



Invasive Plant Management in Kenai Fjords National Park

2016 Summary Report

Natural Resource Report NPS/KEFJ/NRR—2016/1351





ON THIS PAGE

Photograph of Kenai Fjords National Park Exotic Plant Management Team mapping and hand-pulling invasive plants.
Photograph by Christina Kriedeman.

ON THE COVER

Clockwise from top: Photograph of Kenai Fjords National Park Exotic Plant Management Team and Student Conservation Association crew posing with bags of hand-pulled invasive plants; Exotic Plant Management Team surveying remote coastal location for invasive plants; NPS staff collecting native grass seeds for restoration efforts.
Photographs by Christina Kriedeman and Renee Sniegocki.

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Abstract

Since 2004, the Kenai Fjords National Park Exotic Plant Management Team (KEFJ EPMT) has worked to monitor and control invasive plants on park lands. The 2016 KEFJ EPMT successfully surveyed 23.65 acres and treated 2.27 acres using both manual and chemical control methods. The team applied 66.95 gallons of herbicide solution containing 13.39 ounces of Milestone to 2.23 acres and manually treated an additional 0.043 acres. A total of 16 invasive plant species were documented within the park boundary and on NPS owned properties. Invasive plant management is generally split into 3 areas: the Exit Glacier area, the coast, and park properties in the Seward area. Though the Exit Glacier region of the park was the main focus of treatment efforts (figure 1), the team also worked extensively in the coastal areas – surveying 24 coastal sites and treating 8 infestations there. In the Seward area, the Maintenance Facility was the primary focus of control efforts. In the park, several new sites were surveyed for invasive plants; and 3 previously undiscovered populations of invasive plants were found and treated. A survey for Elodea (*Elodea spp.*), an aquatic invasive plant, was conducted on Delight Lake – a lake categorized as potentially high risk to infestation due to float plane access there. Both a visual survey and environmental DNA (eDNA) survey were conducted to sample for Elodea. No Elodea was found in the surface inventory and samples collected for the eDNA survey were sent to a lab for processing. Future KEFJ EPMT staff should continue monitoring and controlling known infestations and surveying for new infestations, focusing particularly on the eradication of high priority invasive species and infestations located outside of developed areas.



Figure 1. NPS staff crossing Exit Glacier Outwash Plain.

Acknowledgments

The Kenai Fjords National Park Exotic Plant Management Team would like to thank all of those who contributed their time and energy to making the 2016 season a success: Student Conservation Association Intern Valeria Briones; Youth Conservation Corps members Brendan McMurry and Karl Pfeiffenberger; NPS employees Chris Overbaugh, Peter Frank, Sharon Kim, Aaron Vachowski, Trey Simmons, Katja Mocnik, Mark Kansteiner, Ian Whittle, Nathaniel Charboneaux, and Amy Miller; and volunteer Carol Griswald. Thank you also to the Student Conservation Association trail crew.

List of Terms Acronyms

ABRS Aialik Bay Ranger Station

AKEPIC Alaska Exotic Plants Information Clearinghouse

ANILCA Alaska National Interest Lands Conservation Act

DNR Department of Natural Resources

EPMT Exotic Plant Management Team

GIS Geospatial Information System

GPS Global Positioning System

HIT Harding Icefield Trail

KEFJ Kenai Fjords National Park

KP-CWMA Kenai Peninsula Cooperative Weed Management Area

M/V Motor Vessel

NISIMS National Park Service's National Invasive Species Information Management System

NPS National Park Service

PUC Public Use Cabin

SCA Student Conservation Association

SNOTEL Snowpack Telemetry

SWAN Southwest Alaska Network

YCC Youth Conservation Corps

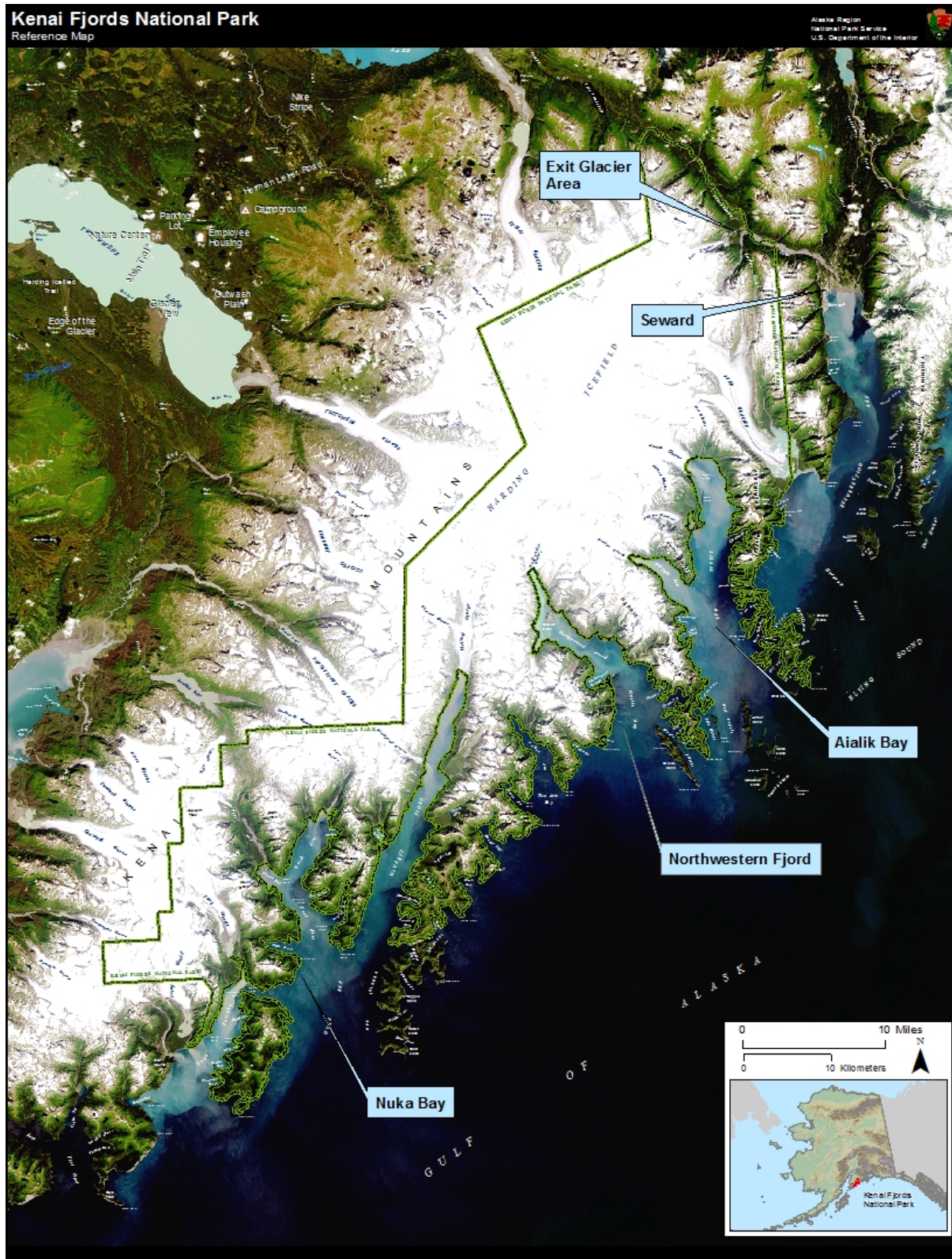
Introduction

Established in 1980 by the Alaska National Interest Lands Conservation Act (ANILCA), Kenai Fjords National Park (KEFJ) is a 669,983 acre park made up of unique fjord and rainforest ecosystems and an expansive icefield. The Harding Icefield covers about 51% of the total land area and feeds 38 outflowing glaciers on Alaska's Kenai Peninsula (figure 2).

The Alaska Exotic Plant Management Team (EPMT) began inventorying and controlling invasive plants in KEFJ in 2004, following protocols established at the regional level. Since 2004, the EPMT program has expanded, increased their staffing, and created a more comprehensive method of invasive plant control. The Kenai Fjords Exotic Plant Management Team (KEFJ EPMT) focuses on an early detection and rapid response strategy to manage new infestations, and containing and eradicating existing populations. Advances in GPS mapping methods have improved the EPMT's ability to accurately document new infestations and monitor the successes of control efforts.

Visitor use within the park can be divided into two main areas: the Exit Glacier area and the coastal fjords. The Exit Glacier area, located near the town of Seward, AK, is the most highly visited area in the park. Between the months of June and September 2016, this area of the park received approximately 156,336 visitors. The Exit Glacier area is the only part of the park that can be accessed by road and also contains the only maintained trail system in the park. The Seward Highway, which connects Anchorage to Seward, acts as a vector for the spread of invasive plants. Both this link to the Seward Highway and the high visitation to Exit Glacier have led to the introduction of multiple invasive plant species to this area and have made invasive plant management an ongoing challenge for the KEFJ EPMT. Because of its close proximity to the town of Seward, the Exit Glacier area is relatively easy to access and is the main focus of invasive plant management each season.

The park's coastal areas which are only accessible by boat or plane, receive relatively low visitation. The difficulty and expense of accessing these areas limits the number of visitors, park staff, and researchers who get to actually set foot in these coastal areas. Most visitors to the coast do so in tour boats and never actually set foot on the coast. Lower visitor use in coastal areas reduces the chances of new invasive plant infestations in these pristine areas. Typically, new infestations are found in areas of higher use such as campsites and public use cabins (PUCs). Occasionally, infestations are found in unlikely and remote areas with little visitor use or impacts. These coastal infestations, though difficult to reach, are a major concern for the KEFJ EPMT. Continued monitoring and control are vital to keeping these coastal areas pristine and their native plant communities healthy.



Methods

The 2016 KEFJ EPMT conducted all fieldwork between May 17th and September 1st and followed the protocols set out by the Alaska Exotic Plant Management Team 2016 Field Protocol (Million et al. 2016). Management strategies for the season included returning to and controlling all documented invasive plant populations, surveying new areas to look for potential infestations, preventing the introduction of new invasive species, and restoring native plant communities. All known infestations were relocated using legacy data.

Historical data and recommendations from previous seasons were used for planning the 2016 season. The goal was to control all known populations of invasive plants, but site control work was prioritized using a number of factors including: plant phenology, plant invasiveness ranking, site location, site accessibility, population size, weather and staffing. Small disjunct populations and populations located in undeveloped backcountry areas were high priority. Plants with a high invasiveness ranking were targeted before lower ranked species. Invasiveness ranking is assigned to each plant species based on 4 factors: ecological impacts, biological characteristics and dispersal ability, distribution, and feasibility of control (Carlson et al. 2008). The scale is between 1 and 100; the higher the number, the higher the invasiveness of a plant species. Control efforts in the frontcountry were prioritized by treating the least developed areas along trails to the most developed areas around the Nature Center and parking lot. Site specific factors, including elevation, slope, and aspect, also affected the maturation of plant species at specific sites and were considered when prioritizing sites.

Below average amounts of snowfall at lower elevations during the winter of 2015/2016 caused a shift in plant phenology. With no snow on the ground in May, invasive plants reached maturation earlier in the season. The KEFJ EPMT typically does not start control efforts until after spring training in early June when there is typically some snow on the ground. Control efforts were pushed forward at least two weeks, which made it difficult to control early bloomers like common dandelion (*Taraxacum officinale*) before they went to seed. More time was spent pulling flower heads off plants to prevent them from going to seed before they could be controlled. Herbicide applications that typically begin in mid-June began at the end of May to accommodate this phenology shift this year.

Table 1. Comparison of monthly snow depth at Exit Glacier between the last 15 year average and the winter of 2015/2016. (NRCS SNOTEL Update Report downloaded on 9/15/2016.)

	December	January	February	March	April	May
2015-2016 snow depth in inches	13.3	15.4	18.7	30.6	29.9	0
Average snow depth in inches of the previous 15 years	14.55	27.18	36.92	49.12	53.73	33.50

Work sites are split into 3 general areas of the park: the Exit Glacier area, coastal areas, and the city of Seward.

Table 2. 2016 Project areas.

Areas	Field Sites
Exit Glacier	Herman Leirer Road, Campground, Employee Housing, Exit Glacier Parking Lot, Nature Center Plaza, Main Trail, Trail to the Glacier View, Trail to the Edge of the Glacier, Harding Icefield Trail, SNOTEL, Nike Stripe, Outwash Plain
Coastal	Nuka Bay, McCarty Fjord, Northwestern Fjord, Aialik Bay, Resurrection Bay
Seward	Maintenance Facility, Visitor Center, Park Headquarters Building, Shea Parking Lot

Control Methods

Manual Treatment

Manual treatment of invasive plants involved the physical removal of invasive plant material by digging, hand-pulling, or flower head removal (figure 3). Some species of invasive plants had root structures that were easily removed by hand-pulling, while others required the use of digging tools. Flower heads were removed in areas where manual or chemical control was not immediately possible to prevent the plants from going to seed. All plant material collected was bagged and discarded at the Seward Transfer Facility and eventually transported to the Central Peninsula landfill in Soldotna, AK.



Figure 3. SCA Intern hand-pulling invasive plants.

Chemical Treatment

Sites were chosen for chemical treatment using the integrated pest management decision tree found in the Alaska Region Invasive Plant Management Plan (NPS 2010). The chemical used was Milestone, a broadleaf herbicide which is applied directly to the foliage. The active ingredient of this herbicide is aminopyralid. The herbicide spray solution consisted of 6 ml of Milestone concentrate

per one gallon of water and blue marker dye at the recommended concentration. All herbicide applicators were certified Pesticide Applicators through the Alaska Department of Environmental Conservation.

Infestations were spot sprayed using a calibrated backpack sprayer. Several small infestations were spot sprayed using a hand-held sprayer.

Data Collection and Analysis

All invasive plant populations surveyed and treated in 2016 were mapped using Trimble Geo7X and a Trimble GeoXT 6000 Series GPS units (figure 4) with a customized data dictionary following the 2016 Alaska EPMT field protocol (Million et al. 2016). The data dictionary included a variety of attributes such as: species found, disturbance type, percent cover, phenology, stem count, control effort (i.e. manual, chemical, inventory), and control person hours.



Figure 4. NPS staff using GPS to locate invasive plant infestations.

Area calculations for manual treatments represent the total area treated multiplied by the percent cover of invasive plants. Area calculations for chemical treatment represent the amount of total chemical applied divided by the calibrated herbicide application rate.

All geospatial data was transferred, corrected, and edited using Pathfinder Office software and then sent to the Alaska Regional EPMT data manager to be converted into Geospatial Information System (GIS) data. This data will be included in two databases: the National Park Service's National Invasive Species Information Management System (NISIMS) and the Alaska Center for Conservation Science's (formerly the Alaska Natural Heritage Program) Alaska Exotic Plants Information Clearinghouse (AKEPIC).

Personnel

There were 5 full-time EPMT crewmembers during the 2016 field season. The members were National Park Service (NPS) GS-06 Biological Science Technician Renee Sniegocki, Student Conservation Association (SCA) Intern Valeria Briones, and two Youth Conservation Corp (YCC) members Brendan McMurry and Karl Pfeiffenberger. The team was supervised by KEFJ Environmental Protection Specialist Christina Kriedeman, who led herbicide spraying operations, assisted in field work, completed all planning and compliance work, and supported daily operations of the crew. Alaska Region EPMT Liaison Chris Overbaugh led EPMT spring training efforts for the Alaska region, assisted with herbicide application at KEFJ, and provided technical assistance throughout the season. EPMT Biological Science Technician and Data Manager Peter Frank of Wrangell St. Elias National Park co-led the EPMT spring training for the Alaska region and provided technical assistance and data management throughout the season. A visiting 6-person SCA crew worked full time with the EPMT from August 1st through August 5th.

Results

2016 Season Overview

The goals of the 2016 season were to return to and control all documented invasive plant populations, survey new areas to look for potential infestations, look for the presence of the aquatic invasive Elodea (*Elodea spp.*) in Delight Lake, do invasive plant education and outreach, continue invasive plant prevention efforts, and participate in the Alaska Division of Agriculture's gypsy moth monitoring program. The 2016 KEFJ EPMT successfully revisited all known invasive plant sites. Each of these sites, with the exception of the infestation south of Dinglestad Glacier in McCarty Fjord which was only partially treated, was controlled and mapped. Several new areas were surveyed for invasive plants, and 3 new populations were found: a population of common chickweed (*Stellaria media*) was discovered in the Exit Glacier area, one population of annual bluegrass (*Poa annua*) was found in Northwestern Fjord, and a population of common dandelion growing on a nunatak was discovered in Nuka Bay. A common dandelion infestation at the Head of Beauty Bay in the Nuka Bay area was scheduled for chemical treatment but was manually treated instead due to rainy conditions. A total of 0.043 acres were manually controlled throughout the season. Herbicide was applied to eight different sites: 6 sites in the Exit Glacier area, one coastal site, and in the Maintenance Facility. In total, three NPS staff applied 66.95 gallons of herbicide solution containing 13.39 ounces of Milestone to 2.232 acres.

Table 3. Summary of Kenai Fjords National Park Invasive Plant Work in 2016.

Invasive Plant GPS Data NPS Lands (non-NPS Lands)			
Year	Species Acres Surveyed ¹	Species Acres Infested ²	Acres Treated ³
2016	23.65 (2.88)	2.63 (0.001)	2.63 (0.001)

The January 2015 NPS Land Status geodatabase was used to delineate NPS lands in acreage calculations.

¹Acres surveyed represent the total area mapped.

² Acres infested represent the area of a mapped infestation multiplied by the percent cover of invasive plants in that mapped area.

³ Acres treated represent the area of a mapped infestation multiplied by the percent cover of invasive plants in that mapped area and by the percent of the infestation treated.

Both visual and eDNA surveys for Elodea were completed at Delight Lake in McCarty Fjord. No Elodea was found in the visual survey and the eDNA samples were sent in for lab analysis. The KEFJ EPMT led three separate outreach and education events for park staff and volunteers and created two social media post highlighting invasive plant management efforts in the park. Gypsy moth traps were installed and maintained but no gypsy moths were detected in 2016.

Table 4. Invasive plant species and locations

Species		AKNHP Ranking	Location			
Latin Name	Common Name		Exit Glacier	Coast	Shea Lot*	Maintenance
<i>Alopecurus pratensis</i>	meadow foxtail	52	X			
<i>Bromus inermis</i>	smooth brome	62	X			
<i>Capsella bursa-pastoris</i>	shepherd's purse	40	H		X	X
<i>Cerastium fontanum</i>	big chickweed	36	H			
<i>Crepis tectorum</i>	narrowleaf hawksbeard	56	H			
<i>Elymus repens</i>	quackgrass	59			X	
<i>Galeopsis spp.</i>	hemp nettle	50			X	
<i>Hordeum jubatum</i>	foxtail barley	63	H			
<i>Leucanthemum vulgare</i>	oxeye daisy	61	H		X	
<i>Linaria vulgaris</i>	yellow toadflax	69	H			
<i>Matricaria discoidea</i>	pineapple weed	32	X	X	X	X
<i>Papaver croceum</i>	Icelandic poppy	39	H			
<i>Phleum pratense</i>	common timothy	54	X	X	X	
<i>Plantago major</i>	common plantain	44	X	H	X	X
<i>Poa annua</i>	annual bluegrass	46	X	X	X	X
<i>Poa Pratensis</i>	Kentucky bluegrass	52	H			
<i>Polygonum aviculare</i>	prostrate knotweed	45			X	X
<i>Ranunculus acris</i>	tall buttercup	54	H			
<i>Rumex acetosella</i>	common sheep sorrel	51	X		X	
<i>Rumex crispus</i>	curly dock	48	H	H	X	
<i>Stellaria media</i>	common chickweed	42	X		X	X
<i>Taraxacum officinale</i>	common dandelion	58	X	X	X	X
<i>Trifolium hybridum</i>	alsike clover	57	H			
<i>Trifolium pratense</i>	red clover	53	H			
<i>Trifolium repens</i>	white clover	59	X		X	H

Key: X=Present, H=Historically Present

*List of invasive plants in the Shea lot is not comprehensive.

Exit Glacier Area

The Exit Glacier area is the most heavily visited area of the park and includes the only road and maintained trail system at KEFJ. Both roads and trails are known to be vectors for the movement of invasive plants into natural areas. For this reason and because of its accessibility, the Exit Glacier area is a large focus of invasive plant management in the park.

Herman Leirer Road

Herman Leirer Road is an eight mile road that stretches from its intersection with the Seward Highway to the Exit Glacier parking lot. The first seven miles crosses private land, Chugach National Forest land, and State of Alaska Department of Natural Resources (DNR) land before crossing the park boundary. The margins of this seven mile section are densely infested with a variety of invasive plants including several species not yet found in KEFJ. For this reason, the 1.3-mile section of Herman Leirer Road within the park boundary acts as a major vector for the spread of invasive plants into the park. The KEFJ EPMT focused primarily on the inventory and control of this area during the 2016 season.

Because of a road construction project occurring along approximately .8 miles of the road in 2016, only a portion of the road was treated. Species controlled along the road within KEFJ were: common dandelion, common plantain (*Plantago major*), pineapple weed (*Matricaria discoidea*), and white clover (*Trifolium repens*). Common dandelion is the most abundant invasive species found in the road margins and was treated with herbicide for the second year in 2016. Common dandelion flower heads were removed in May and June as they began to bloom to prevent the maturation and spread of seed. NPS employees applied 27.45 gallons of Milestone solution to 0.92 acres of roadside common dandelion on June 21st and 22nd. Staff members who were not certified to apply herbicide removed common dandelion flower heads prior to herbicide application (figure 5). Removing flowers prevented seeds from maturing on plants that were treated with herbicide. Scattered populations of common plantain and pineapple weed were manually controlled in the road margins as well as one individual white clover plant.



Figure 5. NPS staff applying herbicide to roadside.

In 2015, two small populations of smooth brome were chemically treated with the herbicide AquaMaster which has the active ingredient glyphosate (Stover 2015). In 2016, these populations of smooth brome were not accessible due to an ongoing road construction project on Herman Leirer Road. It is unknown whether these populations were destroyed during road construction and will need to be revisited in 2017. One population of meadow foxtail was located in June but was not treated after roadside mowing operations removed all flower parts and leaves making identification impossible.

KEFJ EPMT staff conducted a vehicular survey along the portion of Herman Leirer Road located on non-NPS lands. Yellow sweet clover (*Melilotus officinalis*), bird vetch (*Vicia cracca*) and oxeye daisy (*Leucanthemum vulgare*), all invasive species not found within KEFJ during the 2016 season, were manually treated.

Exit Glacier Parking Area

The Exit Glacier parking area is located beside the Nature Center in the Exit Glacier area. It includes a large parking lot, several vegetated islands and a mostly wooded perimeter. The initial species of focus in the Exit Glacier parking lot was common dandelion as this species is one of the first to bloom in the spring. The KEFJ EPMT manually treated a variety of other species including: pineapple weed, common plantain, sheep sorrel (*Rumex acetosella*), white clover, and annual bluegrass (figure 6). NPS staff spent over 90 hours manually controlling invasive plants in the parking area. Pineapple weed, common plantain, and annual bluegrass were found scattered throughout the edges and vegetated islands of the parking lot while sheep sorrel was found in two small, distinct sites. One small population was located and manually treated near the bus loading and unloading zone. A second population, last found there in 2012, was rediscovered and retreated in 2016. It was located beside the gravel pullout in the northeast corner of the parking lot just before the bus parking begins. Also growing on this gravel pullout was a small scattered infestation of common chickweed which was hand-pulled. While found in other areas of the park, this is the first time common chickweed has been found in the Exit Glacier area. One population of white clover growing along the road on one of the large vegetated islands on the north side of the parking lot was manually controlled.

Campground

The KEFJ campground is made up of 12 walk-in tent sites, a parking lot, a well-pump, pit toilets, and a food cooking and storage facility. Although the tent sites and trails in the campground are free of invasive plants, the parking lot has a few minor infestations of annual bluegrass, common dandelion, pineapple weed, and common plantain. The annual bluegrass is mostly concentrated on the southwest side of the parking lot while the common dandelion, pineapple weed, and common plantain are scattered. The campground was visited once on July 19th and 52.27 square feet were manually treated.



Figure 6. EPMT and SCA crew hand-pull annual bluegrass.

SNOTEL

The Snowpack Telemetry (SNOTEL) site is situated in a small clearing northeast of the employee housing area. Common dandelion was first discovered there in 2013. In 2015, the KEFJ EPMT chemically treated this site for the first time, treating 45 common dandelions (Stover 2015). In 2016, on May 25th the KEFJ EPMT applied 0.0175 gallons of Milestone solution to 17 common dandelion plants. This site was revisited on July 20th and two common dandelions were manually treated.

Nature Center Plaza and Main Trail

The Nature Center Plaza includes the visitor center and bathroom facilities. The Main Trail is the paved trail segment which begins south of the Nature Center and connects with the Harding Icefield Trail (HIT), the Trail to the Glacier View, and the Trail to the Edge of the Glacier. During the 2016 season, the KEFJ EPMT surveyed the Nature Center and Main Trail area 6 times and manually treated common dandelion, pineapple weed, common plantain, and annual bluegrass (figure 7). The common dandelion, common plantain and pineapple weed were scattered throughout the trail margins, near the pump house, and in front of the Nature Center. Most of the annual bluegrass is found along the trail margins of the Main Trail and near the pump house located behind the Nature Center. Annual bluegrass was also found and pulled along the trail leading from the Main Trail to the warming hut. On August 2nd – 4th a 6 person SCA crew helped to pull 210 pounds of annual bluegrass from the Main Trail and the pump house area. The weight of the annual bluegrass pulled is somewhat exaggerated by the weight of the wet soil which remained on the roots of the plants.

A local community member contacted the park with concerns about the spread of large-leaved avens (*Geum macrophyllum*) along the trails and offered to volunteer to hand pull this plant. It has been spreading along the park's trails into plant communities that it would not normally inhabit. This is a native plant, but the population occurs in unnaturally high levels and in locations that it would not be

located as a result of trail construction. Over several days, 30 hours were spent controlling large-leaved avens along the Main Trail and the lower elevations of the Harding Icefield Trail.



Figure 7. EPMT crew hand-pulling common dandelions along trail.

Trail to the Glacier View

The Trail to the Glacier View is a 0.5 mile loop off of the Main Trail. Annual bluegrass was found in multiple places along the trail. Common dandelion and common plantain was mostly found near the intersection with the Main Trail near the Pavilion. There was also a small population of common dandelion found on the west side of the 1917 moraine in the same area. Common dandelion is the first to bloom in the spring so it was the initial focus, followed by common plantain and annual bluegrass later in the summer. This site was visited 3 times and a total of 8.581 square feet was treated.

Aside from the invasive plant populations found alongside the trail, there was a population of common dandelion found in a large clearing between the Main Trail and the Trail to the Glacier View. This trail can be accessed using a social trail near the east end of the Trail to the Glacier View. This population was chemically treated on May 25th. The KEFJ EPMT applied 0.0225 gallons of Milestone solution to 18 common dandelions. On August 25th the site was revisited and 28 common dandelions were manually treated.

Trail to the Edge of the Glacier

The Trail to the Edge of the Glacier is a 1.2 mile long loop which branches off of the Main Trail and leads to the north side of the terminus of Exit Glacier. Annual bluegrass was found scattered along the trail at lower elevations. There was a medium sized population of common dandelion on both sides of the trail along the northeast side of the loop. This population was treated early in June to prevent seed maturation. Both common plantain and common dandelion were scattered along the trail at lower elevations. The 2016 KEFJ EPMT visited this site 4 times and manually treated a total of 30.231 square feet.

Harding Icefield Trail

The Harding Icefield Trail (HIT) is a steep and strenuous 4.1 mile trail leading to an overlook of the Harding Icefield. The trail winds through cottonwood and alder forest at lower elevations and then climbs to sub-alpine and alpine zones before ending at a large rocky overlook. Most invasive plants were found in the lower elevations but extend into the sub-alpine zone just below tree line (figure 8). The snow at lower elevations generally melts early in the spring, so it was a priority for treatment early in the summer. A few common dandelions and common plantains were found scattered along the trail up to Marmot Meadows at mile 1.4. Dense patches of annual bluegrass were found along the trail margins from the beginning of the trail to the middle of the cliff area about 2 miles up the trail. The 2016 KEFJ EPMT manually treated invasive plants along the HIT four times. A total of 332.798 square feet of annual bluegrass and 5.793 square feet of common dandelion and common plantain were hand-pulled along the trail. A six-person SCA crew worked alongside the KEFJ EPMT for two days to pull 180 pounds of annual bluegrass along the trail on August 1st and 2nd.

One particular population of common dandelion located in an old section of trail about 0.25 miles up the HIT and several others along the HIT nearby were chemically treated using a hand sprayer on May 25th. The KEFJ EPMT applied 0.03875 gallons of Milestone solution along the HIT treating 56.26 square feet.



Figure 8. SCA Crew pulling annual bluegrass along the Harding Icefield Trail.

Nike Stripe

This narrow clearing, locally referred to as the Nike Stripe, is located on the north side of Herman Leirer Road. There are small scattered populations of common dandelion in the Nike Stripe that were manually treated from 2004 to 2011 and chemically treated from 2012 to 2015. On June 16th, 2016 the KEFJ EPMT chemically treated 24 common dandelions located in the Nike Stripe and three

common dandelions located directly southwest of the Nike Stripe. The total treatment of the 27 plants required 0.019 gallons of Milestone solution.

Outwash Plain

The Outwash Plain is a large area of glacial sediment which was left behind by the retreat of Exit Glacier. It is located east of Exit Glacier's terminus. This area is sparsely vegetated, which provides an environment easily colonized by common dandelion likely spread to this area by animals and the wind. Small portions of the common dandelion infestation in the Outwash Plain were manually treated from 2006 to 2010. From 2011 to 2014, much of the site was chemically treated (figure 9). To access the site, the KEFJ EPMT must wade across Exit Creek. The level of this creek can rise rapidly during the spring and summer seasons and cut off safe access to the Outwash Plain, making treatment impossible. During the 2015 season the KEFJ EPMT was only able to access the Outwash Plain once and treated several small outlying populations before the creek rose to an unsafe level for crossing (Stover 2015).



Figure 9. Common dandelion showing effects of herbicide treatment.

During the 2016 season, the KEFJ EPMT was able to cross Exit Creek behind the campground to chemically treat the site for 6 days before the creek became too high to cross safely. Most of the areas treated chemically in previous years were retreated in 2016, as well as an additional population that had not been treated before. Although an extensive portion of previously mapped areas were treated this year, large populations of common dandelion still remain to be mapped and treated in this backcountry area.

In previous seasons, invasive plant populations were remapped each time the site was retreated. This was very time consuming due to the large area and thick brush in many of the sites. Mapped polygons also vary in size and shape from season to season, making it difficult to detect change or see results from chemical treatment. In 2016, standardized polygons were created by digitizing the actual mapped polygons in GIS. These polygons will be used each year until the area of the populations is reduced in size enough to warrant remapping. The efficacy of herbicide use will be determined by calculating the change in amount of herbicide applied to invasive plants each year

within the standardized polygon. Alaska Regional EPMT Liaison and two people from the KEFJ EPMT applied a total of 33.039 gallons of Milestone solution to the seven standardized polygons and outlying areas. The total area treated in this region of the outwash plain was 1.101 acres.

Many of the common dandelions found in the Outwash Plain polygons appeared to have been grazed by an unidentified animal. Signs of snowshoe hare, bear, and mountain goat were found in the area, but it could not be determined which species was consuming the plants.

A separate, small population of common dandelion located on the Outwash Plain, north of Exit Creek and near its confluence with the Resurrection River, was visited on two separate occasions. A total of 146 common dandelions were chemically treated on June 15th using 0.077 gallons of Milestone solution (figure 10). On August 22nd, the KEFJ EPMT returned to monitor the area and inventory a larger area of the Outwash Plain north of Exit Creek. During this inventory the KEFJ EPMT found and manually treated a second small population of common dandelion south of the park road along the small creek which runs along the east end of Herman Leirer Road in the park. Two more small populations of dandelions were discovered on June 3rd when KEFJ EPMT staff were scouting the water level of Exit Creek. They were both located on the north side of Exit Creek along the bank south of the housing area. Both populations were manually treated.



Figure 10. NPS staff applies herbicide in the Outwash Plain.

Employee Housing

The employee housing area is made up of three employee cabins, a pit toilet, a trail builders' camp, a small social trail leading from the Nature Center to employee housing, and a parking lot. On July 22nd, 2016 the KEFJ EPMT controlled several species of invasive plants including: common dandelion, common plantain, pineapple weed, and annual bluegrass. A total of 5 dandelions were manually treated along the social trail leading from the Nature Center to employee housing. Small populations of both common dandelion and pineapple weed were manually treated in front of the Alder Cabin. A few small populations of annual bluegrass and one dandelion were manually treated in the parking lot.

Coastal Areas

KEFJ's coastline, though less frequently visited than the Exit Glacier area, is still subject to occasional invasive plant infestations. The 585 miles of remote coastline are only accessible by boat or floatplane but still receive a substantial amount of visitation, especially in Aialik Bay. Each year, the KEFJ EPMT makes several trips to the coast to retreat known invasive plant infestations and survey for new infestations. In 2016, three trips were made to the coast on the park's M/V Serac: a 4 day trip from June 28th to July 1st to Aialik Bay, a 3 day trip from July 5th to July 7th to Nuka Bay, and a 5 day trip from August 8th to the 12th to Nuka Bay, Northwestern Fjord and Aialik Bay. The 2016 KEFJ EPMT traveled to 24 different coastal sites to inventory and treat invasive plants. Invasive plants were treated at eight sites during these coastal trips: seven previously discovered infestations and one new infestation.

Resurrection Bay

On July 1st, the KEFJ EPMT visited Bulldog Cove to survey for invasive plants. Bulldog cove receives heavy visitation because of its proximity to Seward yet no invasive plants have been found there to date.

Aialik Bay



Figure 11. NPS staff navigating to a known invasive plant infestation.

The KEFJ EPMT spent 3 days, between June 28th and July 1st, surveying for and controlling invasive plants in multiple sites in Aialik Bay: Aialik PUC, the camping beach north of the Aialik Bay Ranger Station (ABRS), the beach at ABRS, the beach west of Aialik Glacier, Bear Cove, Tooth Cove, Abra Cove, Verdant Cove, McMullen Cove, Quicksand Cove, the Holgate PUC beach, Holgate PUC, Kenai Fjords Glacier Lodge kayak landing beach, and the Pederson Lagoon camping easement (figure 11).

The KEFJ EPMT manually controlled annual bluegrass at 4 known sites in Aialik Bay: Aialik PUC, Holgate PUC, Abra Cove, and the Kenai Fjords Glacier Lodge kayak staging area. At Aialik PUC the annual bluegrass was found growing in small patches surrounding the cabin and along the trail leading to the beach. A total of 28.44 square feet was hand-pulled around the Aialik PUC. Similarly at the Holgate PUC, annual bluegrass was in scattered patches around the cabin and on the trail which leads to the privy. A total of 90.21 square feet was hand-pulled around the Holgate PUC. Annual bluegrass was manually controlled in the camping area of Abra Cove in one of the campsites and along a small adjacent social trail. A total of 11.108 square feet was pulled at Abra Cove. This site was revisited on August 11th during another trip to the coast. No annual bluegrass was discovered during this visit.

One infestation of annual bluegrass, located at the Kenai Fjords Glacier Lodge kayak staging area on the beach outside Pederson Lagoon, was revisited and manually controlled. This site is located on a private inholding owned by the Port Graham Corporation and leased to Alaska Wildland Adventures. Although this beach is not on NPS administered lands, the KEFJ EPMT has been granted permission to access this area to control the infestation since its discovery in 2011 (Fulton 2011). Several scattered patches of annual bluegrass were controlled near the kayak storage area and along the dirt two-track road leading from this area to the Kenai Fjords Glacier Lodge. The park leases a small camping easement located next to Pederson Lagoon which includes a small camping area and a bear resistant food storage locker. This area was also surveyed and no invasive plants were found.

Additionally, the KEFJ EMPT surveyed the camping beach north of ABRS, the beach at ABRS, the beach on the west side of Aialik Glacier, Bear Cove, Tooth Cove, Verdant Cove, McMullen Cove, Quicksand Cove, and the Holgate PUC beach but no invasive plants were found.

Northwestern Fjord

On August 10th the KEFJ EPMT surveyed for invasive plants on four beaches in Northwestern Fjord: Sunlight Glacier beach, Southwestern Glacier camping beach, Northeastern Glacier camping beach, and the camping beach on the northeastern side of Northwestern Fjord. Areas of high visitor use such as campsites and bear food storage lockers were the main focus of the invasive plant surveys; however, the beaches were also thoroughly searched. One new infestation of annual bluegrass was discovered at a camping beach on the northeastern side of Northwestern Fjord. The annual bluegrass was mostly concentrated near the bear food storage locker and along an adjacent short trail. A total area of 13.199 square feet was hand-pulled.

Nuka Bay

On July 5th and 6th the KEFT EPMT visited Beauty Bay and the North Arm of Nuka Bay. Common timothy (*Phleum pretense*) was first manually controlled along an abandoned airstrip in Beauty Bay in 2006; and a total of 150 pounds were removed from the site (Wetherbee 2007). Although no common timothy was found in Beauty Bay in 2015 (Stover 2015), 10 stems were found and manually controlled in 2016. These common timothy plants were found growing alongside the native timothy plant known as alpine timothy (*Phleum alpinum*) which often made identification difficult. The KEFJ EPMT was concerned about the possibility of hybridization of the two species. Nine

common dandelions were mapped and manually controlled near the abandoned airstrip in 2016 (figure 12).



Figure 12. NPS staff mapping invasive plants in abandoned airstrip.

The 2016 KEFJ EPMT also revisited and manually treated an infestation of common dandelion on the coastline at the head North Arm. Because of the large number of common dandelions growing at this site, it was a candidate for chemical treatment in 2016. Unfortunately, herbicide application was made impossible by the rainy conditions, so a total of 4.617 square feet were hand-pulled. Additionally, the beach in Pilot Harbor in the North Arm of Nuka Bay was surveyed for invasive plants but none were found.

In late August, the Southwest Alaska Network (SWAN) Inventory and Monitoring staff revisiting vegetation plots at nunataks discovered an unknown population of common dandelion at one of their sites. The site was located east of Petrof Glacier, north of Nuka Passage, (see Appendix A) and accessed by helicopter. There were approximately 50 plants and 10 of the larger plants were hand pulled. None of the plants were in flower. The site was dominated by grasses and there were signs of extensive grazing and trampling by mountain goats (*Oreamnos americanus*). The site was visited previously in 2005 and no common dandelions were seen at that time.

McCarty Fjord

An infestation of common dandelion growing on a rocky cliff just south of Dinglestad Glacier was revisited on July 7th, 2016. This infestation was manually treated from 2006 to 2012 with some success, but because of the large extent and remoteness of the site, chemical treatment was determined to be a more effective option. The site was chemically controlled in 2013 and 2014. In 2015, rain prevented the application of herbicide so all common dandelions were hand pulled. In 2016, 59.68 square feet was treated using 0.041 gallons of Milestone solution. Unfortunately, an injury to another crew's team member necessitated a quick return to Seward and left the common

dandelion population only partially treated. A second site in McCarty Fjord, James Lagoon outer beach, was surveyed for invasive plants on July 6th but none were found.

Seward

Two park properties located in Seward are infested with multiple invasive plant species. The Shea parking lot on 3rd Avenue and the Visitor Center located near the Seward Small Boat Harbor infestations were both manually treated by the KEFJ EPMT and a visiting SCA crew on August 4th and 5th.

The Shea parking lot located downtown is where many of the employees who work in the Park Headquarters Building park both their personal and government vehicles. This parking lot is infested with a number of invasive species. Due to the amount of infestation present in the Shea parking lot, manually treating the entire site would not be feasible. Instead, the crew focused on only a few species in the center and northern end of the parking lot. Species pulled include: hemp nettle (*Gaelopsis spp.*), sheep sorrel, shepherd's purse (*Capsella bursa-pastoris*), and pineapple weed. The parking area was also mowed by the maintenance staff several times in 2016.

The Visitor Center is located near the Seward Small Boat Harbor (figure 13). The building is in an urban area with only a small strip of vegetation around its perimeter and a flower bed near the front steps. Invasive plants manually treated there include sheep sorrel, common plantain, common dandelion, prostrate knotweed (*Polygonum aviculare*), common chickweed, and pineapple weed.

Maintenance Facility

The Maintenance Facility is located on Old Exit Glacier Road and is infested with multiple invasive plants species. This site experiences heavy traffic by park vehicles making it a potential vector for the spread of invasive plants into the Exit Glacier area. 2016 marked the first year that invasive plants were chemically treated in the Maintenance Facility. On June 23rd the KEFJ EPMT applied 6.325 gallons of Milestone solution to the Maintenance Facility. A total of 0.242301 acres was chemically treated. Species treated were common plantain, common dandelion, prostrate knotweed, common chickweed, and pineapple weed. Annual bluegrass was scattered throughout while shepherd's purse and prostrate knotweed were found only in the northeastern corner of the Maintenance Facility. On August 4th, a 6-person SCA crew hand-pulled all invasive plants that were missed or not treated during the chemical treatment.

Outreach and Education

One of the goals of the KEFJ EPMT is to educate both park staff and the public about the importance of invasive plant management and how they can help prevent the spread of invasive plants. Time spent teaching awareness and best work practices takes little time and effort, but can have far reaching results as park staff and visitors take these messages home with them. This type of outreach and education is a preventative measure to stop new infestations which can significantly reduce the management cost of eradication efforts.

KEFJ EPMT staff gave a presentation to the park interpretive staff during seasonal training on invasive plant management initiatives and successes. Two SCA trail crews received training on how

to prevent the spread of invasive plants while working and living in the park and were taught how to identify commonly found invasive plants.



Figure 13. KEFJ EPMT and SCA crew hand-pulling invasive plants at the Visitor Center.

A boot brush and informational sign was reinstalled at the Exit Glacier Nature Center near the beginning of the main trail. The boot brush provides both an educational message about the dispersal of invasive plants on shoes and clothing, and a means to clean footwear before entering the trail system.

Invasive plant management efforts in remote coastal areas were highlighted on the park's Facebook page. This post discussed the importance of gear inspection and cleaning before going into the backcountry to prevent the establishment of new invasive plant infestations in these pristine coastal areas.

Elodea Monitoring

KEFJ EPMT staff received Elodea identification and eradication training during the 2016 Alaska region EPMT spring training and participated in a sampling protocols training given by Alaska region Elodea specialists prior to conducting all Elodea sampling efforts. Elodea sampling was conducted on Delight Lake, one of three lakes within the park boundary considered vulnerable to the spread of Elodea because of possible float plane access.

Sampling was carried out on August 9th. KEFJ EPMT staff deployed from the M/V Serac and hiked into Delight Lake carrying all survey equipment. This area can be accessed by a trail easement across Port Graham Corporation lands leading from the Delight cabin, which follows the outlet stream, to the lake. The lake was too large to survey in one day using packrafts so only the southwestern end of the lake was sampled. A survey technique using Environmental DNA, or eDNA, was completed on Delight Lake following the Central Alaska Network eDNA Field Sample Collection Protocol for use with the Mityvac hand pump (Simmons 2016, unpublished). Samples of lake water were collected

from several sites around the perimeter of the lake, focusing on the area near the outlet stream where Elodea fragments might accumulate (figure 14). The water samples were filtered to collect potential Elodea DNA and filters were stored in vials containing Longmire buffer and later sent in for lab analysis.



Figure 14. KEFJ EPMT conducting eDNA survey on water samples from Delight Lake.

In addition to eDNA sampling, the KEFJ EPMT also completed an inventory of the southwestern portion of Delight Lake using packrafts, double-headed sampling rakes, and underwater viewing scopes to visually analyze the lake for the presence of Elodea (figure 15). Due to the large size of the lake, only a portion of it could be surveyed with packrafts. The rapid screening method used was adapted from the U.S. Fish and Wildlife Service Aquatic Invasive Species Survey Protocol (Rich 2012). Using packrafts, the team completed an “intuitive meander” survey which involved paddling in a zig-zag pattern and visually inspecting the gravel bottom of the lake. Underwater viewing scopes, which eliminate surface glare, were used when necessary. Only the littoral zone, which is the near shore area where light penetrates all the way to the lake bottom allowing aquatic plant growth, was surveyed. Adequate sunlight, calm water conditions, and very little suspended sediment made the lake bottom extremely visible, although the underwater viewing scopes became more helpful as wave size and frequency increased throughout the day. Surveyors searched for the presence of Elodea on both sides of their packraft as far as the eye could see. The double-headed sampling rakes, which were to be used to collect any aquatic vegetation in areas where the bottom was not visible, were not needed. No aquatic vegetation was found growing on the gravel bottom of Delight Lake.



Figure 15. NPS staff using an underwater viewing scope to survey for Elodea

Restoration and Prevention

Native plant seeds were collected from the Exit Glacier area in July, August, and one day at the beginning of September. Changes in plant phenology due to the less than average amounts of snowfall received during the winter of 2015/2016 seemed to cause many plants in KEFJ to both flower and produce seed earlier in the season than other years. Typically seeds would be collected well into September, but most species were fully senesced by this point in 2016. These native plant seeds will be used in future restoration efforts in the park including the restoration of the Herman Leirer Road margins after the road construction project is completed in the fall of 2016 (figure 16).



Figure 16. NPS staff collecting native plant seeds.

Preventing the spread of invasive plants is one of the most cost-effective ways of managing them. Park maintenance staff cooperates in prevention efforts by power washing their equipment after

working in infested areas before moving to more pristine areas. Both trail crew and maintenance are encouraged to work from the areas of the most infestation towards the areas of least infestation.

Mitigation measures to prevent introduction of invasive plants were included in the contract for a large road construction project in the park on Herman Leirer Road this summer. Contractors were required to clean all equipment of dirt and debris before entering the park. Weed free gravel certification was also required. Gravel inspections were completed at a local gravel extraction site and rock quarry used as a source for road construction material. The gravel extraction site was visited twice in the summer and certified weed-free for 2016 based on the standards of the Alaska Weed Free Gravel Certification program (Alaska DNR 2012). Weed-free construction products like wattles and other erosion control materials were required on the project. Topsoil from the project site was salvaged for reuse along the road margins, preventing the introduction of nonnative plants through the importation of potentially contaminated topsoil.

Gypsy Moth Monitoring

KEFJ has worked with the Alaska Division of Agriculture to monitor for gypsy moths in the park since 2009. In 2015, traps were not installed due to an employee transition period within the division. The Gypsy Moth program at the State of Alaska resumed in 2016 and traps were installed at KEFJ on June 16th. These traps were monitored once on July 27th and then removed on September 16th. To date, no gypsy moths have been detected in the park (figure 17).



Figure 17. YCC employee installing a gypsy moth trap.

Discussion and Recommendations

Since 2004, the KEFJ EPMT has been monitoring, mapping, and treating invasive plant infestations in an effort to eradicate existing populations and to prevent the introduction of new species. Due to these efforts, many infestations have been reduced in size as well as density and some have been completely eradicated. The continued success of our program wouldn't be possible without the technical support and training provided by the Alaska Region Exotic Plant Management Team (EPMT) program. Using recommendations made by the KEFJ EPMT in previous years, management priorities continue to evolve and change. Specific recommendations of the 2016 KEFJ EPMT are outlined below.

Exit Glacier Area

Highest priority areas should continue to be those that have the highest human use, but remote and pristine backcountry sites will continue to be monitored as well. Monitoring efforts play an important role in our ability to find new invasive plant populations while they are small and require less time and fewer resources to control. In the Exit Glacier area, the focus should continue to be on controlling all invasive plants, but focusing particularly on species with high invasiveness ranking and on eradicating small disjunct populations found in backcountry sites.

Herman Leirer Road has been a vector for the spread of dandelion populations into the backcountry. The KEFJ EPMT applied herbicide to the roadside for the first time in 2015 in an effort to reduce this seed source to a more manageable level. Because a road construction project was being completed on the east end of the road in 2016, only a portion of the roadside was treated in 2016. Treating Herman Leirer Road with herbicide should be repeated in 2017 in an effort to further reduce the dandelion population along the road. Special attention to monitoring efforts should be given to the Herman Leirer Road corridor over the next several years to look for any new species that might have been introduced during the road construction project completed in the fall of 2016.

The Nike Stripe has been chemically treated since 2012. The common dandelion infestation there has shown substantial decreases in population size and density since its first chemical treatment. In 2014, 2.25 gallons of herbicide solution were used to treat the population compared to 0.019 gallons used in 2016. This population could be a good candidate for total eradication and should continue to be a high priority for chemical control in future seasons. The result of control efforts at this site is truly a success story for the park!

New in 2016, the Outwash Plain was divided into 7 standardized polygons to streamline treatment and to circumvent remapping each season. The standardized polygons will be used over a number of years until the plant population changes enough to warrant remapping them. The treatment went smoothly for the 7 standardized polygons created this year. The standardized polygons simplified daily operations and provided manageable stopping points to work toward each day. The total herbicide applied determined the density of common dandelion in each polygon and will be useful to determine efficacy of treatment over time. It was recommended to the EPMT Data Manager to split Polygon 6 (See Appendix A) into two polygons. With both the large size of the polygon and the high density of common dandelions found there, it was difficult to complete herbicide application in one

day. New standardized polygons should be created as new large populations of dandelions are discovered in the Outwash Plain in the future.

In 2017, it is recommended to focus on treating sites in the Outwash Plain located farthest away from Exit Creek first, working back toward the closest sites. Most of the areas that have been treated repeatedly were smaller and easier to treat in 2016, but there are still populations of dandelions that have not been treated at all. Because Exit Creek eventually rises to unsafe levels for crossing, not all populations can be treated in a season. It is hoped that focusing on treating new sites first will help contain the larger dandelion population and stop the spread into new areas.

Coastal Areas

Coastal areas with high visitor use should be prioritized for surveying efforts, but lower use areas should be systematically surveyed as well. Invasive plant populations have been found in surprising locations and if caught early are good candidates for eradication. Known populations of invasive plants should be a priority for control efforts on the coast. Most of these populations are fairly small, but some are in remote locations and can be difficult to access. Annual bluegrass has been hand pulled around the park's two PUCs annually since 2009, but populations have been persistent. The use of herbicide on annual bluegrass populations in coastal areas may be the best strategy to control this species.

During the 2016 field season, SWAN Inventory and Monitoring staff conducting nunatak vegetation surveys unexpectedly discovered a common dandelion population located at their survey site between Petrof and Yalik Glacier. This site was accessed by helicopter because of its remote location. Because this site cannot be easily accessed on foot and the likelihood of having the resources to use a helicopter to control this infestation is low, more research will have to be conducted to provide a realistic recommendation for this site.

Maintenance Facility

Herbicide was applied for the first time to the Maintenance Facility yard in 2016. This area continues to be a priority as the number of species and density of invasive plants in the yard has increased in the last few years. Park vehicles come and go frequently from this facility and could be a vector for the spread of invasive plants into the park. One standardized polygon was created for the Maintenance Facility yard. Because many species were treated within a single standardized polygon, there were questions about how to best document herbicide use for each species in the data dictionary. It would be useful to staff collecting data in parks for the Alaska Region EPMT to either develop a protocol for the data dictionary we have or to modify the data dictionary to address this specific situation.

The maintenance yard was chemically treated on June 23rd and then manually controlled on August 4th. The KEFJ EPMT revisited the site in late September and found that many of the surviving invasive plants were still actively growing. Typically, many plants have senesced and are dying or becoming dormant at this time. In 2017, the EPMT should consider chemically treating the Maintenance Facility a second time in late August to more thoroughly control the infestation there.

Seward

The Shea parking lot is the parking area for the Park Headquarters building located in downtown Seward. This parking lot contains scattered populations of invasive plants that have increased over the last several years. It contains a diversity of invasive plants, with over 14 known species. Control efforts in the Shea Lot are typically a relatively low priority; however, this parking lot could easily act as a vector for invasive plants to spread into the park on the NPS vehicles parked there. In 2016, hemp nettle was pulled in the Shea lot in order to prevent its introduction into any other areas of the park. Oxeye daisy, another highly invasive plant not currently found in other regions of the park, has also been identified in the Shea Lot. It is recommended that the Shea lot should be thoroughly inventoried and all invasive species present should be identified and mapped. This will help to create a plan of action to reduce the number of species there and prevent their spread into more remote areas of the park. Maintenance staff should continue to mow regularly throughout the summer to keep plants from going to seed. Much of the concern comes from invasive plants growing on the parking surface and vehicles picking up seeds in tire tread. One option is to pave the parking area, which would be expensive, but further treatment of invasive plants would not be needed in the parking area. Another option is to use herbicide to treat the gravel parking area, which would have to occur on a regular interval to retreat newly emerging plants. Other invasive plants with high invasiveness rankings could also be treated with herbicide at the same time. Because the parking lot is located in the City of Seward, there will always be a seed source for reinfestation.

Elodea

The first Elodea survey at KEFJ was conducted on Delight Lake near McCarty Fjord during the 2016 season. Elodea is a highly invasive aquatic plant that can spread from a single plant fragment. As more infested lakes are discovered in Alaska, conducting Elodea surveys in lakes in the park has become a higher priority. Because of its large size, only a portion of Delight Lake could be surveyed in one day. The outlet of the lake was the focus of surveys this season because access to the lake was limited, but the east end of the lake should be surveyed as well in the future to be sure that Elodea is not found there. Other agencies have used floatplanes to access and survey lakes. This is a more efficient way to conduct Elodea surveys since multiple lakes can be accessed in a day and rake sampling of aquatic plants can be done from plane floats. This would make surveying the entirety of the lakes found in KEFJ possible in a single season. It is recommended to look for other agency partners and project funding in the future to accomplish this goal.

There are two other freshwater lakes within the park boundary and they are both home to Sockeye Salmon runs, which can attract people using float planes to access fishing opportunities. It is recommended that a baseline survey be completed at Desire Lake, located in Nuka Bay, in 2017 and Addison Lake, located in Aialik Bay, in 2018.

A new Elodea detection survey technique was tested in 2016 in Delight Lake and around the state. This technique filters water samples from waterbodies to detect Environmental DNA or eDNA of a target species. This technique has been used to detect fish and other organisms in lakes. It is still yet to be determined how much DNA is needed to detect Elodea in a lake and if this is a feasible option to replace more time consuming sampling methods.

Prevention

Prevention can be a relatively simple and effective way to reduce the chances of the introduction of invasive plants in the park. Many park projects and non-recreational activities in the park provide vectors for the spread and introduction of invasive plants into new areas. The park should continue to implement mitigation measures by including specifications in scientific research permits, construction contracts, and special use permits. KEFJ EPMT should continue to educate other park staff members and SCA trail crews about work practices that reduce the spread and introduction of invasive plants into the park.

Outreach and Education

Forming new partnerships and nurturing existing partnerships with various agencies and community members should continue to be a focus in future seasons. These partnerships can create opportunities for communication and collaboration with other agencies and the local community. It is also an opportunity to educate the public about the negative impacts of invasive plants. Participation and membership in the Kenai Peninsula Cooperative Weed Management Area (KP-CWMA) should continue to be a priority. This is a volunteer group leading efforts to manage invasive plants on lands across the Kenai Peninsula. Continued participation in monthly conference calls and yearly conferences with the Alaska organization Committee for Noxious and Invasive Plant Management (CNIPM) is a great way to keep connected with other agencies and organizations and to learn about new strategies for invasive plant management.

KEFJ EPMT was a part of a group presenting an Alaska Regional EPMT poster at the NPS Alaska Region Natural Resources Centennial Science and Stewardship Symposium in October in Fairbanks. This was an important opportunity to share the success of the program and network with other park staff in the region, scientists, and nongovernmental organizations.

In previous seasons, KEFJ participated in a Herman Leirer Road Community Weed Pull with the Chugach National Forest and the local community. There was no Community Weed Pull in 2016 because agency partners were not available to participate and early snowmelt in the spring moved invasive plant control efforts ahead about three weeks. There was little time and fewer resources available for organizing and planning the event this year. Reestablishing the Community Weed Pull for 2017 should be a priority next year. It is a great opportunity to partner with the Chugach National Forest and the local community.

The KEFJ EPMT should continue public outreach efforts. Outreach should include submissions to the park's Facebook page and articles to local newspapers, and updates to the park website.

The boot brush, installed each season at the Nature Center Plaza in the Exit Glacier area, provides park visitors and staff a means to clean any invasive plant material off of their boots and prevent the spread of invasive plants further into the backcountry. The small boot brush is located near the front door of the Nature Center and is accompanied by an educational sign to inform visitors of its importance. Many visitors walk past the boot brush without noticing it, or simply pass up visiting the Nature Center altogether before hiking down the Main Trail. The KEFJ EPMT recommends that a combined, free-standing boot brush and informational panel be developed and fabricated. This boot

brush should be placed in a more user friendly place, next to the entrance to the main trail. It would most likely receive more use and its educational message would reach a larger audience.

Youth Involvement

Introducing youth to the NPS continues to be a priority of the invasive plant management program. The resource management division's youth program is a great fit for the EPMT and provides an opportunity for youth to be involved with the NPS and the resource management division. The KEFJ EPMT will continue to include an SCA intern and two high school-aged YCC employees. An SCA crew will work with the team for a week during the summer in 2017.

Restoration

Restoring native plant communities continues to be a priority of the invasive plant management program at KEFJ. Disturbed areas that have little or no vegetative cover are more vulnerable to infestations by invasive plants. Revegetating disturbed areas with native seeds helps native plant communities reestablish more quickly. Native seed collection in the Exit Glacier area should continue to be a yearly activity to provide a continued source of seeds for restoration projects. A priority project in 2017 will be reseeding disturbed areas along the roadside after the completion of the road construction project on Herman Leirer Road in the fall of 2016.

Personnel

Most years, the seasonal EPMT Biological Technician begins at KEFJ in mid-April. This allows enough time for the technician to study for and take the Alaska State Pesticide Applicator Test before herbicide application operations begin in the park. This certification is required for all herbicide applicators in the Alaska Region Invasive Plant Management Plan. Having more staff available to apply herbicide makes it significantly easier to reach the herbicide application goals of the season. It is recommended that the EPMT Biological Science Technician be hired early enough to have time to study for and pass the test to become a State of Alaska Certified Pesticide Applicator.

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Appendix A: Invasive Plant Surveys Site Specific Maps

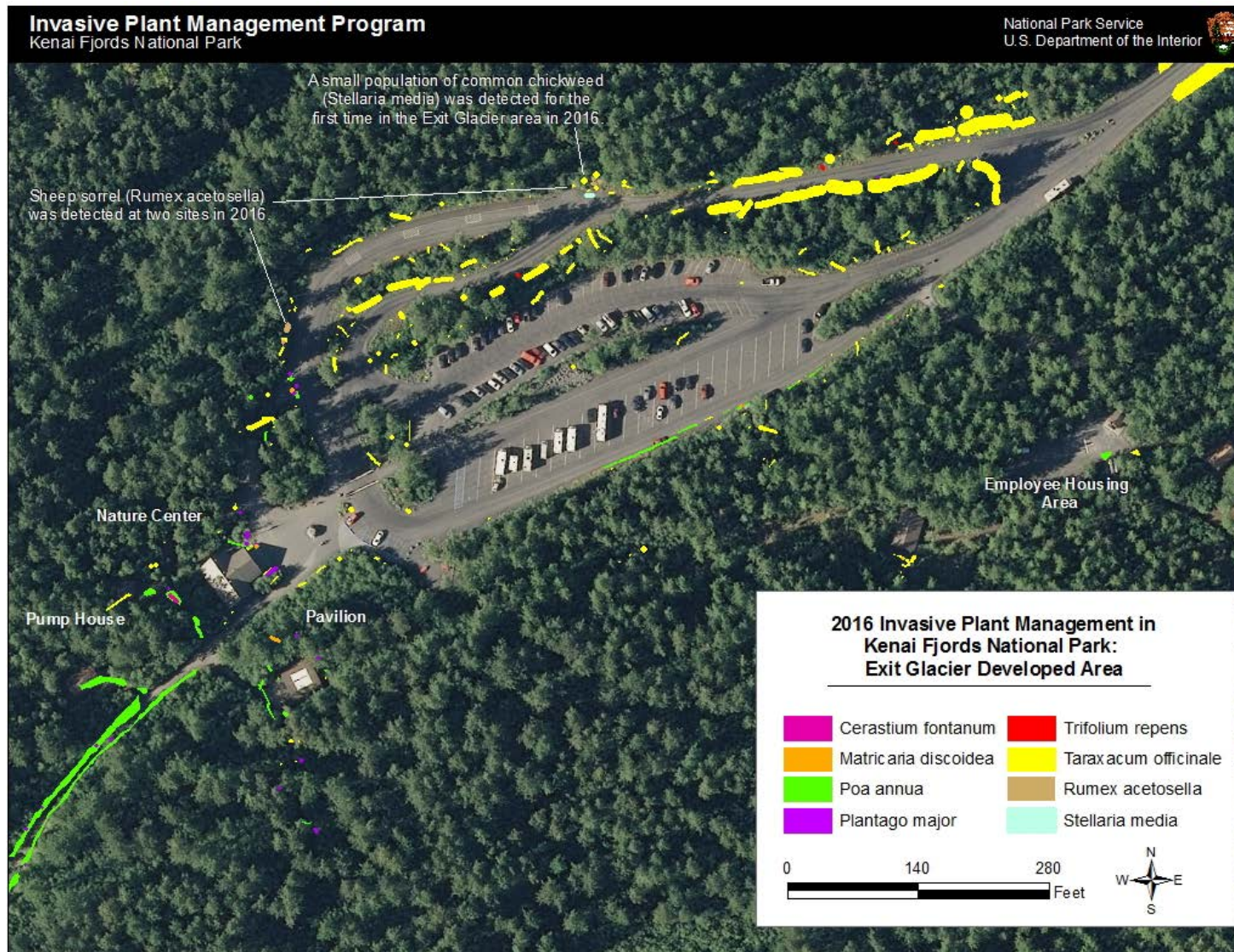


Figure A-1. Plant surveys in Exit Glacier Developed Area.

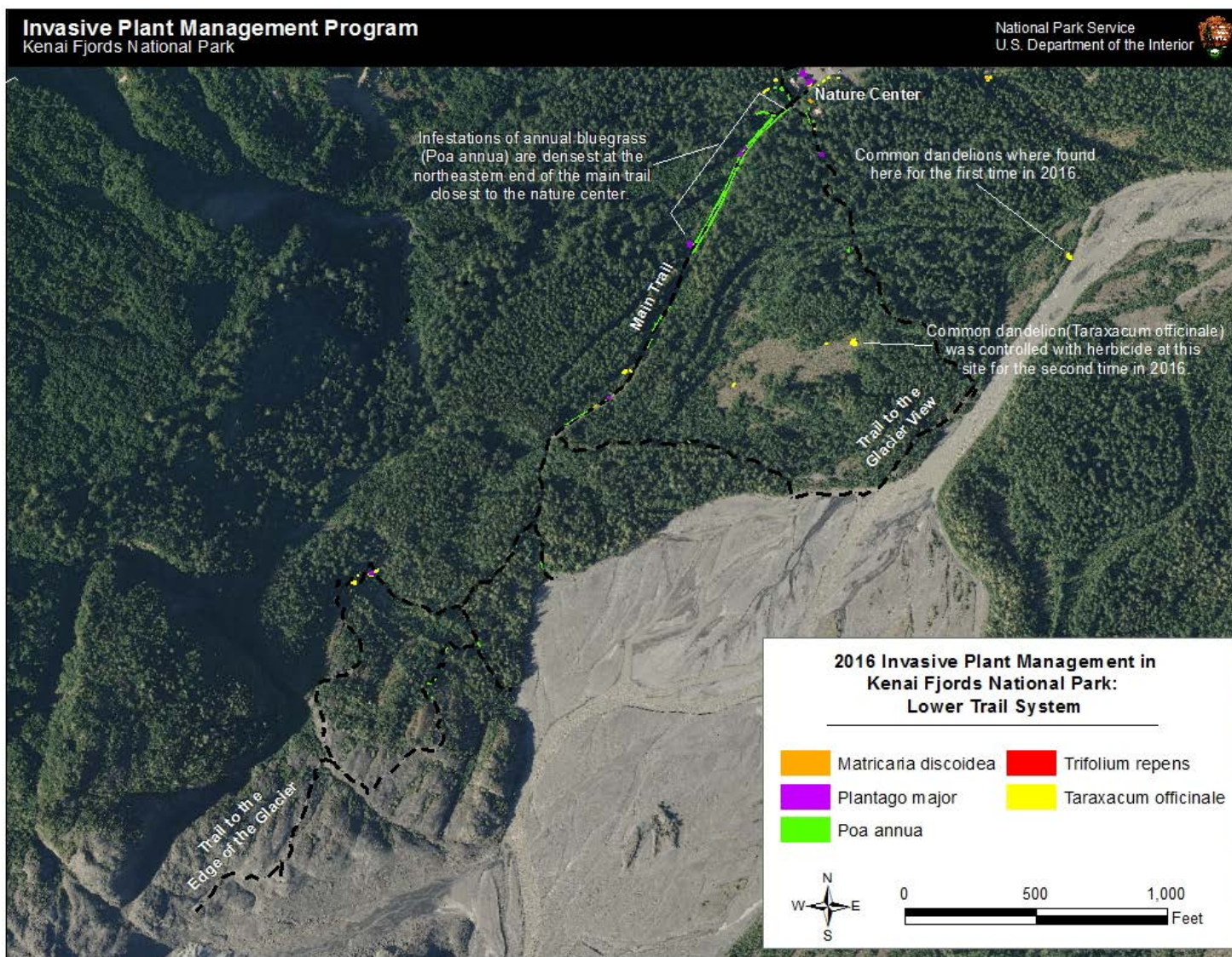


Figure A-2. Plant surveys along the Lower Trail System.

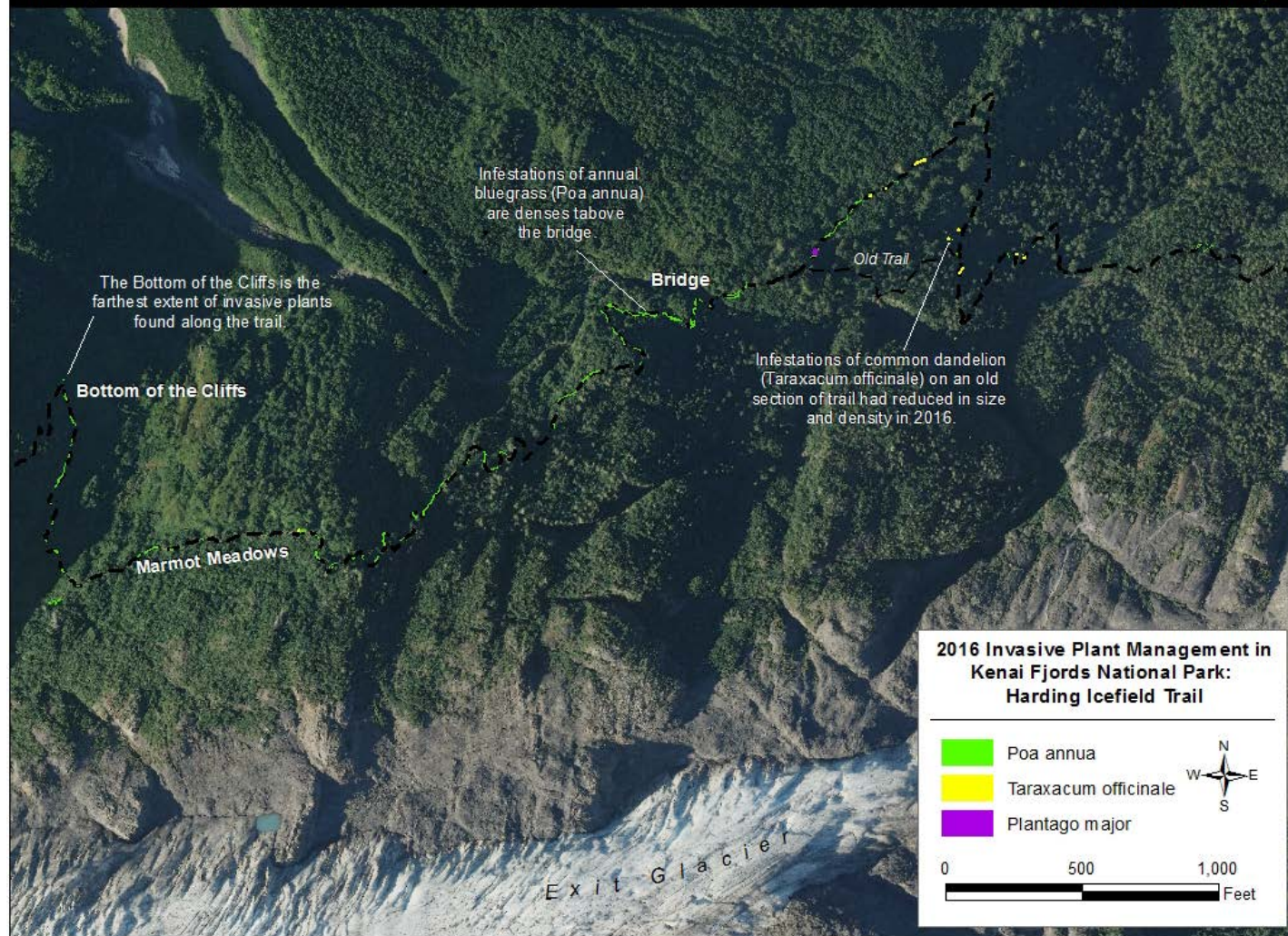


Figure A-3. Plant surveys in Harding Icefield Trail area.

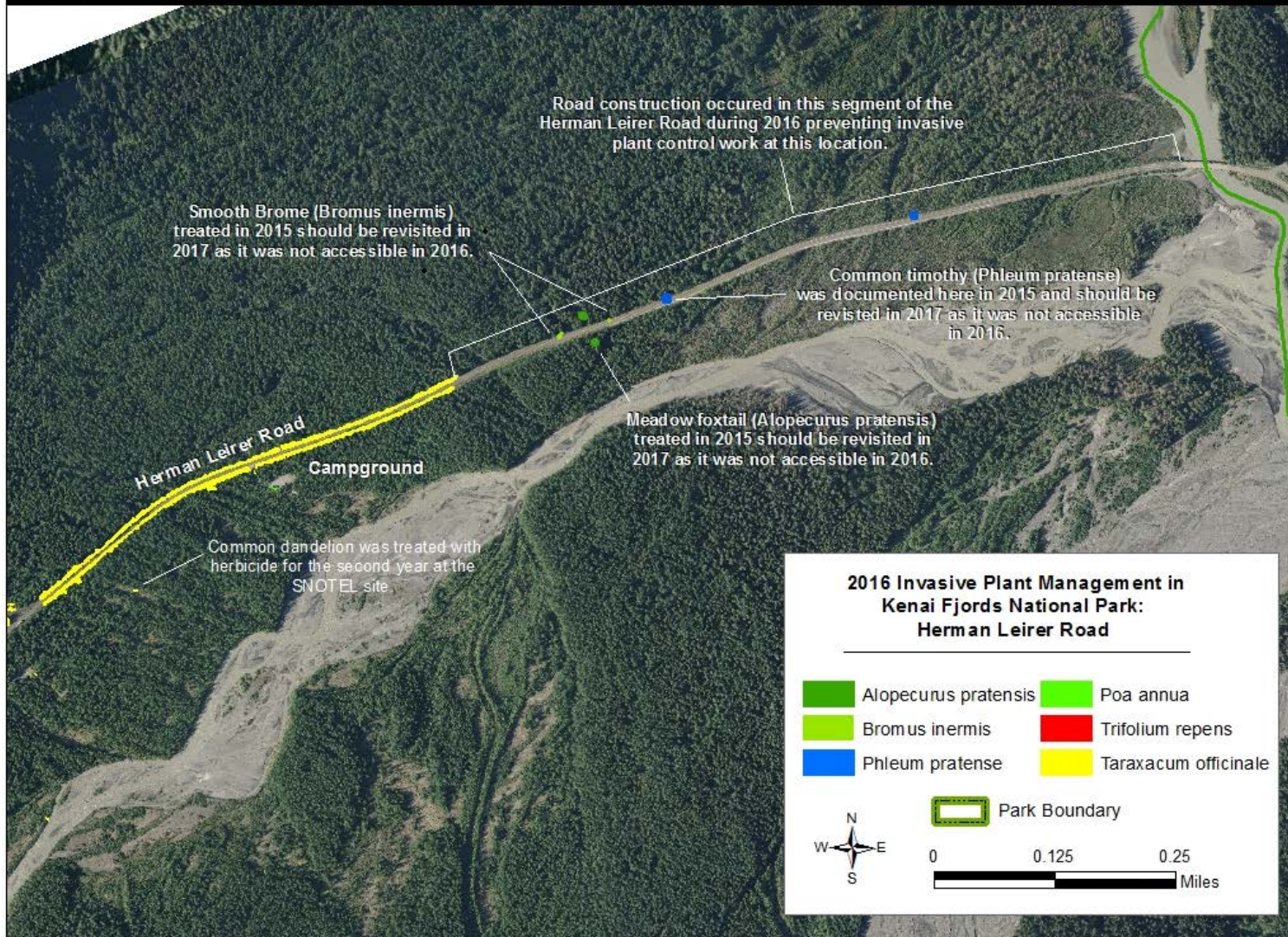


Figure A-4. Plant surveys along Herman Leirer Road

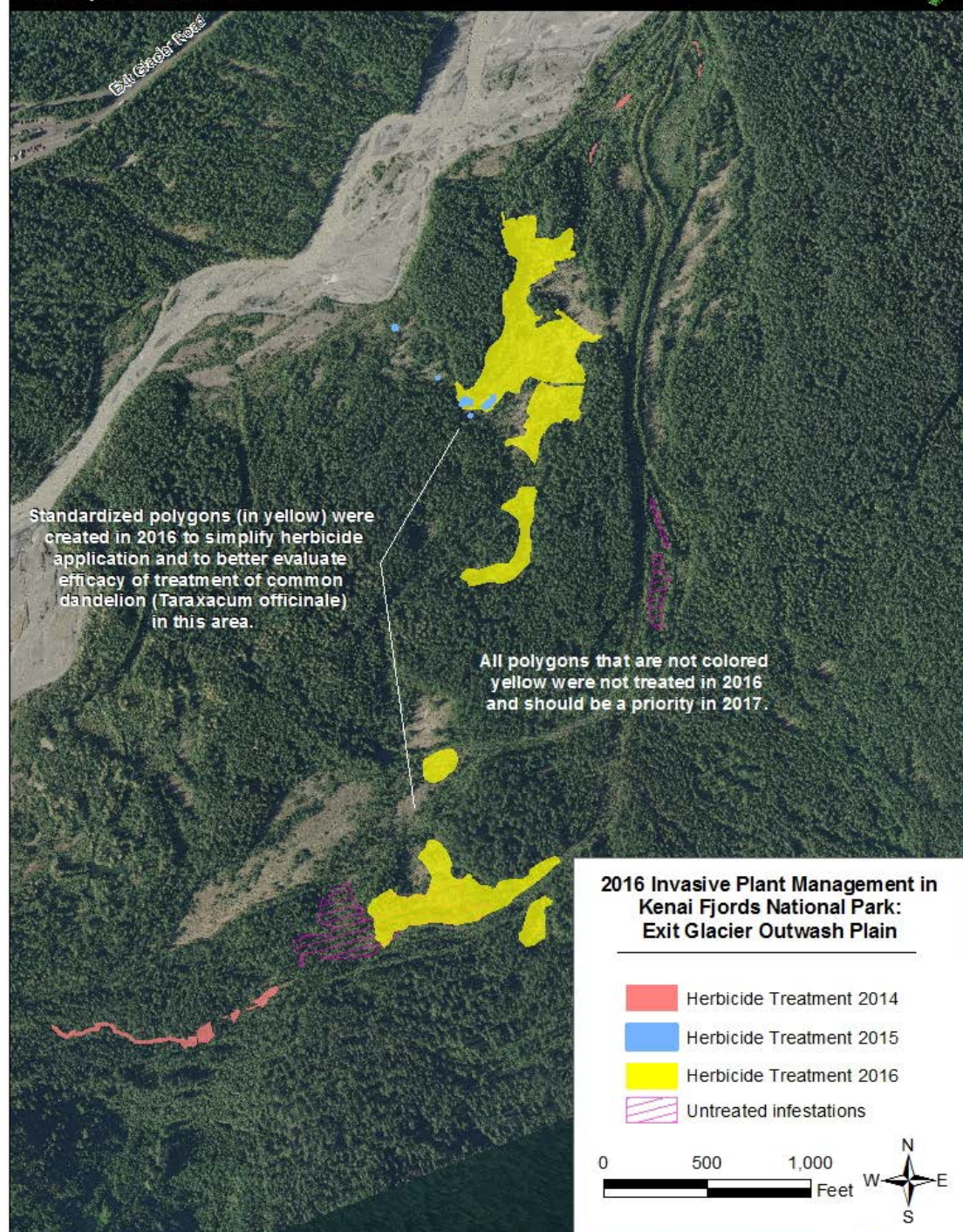


Figure A-5. Invasive plant management in the Exit Glacier outwash plain.

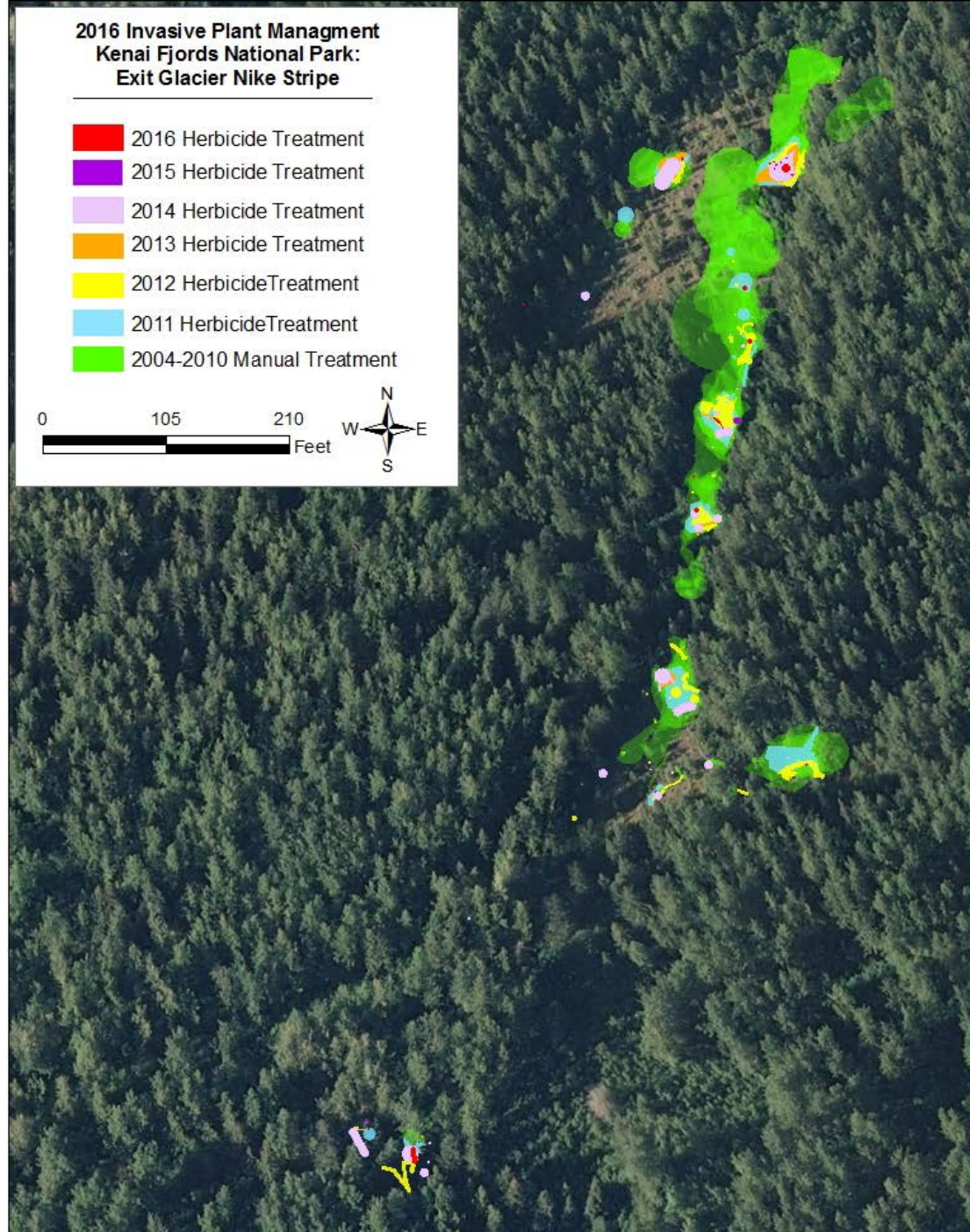


Figure A-6. Invasive plant management in the Nike Stripe of Exit Glacier



2016 Invasive Plant Management in
Kenai Fjords National Park:
Maintenance Facility

Herbicide Treatment

Plant Species Treated

Matricaria discoides
Plantago major
Polygonum aviculare
Stellaria media
Taraxacum officinale

Manual Treatment

Capsella bursa-pastoris
Chenopodium album
Poa annua

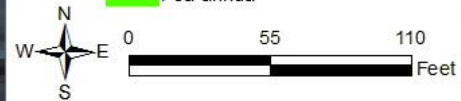


Figure A-7. Invasive plant management in the maintenance area.

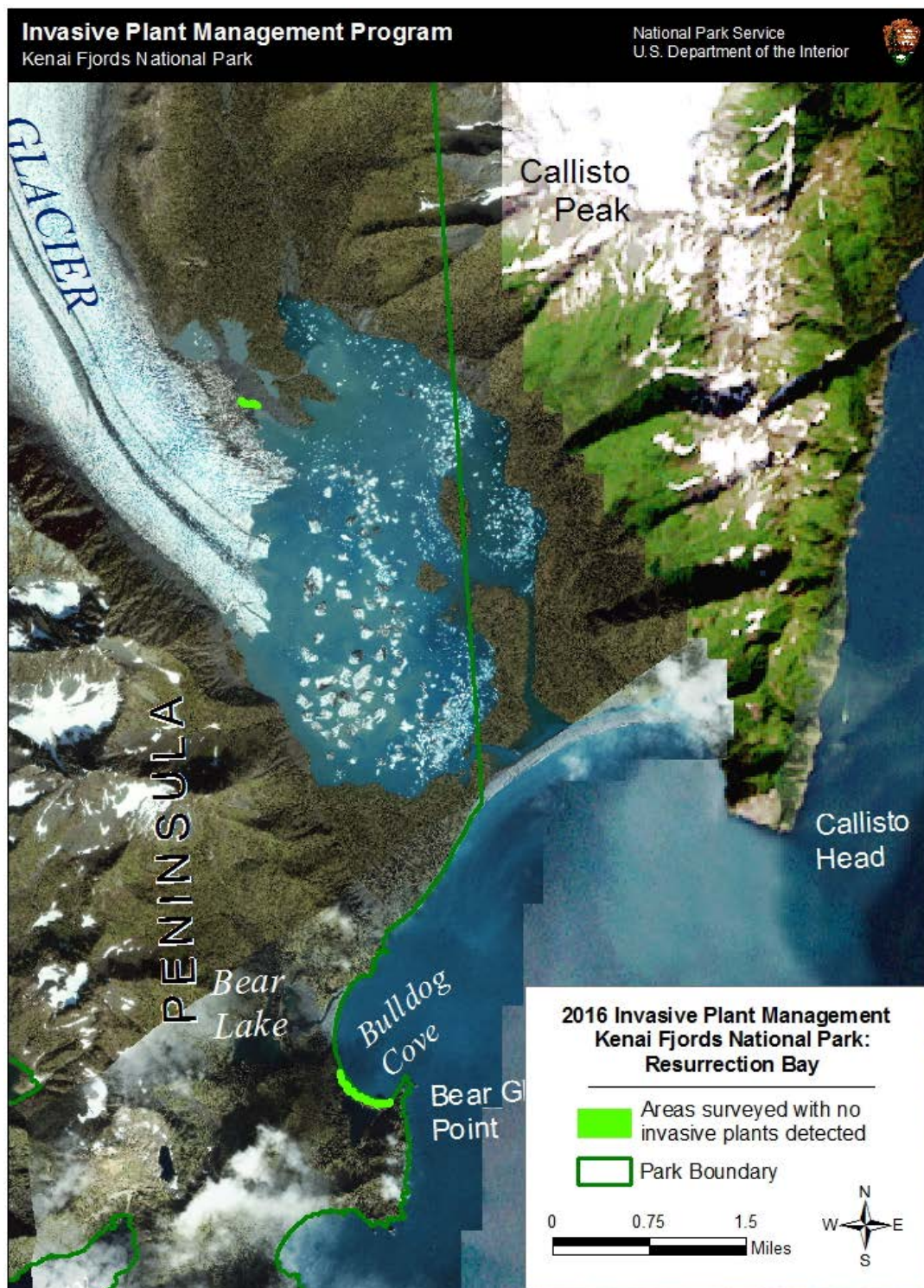


Figure A-8. Invasive plant management in the Resurrection Bay area

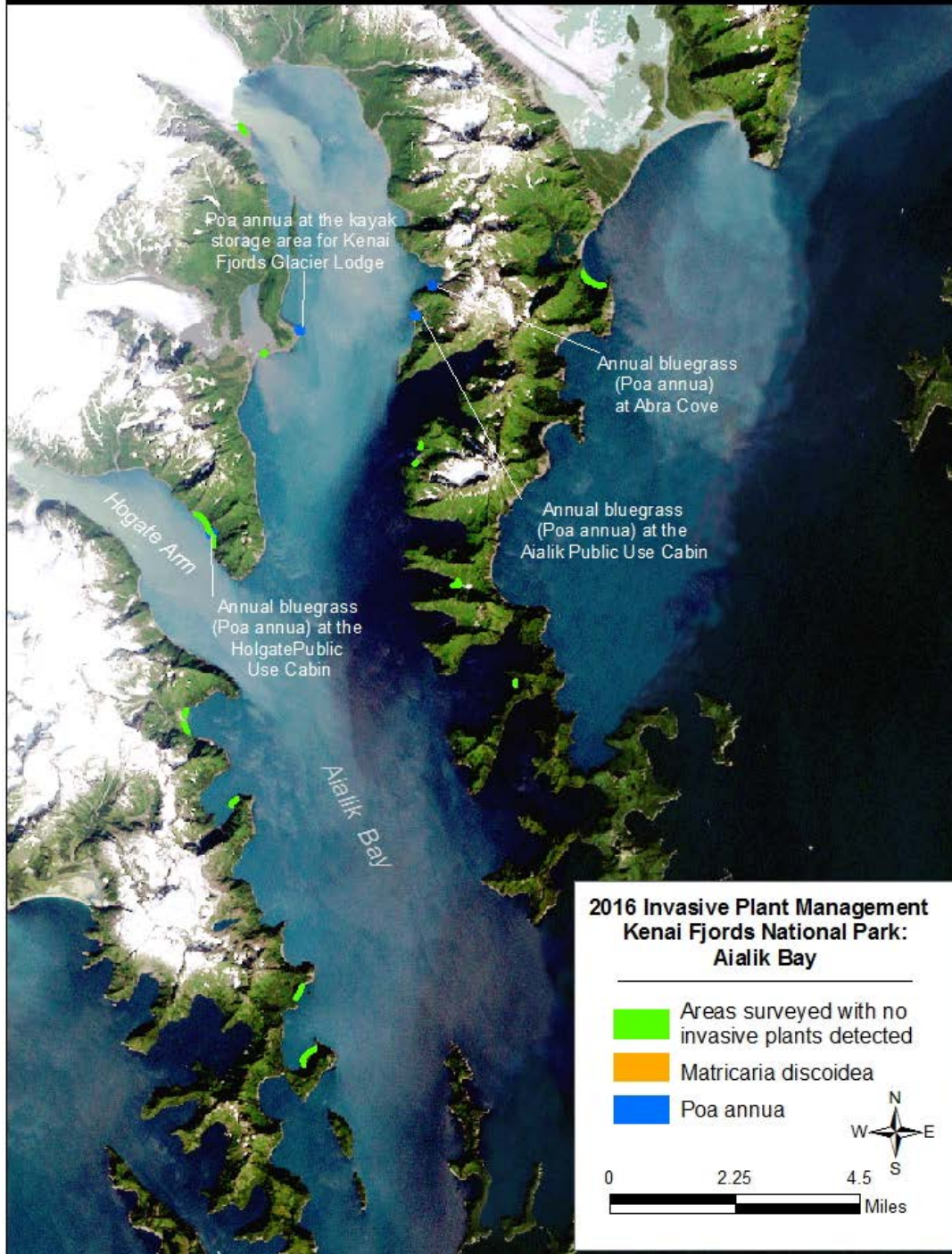


Figure A-9. Invasive plant management in the Aialik Bay area

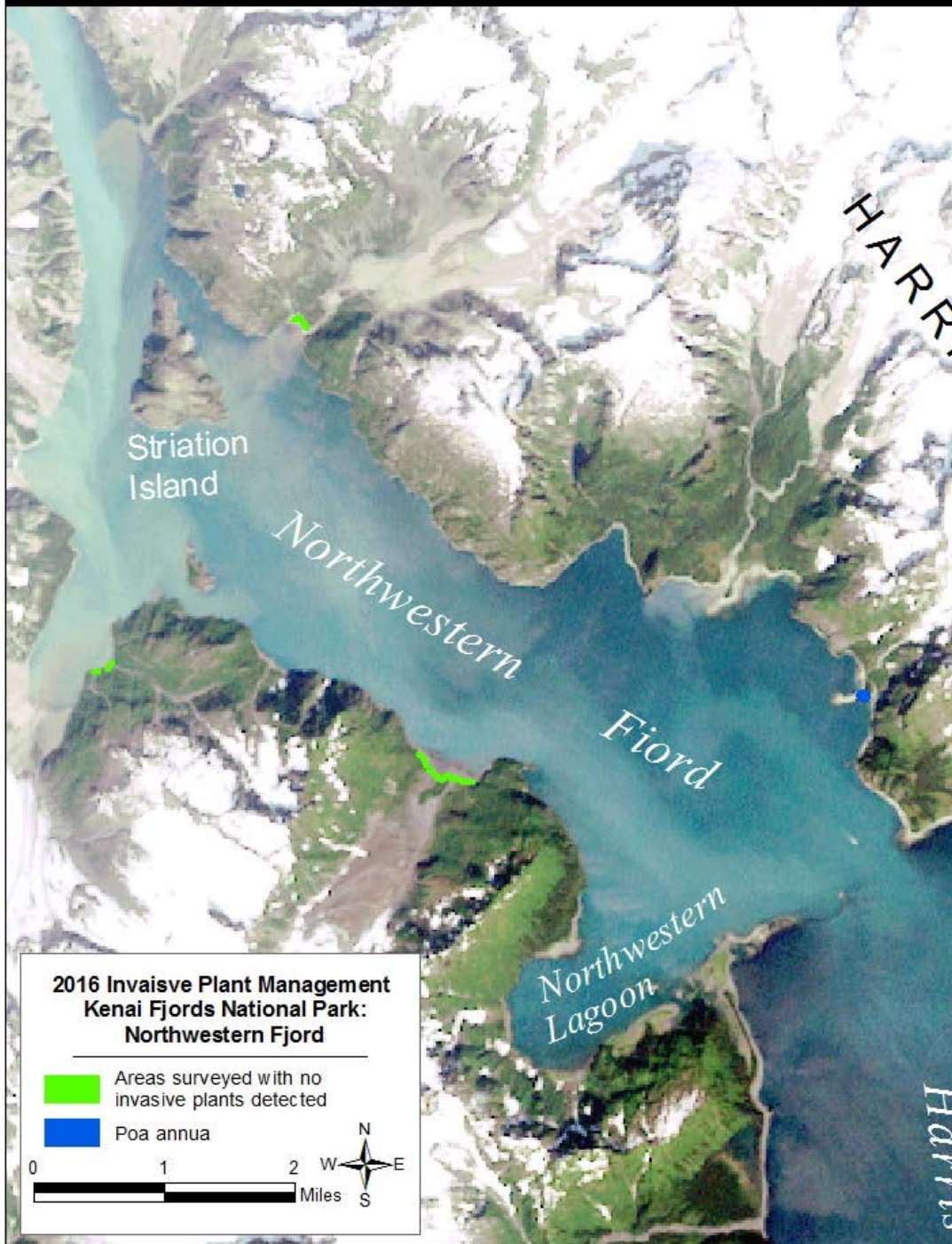


Figure A-10. Invasive plant management in the Northwestern Fjord area.

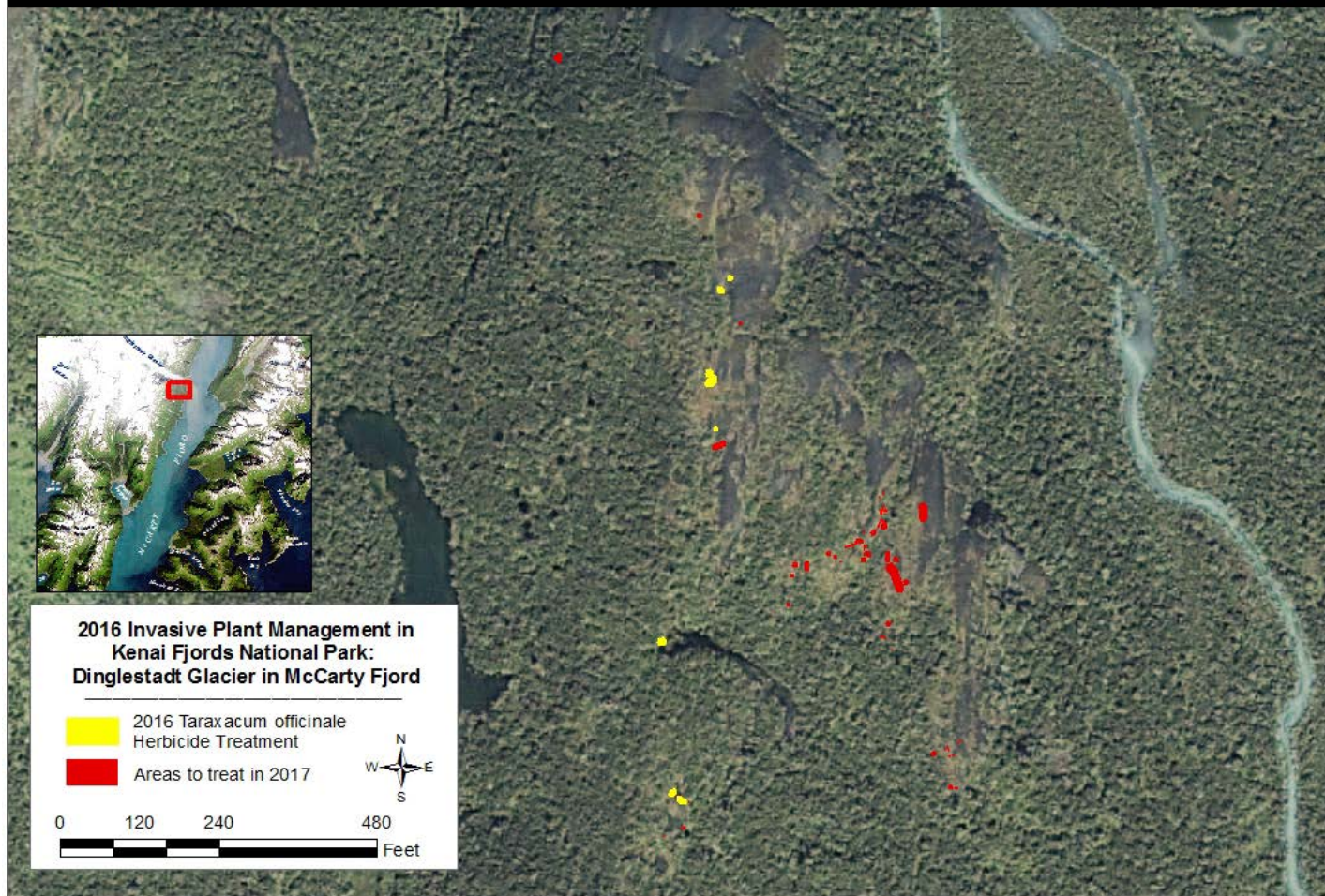


Figure A-11. Invasive plant management in the Dinglestad Glacier in McCarty Fjord area

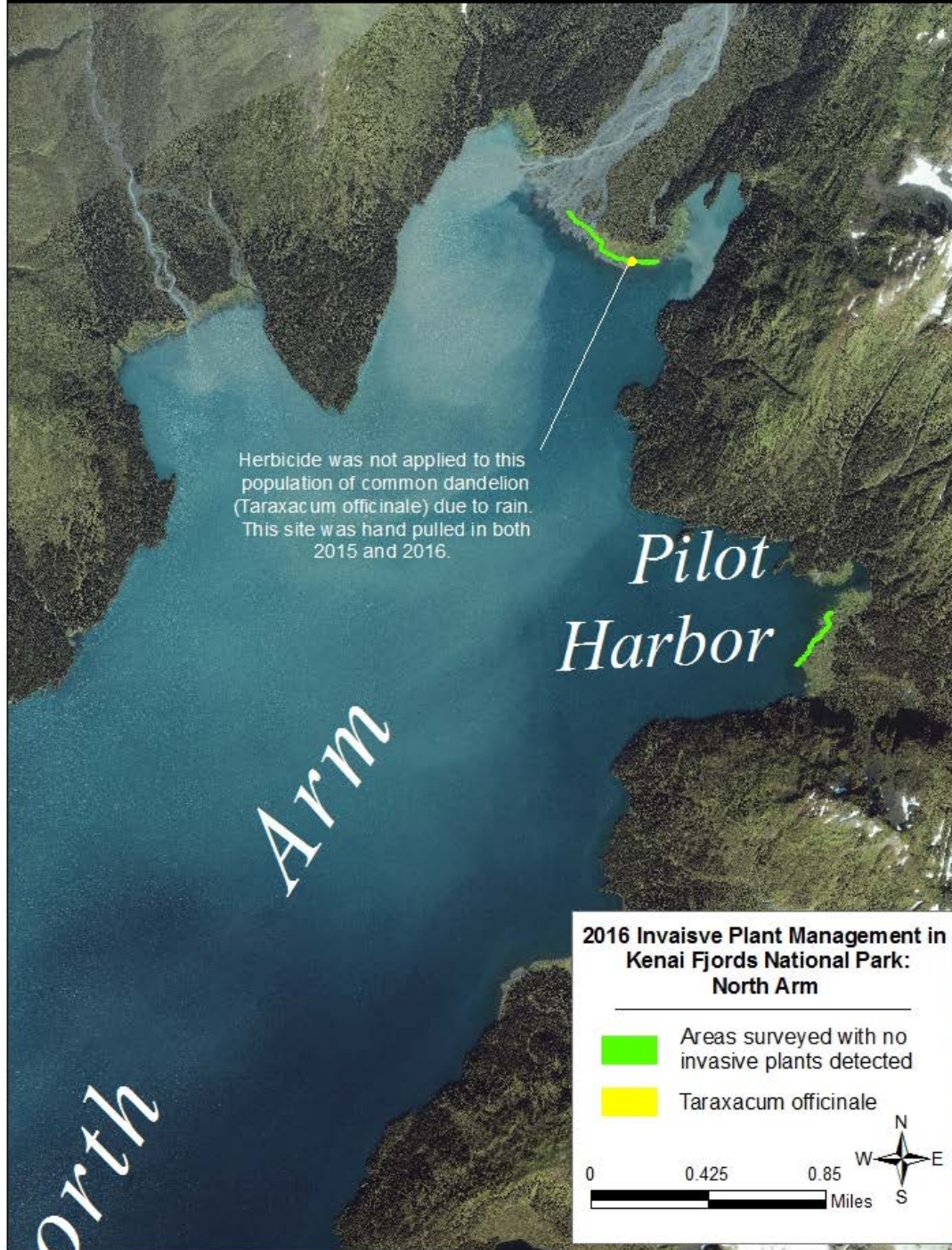


Figure A-12. Invasive plant management in the North Arm area

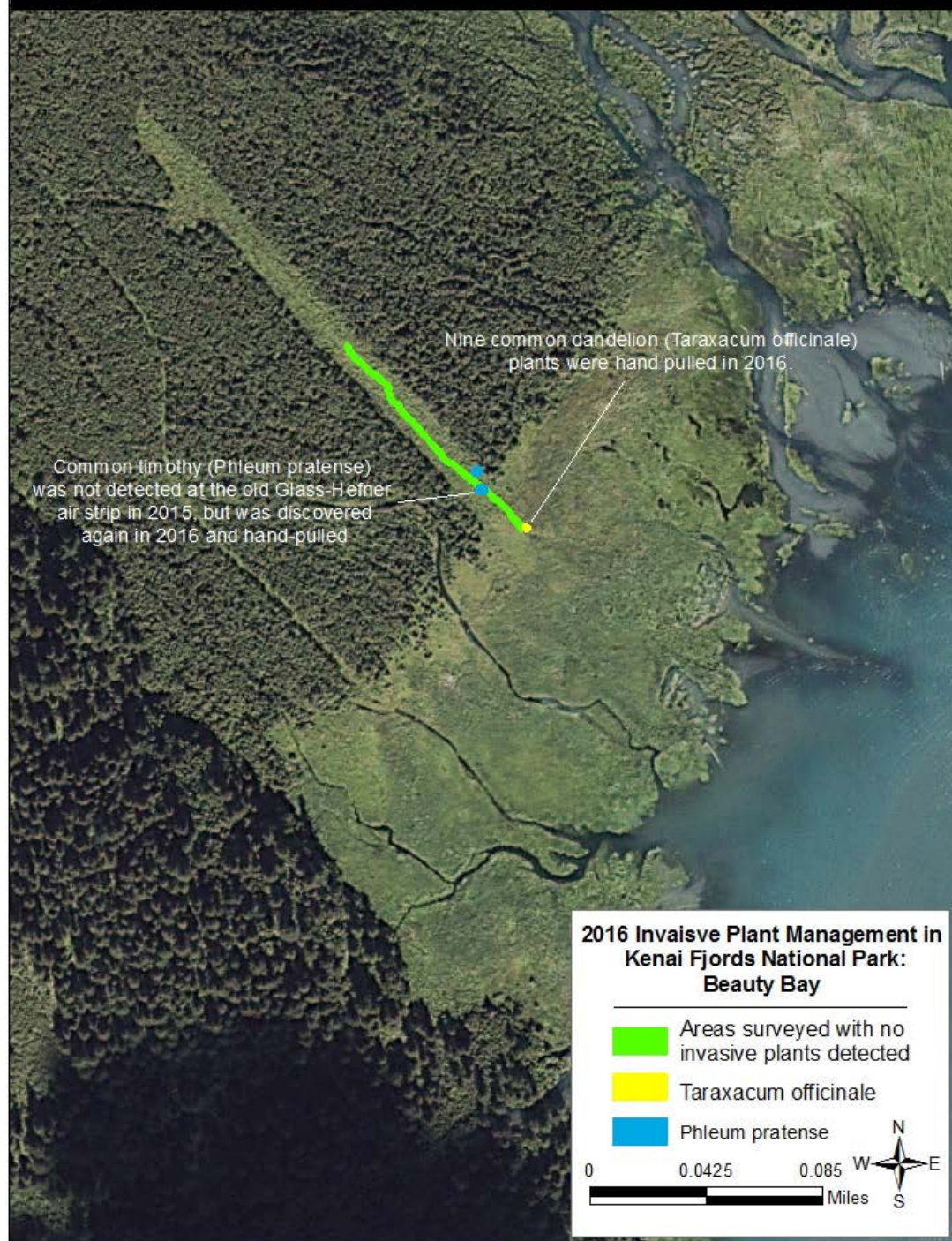


Figure A-13. Invasive plant management in the Beauty Bay area.

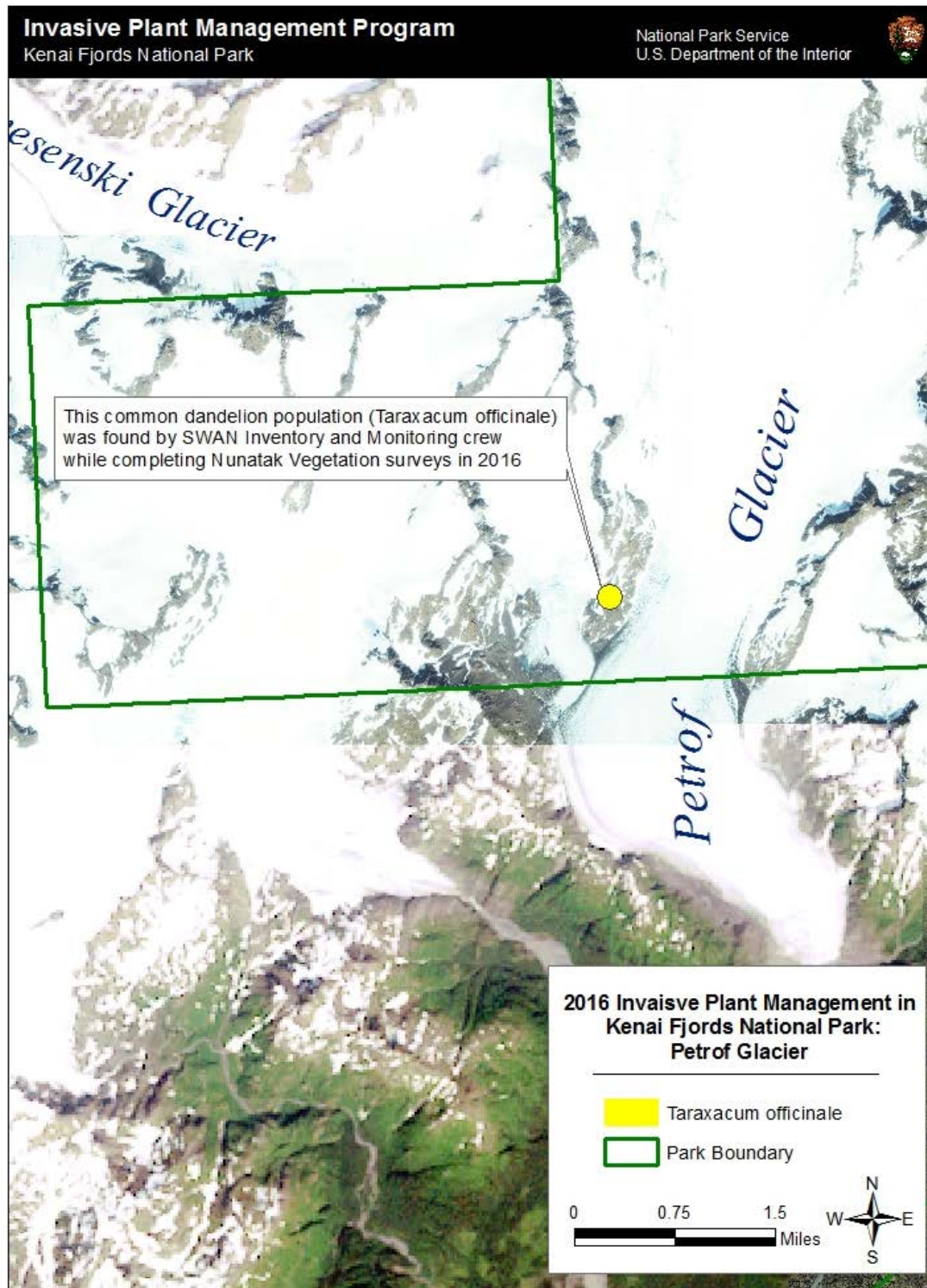


Figure A-14. Invasive plant management in the Petrof Glacier area



Figure A-15. Delight Lake Elodea survey

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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