8 (0.5)	1.7 (0.5)	0.5 (0.5)
2005	9.7 (0.1)	2.8 (0.01)	2.3 (0.01)
2006	42.7 (0.3)	5.4 (0.3)	4.8 (0.2)
2007	23.5 (1.8)	5.2 (0.01)	1.9 (0.01)
2008	24.0 (0.2)	3.4 (0)	1.7 (0)
2009	26.1 (3.2)	2.7 (0.01)	2.3 (0.01)
2010	55.9 (5.9)	5.5 (0.01)	3.4 (0.01)

\* Acres infested are calculated by acres mapped times the percent cover in areas greater than 0.5 acres. If under 0.5 acres, acreage mapped is counted as 100%.

**Table 2.** Invasive plant species observed in and around Kenai Fjords National Park.

Taxon	Common Name	Invasiveness Ranking <sup>1</sup>	Inside park?
<i>Alopecurus pratensis</i> <sup>2</sup>	common foxtail	unranked	Y
<i>Agrostis gigantea</i> <sup>3</sup>	red top	unranked	Y
<i>Aquilegia</i>	columbine	unranked	Y
<i>Brassica rapa</i>	field mustard	unranked	Y
<i>Bromus inermis</i> <sup>4</sup>	smooth brome grass	62	N
<b><i>Cerastium fontanum</i></b>	<b>mouse-ear chickweed</b>	<b>36</b>	<b>Y</b>
<i>Crepis tectorum</i>	narrowleaf hawksbeard	54	Y
<i>Dactylis glomerata</i>	orchard grass	53	N
<i>Elymus repens</i>	quackgrass	59	N
<i>Galeopsis bifida</i>	hempnettle	40	N
<i>Hieracium aurantiacum</i>	orange hawkweed	79	N
<i>Hordeum jubatum</i>	foxtail barley	63	Y
<i>Leontodon autumnalis</i>	fall dandelion	unranked	N
<i>Leucanthemum vulgare</i>	oxeye daisy	61	Y
<b><i>Linaria vulgaris</i></b>	<b>yellow toadflax</b>	<b>69</b>	<b>Y</b>
<i>Lolium perenne</i>	perennial ryegrass	41	N
<i>Lupinus polyphyllus</i>	bigleaf lupine	55	N
<b><i>Matricaria discoidea</i></b>	<b>pineapple weed</b>	<b>32</b>	<b>Y</b>
<i>Medicago lupulina</i>	black medic	48	N
<i>Medicago sativa</i> ssp. <i>falcata</i>	yellow alfalfa	64	N
<i>Melilotus alba</i>	white sweetclover	81	N
<i>Melilotus officinalis</i>	yellow sweetclover	69	N
<i>Neslia paniculata</i>	ball mustard	unranked	N
<i>Papaver nudicale</i>	Icelandic poppy	unranked	Y
<b><i>Phleum pratense</i></b>	<b>common timothy</b>	<b>56</b>	<b>Y</b>
<b><i>Plantago major</i></b>	<b>common plantain</b>	<b>44</b>	<b>Y</b>
<b><i>Poa annua</i></b>	<b>annual bluegrass</b>	<b>46</b>	<b>Y</b>
<b><i>Poa pratensis</i></b>	<b>Kentucky bluegrass</b>	<b>52</b>	<b>Y</b>
<b><i>Prunella vulgaris</i></b>	<b>self-heal</b>	<b>unranked</b>	<b>Y</b>
<i>Ranunculus acris</i>	tall buttercup	54	Y
<i>Rumex acetosella</i>	common sheep sorrel	51	Y
<b><i>Rumex crispus</i></b>	<b>curly dock</b>	<b>48</b>	<b>Y</b>
<i>Spergula arvensis</i>	corn spurry	32	N
<b><i>Taraxacum officinale</i> ssp. <i>officinale</i></b>	<b>common dandelion</b>	<b>58</b>	<b>Y</b>
<i>Trifolium hybridum</i>	alsike clover	57	Y
<b><i>Trifolium pratense</i></b>	<b>red clover</b>	<b>53</b>	<b>Y</b>
<b><i>Trifolium repens</i></b>	<b>white clover</b>	<b>59</b>	<b>Y</b>
<i>Tripleurospermum perforata</i>	scentless false mayweed	48	N
<i>Triticum aestivum</i>	common wheat	unranked	N
<i>Vicia cracca</i>	bird vetch	73	N
<i>Allium schoenoprasum</i>	wild chive	unranked	N

<sup>1</sup>Species ranking based on the Invasiveness Ranking System for Non-Native Plants of Alaska (Carlson et al. 2008).

<sup>2</sup>Species in bold were observed in the park in 2010.

<sup>3</sup>Species in normal font have been observed in the park but were not observed in 2010.

<sup>4</sup>Species in gray have been observed outside the park boundaries.

## Exit Glacier Area

### Exit Glacier Road

Exit Glacier Road stretches eight miles from its intersection with the Seward Highway to the parking lot at Exit Glacier. The road crosses private land, State of Alaska land, and USFS land before ending at the visitor facilities in KEFJ. The gravel fill material that lines the sides of Exit Glacier Road provides habitat for the most visible and dense infestation of invasive plants in KEFJ.

The most apparent invasive plants in KEFJ are the common dandelions located on the sides of Exit Glacier Road. Here the common dandelions are interspersed with native species such as alder, fireweed and yellow avens (*Dryas drummondii*). Other invasive plants mapped and pulled along the road in 2010 include common plantain (*Plantago major*), common timothy (*Phleum pratense*), white clover (*Trifolium repens*), and a small infestation of yellow toadflax (*Linaria vulgaris*). One oxeye daisy (*Leucanthemum vulgare*) and two red clover plants (*Trifolium pratense*) that were mapped and pulled on the north side of the road near the bridge in 2009 were not observed in 2010.

During the first two weeks of June, the KEFJ EPMT program had ten days of assistance from an eight-person SAGA crew. The arrival of the SAGA crew was well-timed with phenology as dandelions and other invasive plants were easily observed and identified but had not yet gone to seed. SAGA crew work was distributed between Exit Glacier Road, the parking lot, the Nike Stripe and the outwash plain. With the assistance of the SAGA crew, 468 pounds of common dandelion and a small amount of common plantain were pulled from the sides of the road. In addition to pulling, a second strategy KEFJ employed against the common dandelions along the side of the road was to remove all flower heads on the dandelions just before they went to seed. One individual dandelion plant can produce up to 5,000 seeds (Royer and Dickinson 1999) which can remain viable in the soil for up to 5 years (Bard 1952). Although the plant remains, removing the flowers reduces the number of seeds produced and hinders the development of a dandelion seed bank. Repeated control efforts on Exit Glacier Road appear to be reducing the density of dandelions at each end of the road (the west end of the road by the parking lot and the east end of the road by Resurrection River Bridge) where more control efforts have been focused.

100% of the yellow toadflax located on the south side of the road was removed, again, in 2010. In 2009 and 2010, KEFJ EPMT made it a priority to control 100% of the white clover dispersed in small patches along Exit Glacier Road as well (fig. 5). Both species appear to be declining within the park.

Some species that appeared along the road in specific locations for the first time in 2009 did not return in 2010. Examples of this early detection and



**Figure 5.** SAGA crew assisting KEFJ EPMT with white clover along Exit Glacier Road.

rapid response (EDRR) effort along Exit Glacier Road include two individual red clover plants and one individual oxeye daisy plant. Flooding of Exit Glacier Creek across Exit Glacier Road occurred for a second consecutive year this season. In 2009 and 2010, flooding events washed away gravel along the shoulders of the road just west of the KEFJ welcome sign in areas containing common dandelions, common plantain, and white clover. In both years, new material excavated from Resurrection River was brought in to stabilize the road. Monitoring in 2010 was conducted with this in mind to determine if existing invasive species were washed away and if new ones were introduced, such as white sweetclover (*Melilotus alba*) which is growing on an island upstream from the commercial gravel-excavation site on the Resurrection River. Prior to the 2010 flooding event, it was noted that there were no invasive plant species in the new gravel. Glacial sediment that was transported from the creek's floodwaters was deposited along with some of the shoulder gravels into the forest north of the road. This forested area should be monitored in 2011 to determine if any plants sprouted from seeds that may have been transported from the road.

Five invasive plant species of concern grow just outside the park boundary on USFS and State of Alaska managed lands along Exit Glacier Road. In addition to the ubiquitous common dandelion, black medic (*Medicago lupulina*) is abundant along the road corridor. Narrowleaf hawksbeard (*Crepis tectorum*), yellow sweetclover (*Melilotus officinalis*), and oxeye daisy grow near the pullout to the Resurrection River trailhead bordering the Exit Glacier area. Infestations of purple alfalfa (*Medicago sativa*) and yellow alfalfa (*Medicago falcata*) have been observed along the road corridor further away from the park boundary. White sweetclover is growing on an island in the middle of the river and at the intersection of Exit Glacier Road and the Seward Highway.

In 2006, the Alaska Department of Transportation (AKDOT) completed roadwork on the Seward Highway including construction of a hike and bike trail. Upon completion of this project, AKDOT reseeded the roadside with a seed mix to discourage erosion and facilitate revegetation. This mix may have included the sweetclover species which sprouted up along the highway in town and along Exit Glacier Road. In addition to the roadside infestations, a less accessible infestation of white sweetclover colonized an island in the Resurrection River, a few miles downstream of KEFJ's boundary.

Concern amongst local natural resource managers lead to focused weed pulls in this area and, in 2010, the near eradication of some of these species. Beginning in September 2008 the local conservation group, Resurrection Bay Conservation Alliance (RBCA), organized weed pulls and weed burns to remove the most invasive nonnative plants from local Seward highways including yellow sweetclover, white sweetclover, bird vetch (*Vicia cracca*), and scentless false mayweed (*Tripleurospermum perforata*). Although these control efforts occurred outside the park, these infestations provide the nearest and most likely seed source for the introduction of these species into KEFJ.

In 2010, KEFJ, RBCA, and Jen Kain, the local Alaska Association of Conservation Districts (AACD) invasive plant coordinator, partnered for the annual end-of-June community weed pull on Exit Glacier Road outside the park boundary. Efforts adjacent to the Resurrection River (which serves as the NPS-USFS boundary) focused on common dandelions and oxeye daisy. Further away from the park, efforts focused on yellow alfalfa, oxeye daisy and various sweetclover species. In 2010 a Kenai Peninsula Cooperative Weed Management Area (CWMA)

youth crew removed a small patch of bird vetch growing at the first pullout on the east end of the USFS section of the road. This infestation was removed by shovels to reduce the seed bank as well as the plants. Although their efforts were aggressive, by the end of the season, a small patch of bird vetch returned at the same location.

In late August, KEFJ EPMT staff partnered with RBCA and the AACD invasive plant coordinator again to hand-pull fall dandelion (*Leontodon autumnalis*) from the east end of Exit Glacier Road approximately a mile from the intersection with the Seward Highway. Although it is not currently ranked by the Alaska Natural Heritage Program's (AKNHP) Invasiveness Ranking System (Carlson et al. 2008), fall dandelion has been observed to be an aggressive colonizer in numerous fields around Homer, Alaska (AACD, B. Spellman, Invasive Plant Program Coordinator, email, 13 September 2010).

### **Exit Glacier Parking Lot**

Common dandelion is the most prevalent species growing around the Exit Glacier parking lot. With repeated control events, control efforts succeeded in pulling 95-100% of the dandelions found in this area, 95-100% of common plantain and 100% of white clover plants in 2010. This year was the first year that common sheep sorrel (*Rumex acetosella*) was not observed along the north side of the parking lot near the bus pullout. 95-100% of common timothy and pineapple weed (*Matricaria discoidea*) scattered around Exit Glacier parking lot were controlled. One individual clump of Kentucky bluegrass (*Poa pratensis*) was documented growing on the south side of the parking lot and pulled for the first time in KEFJ (fig. 6).



**Figure 6.** Kentucky bluegrass in the Exit Glacier parking lot.

### **Campground**

Campsites within the campground near Exit Glacier remain free of invasive plants. Scattered individuals of common plantain and common dandelion were documented and completely controlled in the campground parking lot area.

Dandelions along Exit Glacier Road at the entrance to the campground are very dense. Additional effort should be focused on controlling dandelions along this section of the road to prevent dispersal into the campground.

### **Employee Cabin Area**

There were no new introductions of invasive plants around the employee cabin area at Exit Glacier. The curly dock (*Rumex crispus*) infestation growing along the front deck of the Willow Cabin was not observed in 2009 but returned in 2010. The small patch of common dandelion outside the back door of Cottonwood Cabin returned but appeared to be less dense and smaller in area. A small patch of pineapple weed reappeared in front of the Alder Cabin. All infestations were mapped and completely removed.

### **Main Trail**

The Main Trail was monitored regularly throughout the season and common dandelion and common plantain were pulled when observed. 2010 marks the first year that annual bluegrass (*Poa annua*), mouse-ear chickweed (*Cerastium fontanum*), and common foxtail grass (*Alopecurus pratensis*) were mapped and controlled on this trail. This is the first time common foxtail grass, an invasive grass, has been observed, documented, and removed in KEFJ (fig. 7). One individual specimen of narrowleaf hawksbeard was mapped and pulled on the Main Trail just south of the Nature Center.



**Figure 7.** Common foxtail.

In August 2009, annual bluegrass was observed growing around the Nature Center, along the Main Trail, and up the HIT. Prior to 2009, there were only sparse amounts of annual bluegrass observed along the trails. At the end of the 2009 season the annual bluegrass was observed more widely spread along the trails where it was forming dense borders in some sections (Kurtz 2009).

In 2010, KEFJ initiated mapping and control efforts for annual bluegrass on the lower trails and the HIT in the Exit Glacier area. In early August an eight-person SAGA crew assisted in these first efforts. Priority was given to the HIT where 969 pounds of bluegrass were removed in one week. Effort was focused on the Main Trail and the Nature Trail near the new pavilion (fig. 8). Additional pulling was conducted in September by KEFJ EPMT staff as time allowed. An additional week of SAGA crew efforts should be directed at the annual bluegrass on the HIT and other trails at Exit Glacier in early August 2011. After 2011, it is thought that this species may be more manageable and can be controlled by the regular core EPMT crew at KEFJ.



**Figure 8.** Before and after photos showing the SAGA crew pulling annual bluegrass near the new pavilion.

### **Nature Trail**

A few common dandelions were pulled on the 1917 moraine along the Nature Trail again in 2010. Staff should continue to monitor this moraine carefully. No new infestations of invasive plants were discovered on the Nature Trail in 2010.

### **Overlook Loop Trail**

In 2008, a small patch of common dandelions was observed and mapped for the first time along the Overlook Trail in rocky terrain colonized by early-succession vegetation. This infestation has been monitored closely throughout the 2008, 2009 and 2010 seasons. 100% of plants were controlled each time the site was visited. It is believed that no plants have produced seeds since the discovery of this infestation (Kurtz 2008). It appears that this infestation is continuing to decrease in density and that this patch will be eradicated with continued future control efforts. This patch of common dandelions is closer to areas that have been recently disturbed by Exit Glacier than any other infestation of invasive plants on the lower trails. It is important to continue to closely monitor and control this infestation to prevent seeds from spreading up the newly exposed terrain. No new infestations of common dandelions were discovered on the Overlook Loop Trail in 2010.

In early September 2008, KEFJ interpretive staff reported an infestation of the invasive bladder campion (*Silene vulgaris*) behind the bridge on the Overlook Loop Trail. KEFJ interpretive staff and EPMT staff searched for this species in 2009 with no success in relocating it. In 2010 the species was observed and a few specimens were collected and identified not as the invasive bladder campion but as the native arctic catchfly, *Silene involucrata* (previously known as *Melandrium affine* per Hultén (1968)). A collection of this species will be sent to the AKNHP for final determination. This is the first time this native species has been observed, documented, and reported in the park.

### **Harding Icefield Trail**

The HIT climbs approximately 3,000 ft in 4.1 miles along the north side of Exit Glacier. The trail begins in cottonwood bottomlands and passes through alders, shrubs and alpine meadows before ending on a rocky outcrop overlooking the Harding Icefield. Although the HIT does not receive as much hiker use as the lower trails in the Exit Glacier area, it is a popular destination for locals and visitors.

KEFJ EPMT monitored the HIT for invasive plants weekly throughout the summer. A few scattered common dandelions grow along the trail and are pulled when seen. The largest patch of the common dandelions on the HIT is located on a steep slope at the junction between a rerouted section of the trail that was opened in 2009 and the old section of the trail. This patch has been monitored and controlled each year and appears to be decreasing in percent cover. Although not accessed by visitors, the old section of trail is still monitored for invasive species. Common plantain is also found scattered along the HIT and is mapped and pulled each season.

2010 marks the first year that annual bluegrass was inventoried and pulled along the HIT (fig. 9). During the past few years this species was observed slowly invading the trails in the Exit Glacier area and encroaching along the first mile of the HIT where it started forming dense mats in sections along the sides of the trail (Kurtz 2009). Annual bluegrass may be a dominating pioneer species capable of limiting colonization of native species by reducing native seed germination and survival (Bergelson 1990). Its ability to persist on sites kept open by trampling, such as trails, makes it likely that it will not be outcompeted by native species along the HIT (Hutchinson and Seymour 1982). With the help of a SAGA crew, 95-100% of the annual bluegrass along the HIT (weighing in at 969 pounds) was pulled in early August. Efforts were focused to push the infestation to lower elevations to keep the species from spreading beyond the first third of the trail. In September 2010, annual bluegrass was observed growing along the sides of the trail sporadically and in lower densities. One more week of intense pulling in 2011 should reduce this infestation to a density and area that will be more manageable for the core KEFJ EPMT in future seasons.



**Figure 9.** The SAGA crew pulling annual bluegrass on the HIT.

### ***Nike Stripe***

A patch of common dandelions in a backcountry location north of Exit Glacier Road, locally referred to as the Nike Stripe, has been monitored since it was first discovered in 2002 (Bryden 2002). KEFJ EPMT monitored and pulled common dandelions in early June with the assistance of a SAGA crew, resulting in the control of 95-100% of this infestation. Although the core infestation continues to decline in size and density, scattered individual common dandelions were observed, mapped, and pulled along game trails en route to the primary infestation.

### ***Outwash Plain***

In 2002, a small infestation of common dandelion was reported on the outwash plain on the south side of Exit Creek (Bryden 2002). The infestation was first inventoried and controlled following the Alaska EPMT protocol in 2006 (Weatherbee 2006). The site was monitored and controlled three separate days in 2007 when it was discovered that the common dandelion infestation was larger and more widespread than previously recorded (Weatherbee 2007). In 2008, it was determined, again, to be larger when KEFJ EPMT monitored and discovered the infestation extended farther east than previous mapping efforts indicated (Kurtz 2008). Environmental conditions challenged access to the infestation in 2009, allowing some mapping and controlling to be performed, but not the extensive surveying that had been planned (Kurtz 2009).

In 2010, priority was given to thoroughly map the outwash plain for a complete understanding of the extent of the infestation in order to proceed with planning. In a typical summer the south side

of the outwash plain is difficult to access due to high water levels in Exit Creek. It is often only possible to ford the creek in June and early July and requires using hip waders, crossing at heavily braided sections closer to Exit Glacier, and selecting cloudy, cool days when meltwater is minimal. Even these conditions can make the creek-fording an exciting event.

In early June, the KEFJ EPMT and the SAGA crew spent two full days surveying, monitoring and mapping the outwash plain. Since priority was spent on mapping, very little time was spent digging dandelions, but it is believed that full mapping of the infestation was achieved. It may be desirable to map the area extending south of the outwash plain into Paradise Valley to determine if dandelions are spreading along game trails in that area. Based on mapping efforts this season, it is believed that the southern extent of this infestation has been determined.

The outwash plain should be a priority for control efforts since it is an isolated infestation and there is potential for dispersal into more remote backcountry locations. Accessing the outwash plain across Exit Creek will always be an issue. It is typical that, within a single day, the time and efforts directed at getting to the infestation of common dandelions on the outwash plain outweigh the time available to control this species. If manual control is to be continued in this area, KEFJ EPMT should consider establishing a spike camp on the outwash plain to reduce the travel time and efforts required to access the site. If this is not a possibility, alternative control methods should be considered to control and or eradicate this infestation.

### **Maintenance Yard**

The KEFJ maintenance yard is located outside of the park boundaries, closer to the Seward Highway and the City of Seward. The proximity to these areas which host a greater diversity of invasive species increases the potential for new introductions at the maintenance yard. It is necessary to routinely monitor the maintenance yard to employ EDRR strategies to eliminate new species that may appear, and to prevent them from being spread by maintenance tools, vehicles, and equipment into other areas of the park.

Common plantain and common dandelion have been documented and controlled in the maintenance yard since 2007 (Wetherbee 2007). In 2008, control efforts in the maintenance yard were prioritized and volunteer crews were employed to assist with control, resulting in a decrease in the density of invasive plant species in 2009 (Kurtz 2009). Invasive plant infestations have + decreased and were much sparser in 2010, allowing KEFJ EPMT to spend minimal time mapping and controlling in this area.

### **New Survey Sites**

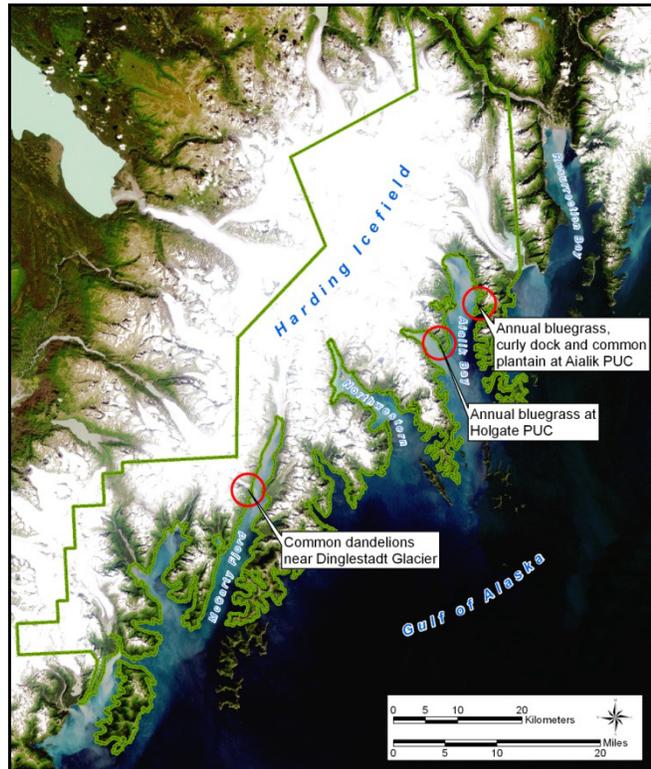
Two new sites were surveyed in the Exit Glacier area in 2010. KEFJ staff walked from the parking lot north and looped around to come out on the road at the campground entrance. This area was chosen because of its proximity to the parking lot, road and Nike Stripe areas which all host common dandelions. It was hypothesized that this area could have dandelion seeds spread into it along game trails. Results of the survey indicate that this location is thick with a healthy, undisturbed forest understory dominated by devil's club (*Oplopanax horridus*) and several fern species. No invasive plants were found. The second new area surveyed was a natural clearing that has been slow to revegetate since Exit Glacier retreated located in the middle of the Main Trail and Nature Trail. Despite abundant moose sign including tracks and scat and a habitat very

similar to that on the south side of Exit Glacier Creek and at the Nike Stripe, no invasive plants were found.

### Coastal Areas

Invasive plant management in KEFJ coastal areas varies from year to year depending on available resources. In 2010, EPMT staff visited twenty locations on the outer coast. Sites that were previously determined to have invasive plant infestations were monitored and initial surveys were conducted when possible.

The outer coast of KEFJ has been monitored for invasive plants by EPMT since 2006 (Wetherbee 2006). Prior to 2006, invasive plant observations were documented during other plant surveys conducted in the park (Carlson et al. 2004). Invasive plants documented on the outer coast to date include: red top agrostis (*Agrostis gigantea*) in Paguna Arm of Two Arm Bay, annual bluegrass at Holgate PUC in Aialik Bay, and mouse-ear chickweed in James Lagoon in McCarty Fjord (Carlson et al. 2004); common dandelion near Dinglestadt Glacier in McCarty Fjord (Wetherbee 2006); and annual bluegrass at the Aialik PUC in Aialik Bay (Kurtz 2009). Common plantain and curly dock were observed, mapped and pulled at Aialik PUC in 2010 (fig. 10).



**Figure 10.** Exotic plant species locations on the KEFJ coast in 2010.

KEFJ EPMT returned to Paguna Arm of Two Arm Bay to locate and remove the red top agrostis that was documented in the 2004 vascular plant inventory. Samples of what was thought to be this species were collected and sent to the AKNHP for identification. The samples turned out to be the native Norcoast Bering hairgrass (*Deschampsia beringensis*). This is the second year in a row the red top agrostis was not located. It is possible that this species no longer exists at this location. Since this species was documented, EPMT crews working in the area, should continue to search for it at 59 41.598’N, 150 08.05’W, 30 m elevation, growing on the edge of large boulder talus (AKNHP, M.L. Carlson, personal communication, 27 April 2010).

In 2003, the KEFJ vascular plant inventory identified the invasive mouse-ear chickweed in James Lagoon within McCarty Fjord (Carlson et al. 2004). In 2009, KEFJ EPMT staff returned to this site to map and remove the mouse-ear chickweed but were unable to locate it. In 2010, KEFJ EPMT contacted the authors of the inventory for more information on this observation and learned that the voucher specimen that was collected at the site had been later determined to be a small but native Fischer’s chickweed (*Cerastium fischerianum*). As a result, the observation of

mouse-ear chickweed in James Lagoon should be removed from all vascular and/or invasive plant lists for KEFJ.

In 2006, a small infestation of common dandelion was discovered and controlled on a small hill south of the terminus of Dinglestadt Glacier in McCarty Fjord (Wetherbee 2006). This site has been monitored and controlled every year since its discovery. In 2010 several new infestations of common dandelions were discovered, mapped, and controlled between the existing site and the beach. It appears that the infestations are consistently found in the clearings and rock outcroppings in this area. The EPMT should continue control efforts to prevent common dandelions from spreading.

In 2004, annual bluegrass was documented growing along the trail to the PUC in Holgate Arm of Aialik Bay (Carlson et al. 2004). KEFJ EPMT revisited this site in 2009 and mapped and pulled most of the infestation (Kurtz 2009). The infestation had not spread beyond the disturbed areas at the cabin. In 2010, the density and area of annual bluegrass at the Holgate PUC was greatly reduced and much less time was required to pull the remaining annual bluegrass. KEFJ EPMT should continue to monitor this site annually and immediately control any invasive plants that appear.

In 2009, KEFJ EPMT staff discovered annual bluegrass at the Aialik PUC. Most of this infestation was mapped and pulled, but time constraints forced staff to leave the densest patch located immediately in front of the cabin (Kurtz 2009). In 2010, KEFJ EPMT monitored and pulled all of the annual bluegrass at Aialik PUC as well as a few common plantain plants and curly dock plants that had not been observed there in previous years (fig. 11). Similar to the findings at the Holgate PUC, the areas along the trail where annual bluegrass had been removed in 2009 had a lower density and required less effort to remove than the patch that had not been controlled in 2009. Both the Holgate and Aialik PUCs should be revisited and treated annually to eradicate this nonnative annual grass and to implement EDRR on any new species that may be introduced.



**Figure 11.** Annual bluegrass at Aialik PUC: (left to right) before and after pulling.

In 2010, KEFJ EPMT monitored for invasive plant species in Nuka Bay at the head of Beauty Bay. A small patch of non-native common timothy that was located and pulled in 2007 and thought to be eradicated in 2009 was relocated and pulled on the south end of an abandoned airstrip associated with past mining operations. KEFJ EPMT will continue to revisit this site each season until all plants have been removed.

KEFJ EPMT surveys were conducted in Palisades Lagoon, Surprise Bay. This area is the site of previous mining activities and includes disturbed areas such as abandoned cabin sites, overgrown roads and trails, and mining tailings. A small, confined patch of self-heal (*Prunella vulgaris*) was identified near the main cabin site (fig. 12). Although this species is described by Hultén as being non-native to Alaska (1968), it is currently being discussed as a possible circumpolar species amongst natural resource managers and academic circles (NPS, B. Million, Alaska EPMT Liaison, personal communication, 24 August 2010). KEFJ EPMT should monitor this infestation and pull flowers to prevent its spread until a final determination has been made on the native status of this species.



**Figure 12.** A small patch of self-heal near the Kinney Mine.

In 2010, non-EPMT park staff reported a infestation of common dandelions along a stream at the head of Yalik Bay. KEFJ EPMT had the opportunity to survey this area later in the season and determined that the dandelions there were not the non-native species. Based on the large horns on the outer edge of the involucrel bracts, this species is likely to be the native horned dandelion (*Taraxacum ceratophorum*). Opportunistic reports of invasive plants are important for successful invasive plant management programs, even when the final determination is a native species.

### **Beyond Kenai Fjords National Park**

In 2007, 64 invasive plant species were recorded on the Kenai Peninsula road system (Arhangelsky 2007). In an effort to assist other natural resource managers including the USFS Chugach National Forest and AACD with invasive plant management, KEFJ EPMT coordinated and assisted with weed pulls outside KEFJ boundaries along Exit Glacier Road. Every year in coordination with Alaska Invasive Weed Awareness Week, KEFJ EPMT partners with the USFS Chugach National Forest, RBCA, and the Alaska SeaLife Center to target invasive plants just outside KEFJ boundaries. This effort allows KEFJ EPMT staff to understand and assist with local invasive plant management outside the park, strengthen bonds with local agencies and organizations, and work toward the prevention of new introductions into the park. At the end of the field season, KEFJ EPMT also participated in a weed pull to remove fall dandelion from the side of Exit Glacier Road near the Seward Highway.

In 2009, U.S. Congress passed ARRA, providing 1.1 million dollars to the USFS for mitigation of invasive plant species in Alaska. The USFS transferred these funds to the AACD, a non-profit organization with a history of invasive plant management in Alaska, to oversee the invasive plant

work (Kain, 2010). With these funds, a full-time invasive plant coordinator position dedicated to education and mitigation of invasive plants was developed in Seward. In 2010, this coordinator worked on invasive plant issues along the roads and trails from Seward north to Girdwood, documenting and controlling invasive plants including white sweetclover, bird vetch, and fall dandelion along Exit Glacier Road. In addition, the ARRA money was used to fund a Kenai Peninsula CWMA youth crew who assisted the Seward invasive plant coordinator in control efforts around the Seward community.



## Discussion

KEFJ is in a unique position to prevent large scale infestations of invasive plant species. Throughout its seven year history, the greatest number of resources and efforts of the KEFJ EPMT program has been control of the common dandelion, the most abundant and widely distributed invasive species in the park. Efforts to control, reduce and, eventually, eradicate this species are important because common dandelion can readily colonize disturbed areas and obtain peak vegetative dominance within two to three years of establishment (Auchmoody and Walters 1988). In western Montana, common dandelion has been observed invading partially disturbed and undisturbed native communities in montane forest and alpine zones (Weaver et al. 1990) and competing with conifer seedlings (Esser 1993). In a location like KEFJ where glaciers are actively retreating and new ground is annually exposed, it is important to maintain ecological integrity by allowing natural vegetative succession to occur without interference from invasive plants.

In addition to common dandelion, any and all invasive plants known to exist in KEFJ are controlled. The higher the invasiveness ranking (Carlson et al. 2008), the more carefully the species is surveyed for, mapped and removed.

Although KEFJ's ten current invasive plant species are all ranked below 70 on the AKNHP's Invasiveness Ranking System for Non-Native Plants of Alaska (Carlson et al. 2008), the park is surrounded by more invasive and aggressive non-native plant species. White sweetclover, bird vetch, and oxeye daisy are found just a few miles away on Exit Glacier Road (Kurtz 2009). Less than 100 miles away, orange hawkweed (*Hieracium aurantiacum*) and reed canary grass (*Phalaris arundinacea*) are found near Girdwood and Canada thistle (*Cirsium arvense*) grows near Portage (Arhangelsky 2007). Keeping these species out of KEFJ is critical in maintaining the health of KEFJ's ecosystems and floral diversity.



## Future Efforts and Recommendations

Invasive plant management in KEFJ will continue to expand as new species will inevitably arrive. Although prevention of new species introductions is best, EDRR strategies can prevent the establishment and spread of any new introductions that occur. Persistent monitoring and control of existing invasive plant infestations is reducing the density and area of these species in KEFJ and should be continued. Increased surveys of coastal areas are necessary for EDRR to maintain these areas free of invasive plants. Inactive mine closures on the coast should also be monitored as NPS employees working in these areas could inadvertently introduce invasive plants. Mine visits in 2010 included Glass-Heifner Mine in Beauty Bay, Waterfield and Sunny Fox Mines in Surprise Bay, and the Rosness Larson Mine in North Arm. Prospecting in the upper parts of Taroka and Paguna Arms could also lead to introductions of invasive plant species.

Currently, KEFJ disposes of its invasive plants by double-bagging them in plastic garbage bags and depositing them at the landfill where they are transported to a larger landfill in Soldotna. KEFJ EPMT should work collaboratively with other natural resource management agencies to more properly dispose of invasive plants to prevent the possibility of seed dispersal.

Community outreach and education efforts should be increased to encourage local residents to participate in invasive plant management and take responsibility for the species growing in their own lawns and gardens. KEFJ should continue partnerships with local agencies and organizations for combined efforts in these tasks. SCA interns could also be a good resource for educating and engaging the community.

The KEFJ coastal areas are rich with archeological evidence of the Alutiiq Pacific Eskimo who historically inhabited the Kenai coast. Today, the preservation of these archaeological sites is an important goal of the KEFJ cultural resource program. In 2010, KEFJ continued to implement cultural compliance for all undertakings in order to protect the park's cultural resources (Appendix A). In regards to these standards, all invasive plant removal practices that disturb the ground in the coastal areas of KEFJ must be cleared with the park's cultural resource specialist prior to removal to prevent damage or disturbance to these sites. Cultural compliance standards are less stringent in the Exit Glacier area of the park. Within the Exit Glacier Area Plan and General Management Plan Amendment, soil disturbance is permitted and invasive plants may be removed using hand tools.



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## Appendix A. Cultural Compliance Protocols for Discoveries of Non-native Plant Species: Kenai Fjords National Park - Summer 2010

The removal of non-native plant species poses a potential threat to the park's cultural resources. The continued presence of non-native plant species, absent removal, also poses a threat to the park's cultural resources. If non-native plants are encountered in the field during summer 2010, the following protocols are to be employed.

On the Coast:

- Record all non-native specimens found on the coast (document species using EPMT protocol, take photographs of the plant species, as well as the larger surrounding area so the exact location of the plant can be verified in the office).
- Before conducting any removal efforts, attempt to report each non-native plant finding and applicable data to the Cultural Resource Program Manager.
  - A satellite phone should be taken in the field at all times to initiate this consultation.
  - The Cultural Resource Program Manager will determine if the specimen is in an area previously surveyed for archeological resources.
- If the plant is found within one of the following areas, the identified action is allowed without consulting the Cultural Resource Program Manager. Standard EPMT documentation is still required and will be reviewed by the Cultural Resource Program Manager in the end-of-year report.
  - **Holgate Pubic Use Cabin: No potential to affect historic properties.** Non-native grasses with surface and shallow root systems (<2") may be skimmed off the surface using trowels. Other forms of ground disturbance require consultation with the Cultural Resource Program Manager.
  - **Glass & Heifner airstrip: No potential to affect historic properties.** Hand tools may be used.
  - **Fuel Cache, McCarty Fjord: No potential to affect historic properties. Hand tools may be used.**
  - **Pedersen Lagoon: No potential to affect historic properties.** Hand tools may be used.
  - **Bear Glacier: No potential to affect historic properties.** Hand tools may be used.
  - **Dinglestadt knob: No potential to affect historic properties.** Hand tools may be used.
  - **Taroka Arm: No potential to affect historic properties.** Hand tools may be used in camping area.

- **James Lagoon:** pending archeological survey, contact Cultural Resource Program Manager.
- **Aialik Public Use Cabin: No potential to affect historic properties.** Hand tools may be used in front of cabin and along trail.
- **In glacial outwash plain:** the plant may be removed with hand tools.
- If the site has not been surveyed or is in an area where archeological sites are known to be present, and the Cultural Resource Program Manager is unavailable for consultation, do not disturb the soil or objects on the ground. All above-ground non-native plant materials may be removed using scissors or knife, including flowers and seed pods.

At Exit Glacier:

- If the site is within the area covered by the Exit Glacier Area Plan and General Management Plan Amendment, soil disturbance is permitted and the plant may be removed using hand tools. There is no need to report this data beyond standard EPMT protocols.

Definitions:

- Ground disturbance - includes any activity which mechanically moves soil, rocks, or other materials; such as pulling plant root materials from the soil, moving rocks, using trowels or shovels, or inserting items into the soil.

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