



Invasive Plant Management in Kenai Fjords National Park

2018 Summary Report

Natural Resource Report NPS/KEFJ/NRR—2019/1926





ON THIS PAGE

KEFJ EPMT performing weather data collection prior to herbicide treatments on the Outwash Plain
Photograph by Christina Kriedeman/NPS

ON THE COVER

Clockwise from top-left: Seward Community Weed Pull, SCA Intern with *Plantago major*, *Phleum alpinum* seed under microscope, KEFJ EPMT crossing Exit Creek, Biological Science Technician collecting survey data in Northwestern Fjord
Photographs by Christina Kriedeman, Geoffrey Geier, Damaris Chenoweth, and Peter Frank/NPS

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Natural Resource Report NPS/KEFJ/NRR—2019/1926

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Natural Resource Stewardship and Science
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Abstract

This report provides a summary of the work completed by the Exotic Plant Management Team (EPMT) in Kenai Fjords National Park (KEFJ) in 2018. Invasive plant species have been documented and controlled in KEFJ since 2004 in coordination with the Alaska Regional Exotic Plant Management Team program. All infestations treated in the 2017 field season were retreated in 2018. In total, the KEFJ EPMT surveyed 110.3 acres and controlled 1.9 acres of invasive plants via chemical and manual control methods on park properties. A total of 49.78 gallons of Milestone and 4.72 gallons of AquaMaster herbicide solution was applied to 1.8 acres. Seventeen invasive plant species were documented in the park and on park properties outside the boundary in 2018. A new invasive plant species to the park, stinking chamomile (*Anthemis cotula*), was documented and hand pulled along Herman Leirer Road. New infestations of oxeye daisy (*Leucanthemum vulgare*) were documented along the Glacier Overlook Loop Trail in the Exit Glacier area and in the Maintenance Facility. Native seeds from eight different species were collected from the Exit Glacier area for use in future restoration projects. No gypsy moths (*Lymantria dispar* & *Lymantria asiatica*) were found in the five traps placed in the Exit Glacier area in 2018. The KEFJ EPMT hosted the Seward Community Weed Pull in cooperation with members of the Kenai Peninsula Cooperative Weed Management Area (KP-CMWA) and participated in several outreach and educational activities including presentations given to park staff, informal talks with visitors, social media posts, and interpretive displays. The KEFJ EPMT continued to engage youth through partnerships with the Student Conservation Association (SCA) and the Youth Conservation Corps (YCC) program.

Acknowledgments

The Kenai Fjords Exotic Plant Management Team would like to thank the following individuals for their contributions to a successful 2018 field season: Alaska EPMT Regional Data Manager Peter Frank for invaluable contributions related to GIS, GPS, herbicide application, plant identification, and field planning and support; Student Conservation Association intern Damaris Chenoweth and Youth Conservation Corps employee Araya Fejes for support in daily field and office activities; Alaska EPMT Liaison Christopher Overbaugh for regional training and field support; Justin Fulkerson, Dr. Matt Carlson, and Sue Salmons for assistance in regional EPMT training; Brandon Russell, Nathaniel Carboneaux, and Amy Mitchell for support on the M/V Serac; Nathan Bawtinhimer for logistical support; and trail crew lead Aaron Vachowski and the SCA crew for assistance in planning and invasive plant removal on the Harding Icefield Trail.

List of Terms

- ABRS** – Aialik Bay Ranger Station
- AKEPIC** – Alaska Exotic Plants Information Clearinghouse
- ANICLA** – Alaska National Interest Lands Conservation Act
- eDNA** – Environmental DNA
- EDRR** – Early Detection Rapid Response
- 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
- LACL** – Lake Clark National Park and Preserve
- M/V** – Motor Vessel
- NISIMS** – National Park Service’s National Invasive Species Information Management System
- PUC** – Public Use Cabin
- SCA** – Student Conservation Association
- SNOTEL** – Snowpack Telemetry
- YCC** – Youth Conservation Corps

Introduction

Established in 1980 by the Alaska National Interest Lands Conservation Act (ANILCA), Kenai Fjords National Park is located on the southeastern coast of Alaska's Kenai Peninsula. The approximately 670,000 acre park is noted for its dramatic coastline, temperate rainforests, intertidal zones, and the Harding Icefield with the nearly 40 associated out-flowing glaciers. Ice covers approximately 48% of the park landscape.

Invasive plant species are of management concern due to their ability to outcompete native vegetation. Once established, invasive plants can crowd out native plant species and form monotypic communities. The resulting loss of biodiversity can have adverse impacts to ecosystems via loss of suitable habitat and food sources for animals; increased fire activity; changes in hydrology; changes in soil composition; loss of fish spawning habitat; and the loss of the ability to adapt to environmental changes over time.

Human activities, such as construction, vehicle travel, and recreation, are the primary mode of introduction for invasive plants into the park. Due to the relatively low level of development within the park boundary, invasive plants have been mostly limited to the Exit Glacier area and areas accessed by visitors on the outer coastline. The KEFJ EPMT has adopted an early detection/rapid response management strategy which emphasizes surveying areas for new infestations and focused treatment efforts on known populations to contain them before they spread into surrounding areas.

Management activities are divided into three primary areas: the Exit Glacier area, the coastal fjords, and the Seward area- which contains properties in town as well as the park Maintenance Facility located on Old Exit Glacier Road. With an estimated 166,591 people in 2018, the Exit Glacier frontcountry area receives the majority of visitors to the park. This area contains the only road inside the park boundary and provides visitors with easy access to Exit Glacier and the Harding Icefield via the park's only maintained trail system. As a result, this area contains the highest level of invasive plant infestations and is of primary concern to the KEFJ EPMT.

Due to the isolated and relatively undisturbed nature of the coastal fjords, this area is also a priority for the KEFJ EPMT. Known invasive plant populations along the coast are resurveyed and retreated on an annual basis to ensure these areas do not become a larger management issue by spreading further into the backcountry wilderness. Coastal campsites and other areas that might attract human use are also surveyed each year for possible invasive plants brought to the area on clothing, camping equipment and gear.

In the Seward area, both the Maintenance Facility and the Shea Parking Lot are of continuing management concern. These areas are located near roads and properties that are infested with invasive plants, and vehicles travel to and from the park from these facilities. Considerable effort is made to control invasive plants in these areas so park vehicles do not transport them into the park boundary.

Kenai Fjords National Park

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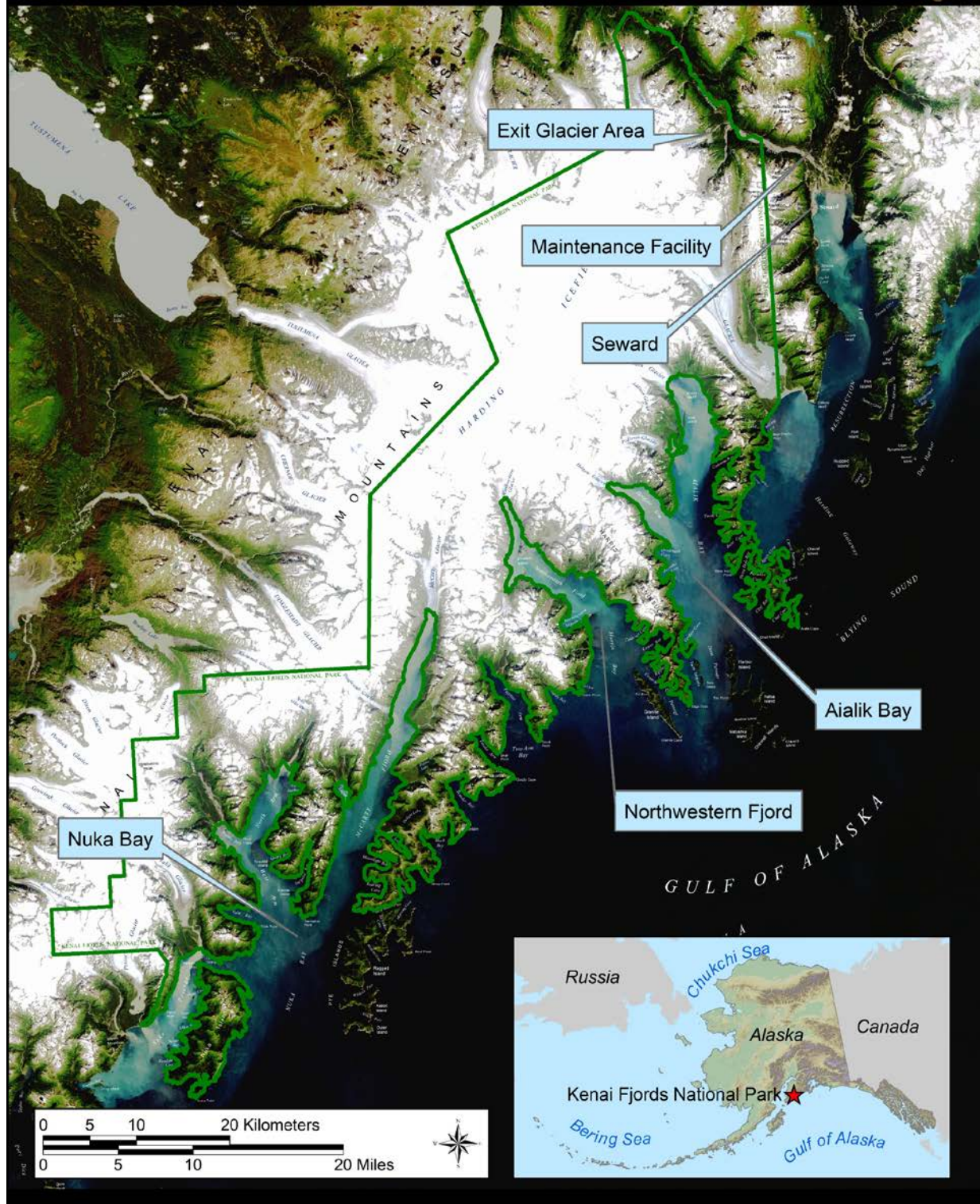


Figure 1. Overview of Kenai Fjords National Park.

Methods

Data collection and control work was performed under the guidelines provided in the 2018 Alaska EPMT Field Protocol (Overbaugh and Frank 2018a). An outline of field activities was created for each week throughout the summer based on recommendations from the previous year's weekly work summaries and final report. Priority was given to revisiting all known invasive plant sites, and new areas were selected for survey based on the potential for visitor access and proximity to known infestations. Field sites were broken into three primary management areas: Exit Glacier, the coast, and Seward.

Table 1. 2018 Project Areas.

Areas	Field Sites
Exit Glacier	Herman Leirer Road, Exit Glacier Parking Area, Campground, SNOTEL, Nature Center Plaza, Glacier View Loop Trail, Glacier Overlook Loop Trail, Harding Icefield Trail, Nike Stripe, Outwash Plain, Employee Housing, Pump House
Coastal	Resurrection Bay, Aialik Bay, Northwestern Fjord, Nuka Bay, McCarty Fjord
Seward	Maintenance Facility, Park Headquarters Building, Shea Parking Lot

The majority of field work for the 2018 season began in early June and lasted until late August. Site visit planning was determined by using a number of factors including plant phenology, accessibility, availability of staff, availability of transportation, population sizes, invasive species ranking, and weather. Cooler temperatures persisted through much of the early field season despite less than average snow accumulation over the winter. This caused plant phenology to be delayed even without much snow on the ground, so treatments were spread out over a longer period of time as plants slowly developed in June. This allowed for a greater window of time for early treatment efforts of common dandelion.

Table 2. Comparison of monthly snow depth at Exit Glacier between the last 15 year average and the winter of 2017/2018. Monthly snow depth measured at the Exit Glacier snow course.

Monthly Snow Depth	December	January	February	March	April	May
2017/18 monthly snow depth (in)	7.9	N/A	15.6	21.6	27.6	7.9
15-year monthly (2003/04-2017/18) average (in)	12.9	25.50	33.1	42.6	50.9	27.4

The Exit Glacier area contains both the highest number of invasive plant species and infested areas in the park and is the primary focus of the KEFJ EPMT. Chemical treatment of common dandelion in the Exit Glacier area, including the Outwash Plain, Herman Leirer Road, the Nike Stripe, and other small outlier populations is an early season priority. Common dandelion is one of the first species to bloom and go to seed in the summer, and access to some sites is limited when creek water levels get too high for safe stream crossings. The parking area, trails, campground, housing area and other

developed areas were surveyed throughout the summer so invasive plant species that emerge at different times would not be missed.

Surveys and herbicide treatment at the Maintenance Facility occurred early in the season and were repeated throughout the summer. Surveys for invasive plant species in the Exit Glacier area that typically emerge later in the summer were conducted in July and August. Late summer and early fall were a good time to look for invasive grasses along the Herman Leier Road since many have flowers by then which makes identification much easier.

Larger hand pulling projects such as annual bluegrass on the Harding Icefield Trail and lower trails, and the Shea Parking Lot were saved for later in the season when help from an SCA crew was available.

Two coastal trips allow for most of the priority sites to be surveyed and treated in Nuka Bay, Northwestern Fjord, and Aialik Bay. The strategy of Early Detection Rapid Response (EDRR) is crucial in these remote areas. Areas on the coast with known invasive plant populations are surveyed each year and other areas are surveyed systematically as resources and time allow. Boat travel was required to access these sites and were scheduled for July so plants could be treated before seeds dispersed. There are fewer documented invasive plant infestations on the coast, but they are a priority for survey and treatment because they are remote, tend to be small, and are typically only accessed once a year.

Table 3. Invasive plant species and locations in 2018. P = Present, H = Historically Present.

Species		AKNHP Ranking	Location			
Latin Name	Common Name		Exit Glacier	Coast	Shea Parking Lot	Maintenance Facility
<i>Alopecurus pratensis</i>	meadow foxtail	52	H	–	–	–
<i>Anthemis cotula</i>	stinking chamomile	41	P	–	–	–
<i>Bromis inermis</i>	smooth brome	62	H	–	–	–
<i>Capsella bursa-pastoris</i>	shepherd's purse	40	H	–	P	H
<i>Cerastium fontanum</i>	big chickweed	36	P	–	P	P
<i>Crepis tectorum</i>	narrowleaf hawksbeard	56	H	–	–	–
<i>Elymus repens</i>	quackgrass	59	–	–	P	–
<i>Galeopsis</i> spp.	hemp nettle	50	–	–	P	–
<i>Hordeum jubatum</i>	foxtail barley	63	H	–	–	–
<i>Leucanthemum vulgare</i>	oxeye daisy	61	P	–	P	P
<i>Linaria vulgaris</i>	yellow toadflax	69	H	–	–	–
<i>Matricaria discoidea</i>	pineapple weed	32	P	H	P	P
<i>Papaver croceum</i>	Icelandic poppy	39	H	–	–	–
<i>Phleum pratense</i>	common timothy	54	P	H	H	–
<i>Plantago major</i>	common plantain	44	P	H	P	P

Table 3 (continued). Invasive plant species and locations in 2018. P = Present, H = Historically Present.

Species		AKNHP Ranking	Location			
Latin Name	Common Name		Exit Glacier	Coast	Shea Parking Lot	Maintenance Facility
<i>Poa annua</i>	annual bluegrass	46	P	P	P	P
<i>Poa pratensis</i>	Kentucky bluegrass	52	H	–	–	–
<i>Polygonum aviculare</i>	prostrate knotweed	45	–	–	P	P
<i>Ranunculus acris</i>	tall buttercup	54	H	–	–	–
<i>Rumex acetosella</i>	common sheep sorrel	51	H	–	P	–
<i>Rumex crispis</i>	curly dock	48	H	H	P	–
<i>Stellaria media</i>	common chickweed	42	P	–	P	P
<i>Taraxacum officinale</i>	common dandelion	58	P	P	P	P
<i>Trifolium hybridum</i>	alsike clover	57	H	–	–	–
<i>Trifolium pratense</i>	red clover	53	P	–	–	–
<i>Trifolium repens</i>	white clover	59	P	–	P	H

Control Methods

Manual Treatment

Manual treatment involves physically removing plants in part or in whole by either hand-pulling or digging with hand tools. This was typically limited to small scale infestations where plants could be removed in a timely fashion with the resources available. Flowering heads of plants were removed prior to chemical treatment to ensure they did not produce viable seed. All materials manually removed were bagged and deposited in the park dumpster located in the Maintenance Facility which was taken to the Seward Waste Transfer Facility. Biodegradable bags were used to reduce the amount of plastic being placed in the landfill.

Chemical Treatment

Two herbicides, Milestone (Aminopyralid) and AquaMaster (Glyphosate), were utilized to treat invasive plants in 2018. Milestone was applied at a rate of 6 ounces per acre to common dandelion (*Taraxacum officinales*), common chickweed (*Stellaria media*), big chickweed (*Cerastium fontanum*), pineapple weed (*Matricaria discoidea*), and prostrate knotweed (*Polygonum aviculare*). AquaMaster was applied at a rate of 48 ounces per acre to annual bluegrass. The KEFJ Biological Science Technician and SCA intern performed herbicide applications under the Alaska pesticide applicator license of the KEFJ Biologist. All herbicide use and reporting was documented in the NPS Pesticide Use Proposal System (PUPS).

Data Collection and Analysis

All data collected in the field was recorded using guidelines provided in the 2018 Alaska Exotic Plant Management Team Field and Office Protocols (Overbaugh and Frank 2018a and b). Treatment and survey data was recorded using a Trimble 7X and Trimble XT6000 Global Positioning System (GPS) equipped with TerraSync software. Data was post-processed with Trimble Pathfinder Office

software and uploaded to the Alaska Region EPMT network drive on a weekly basis. Final data was post-processed by the AK EPMT Regional Data Manager into a Geospatial Information System (GIS) geodatabase. Annual EPMT data was also incorporated into the Alaska Exotic Plants Information Clearinghouse (AKEPIC) and the National Invasive Species Information Management System (NISIMS) databases.

Herbicide applications were also documented through herbicide treatment data sheets and in an herbicide treatment spreadsheet. Weekly field reports were generated to document invasive plant work and timing of control activities. All paper copy datasheets were scanned and stored on the KEFJ network drive.

Standardized polygons were utilized to collect herbicide treatment data on Herman Leirer Road, the Outwash Plain, Dingledale Glacier and the Maintenance Facility. This data collection method utilizes a standardized boundary for a given treatment area that remains constant from year to year. The amount of herbicide used each season within the standardized area can be compared to the previous years' data to determine efficacy of treatments and can be more accurately tracked over time. Only a single data point with herbicide information needs to be taken for each standardized polygon, allowing for much more efficient data collection in the field.

Personnel

The KEFJ EPMT consisted of four full time staff members in 2018 and was assisted on multiple occasions by the Alaska EPMT Data Manager Peter Frank who worked from the KEFJ office in 2018. KEFJ Biologist Christina Kriedeman completed all planning and compliance, supervised the crew, and performed herbicide application. Biological Science Technician Geoffrey Geier led day-to-day field activities and oversaw work performed by Student Conservation Association (SCA) intern Damaris Chenoweth and Youth Conservation Corps (YCC) employee Araya Fejes. Alaska regional EPMT Liaison Chris Overbaugh and Peter Frank assisted with herbicide treatments in KEFJ on the Outwash Plain. An SCA crew assisted in hand-pulling invasive plants on the Harding Icefield Trail the lower trails located in the Exit Glacier area, and in the Shea Parking Lot in Seward.



KEFJ EPMT crossing Exit Creek.

Results

2018 Season Overview

All known invasive plant infestations from 2017 were revisited and retreated in 2018. The KEFJ EPMT conducted chemical and mechanical control efforts in these areas and surveyed for new infestations. Early season priority was given to chemically treating common dandelion found in the Outwash Plain due to low, safe water levels at Exit Creek. Priority was given to treating invasive plants with herbicide at the Maintenance Facility and Herman Leirer Road as well, due to the larger infestations found there. The delay of plant growth due to cool spring temperatures allowed the EPMT to delay smaller, manually controlled projects around the Exit Glacier area, including the Exit Glacier parking area and the Nike Stripe, and permitted extra time to focus on chemical treatments of Herman Leirer Road and the Maintenance Facility.

Revisiting infestations and surveying new areas on the coast continued to be a high priority in 2018. A total of 8 days were spent surveying areas of Nuka Bay, McCarty Fjord, Northwestern Fjord, and Aialik Bay. No new infestations were found aside from a satellite population near a known common dandelion population on a beach at the head of the North Arm of Nuka Bay. In August, an SCA crew assisted in hand-pulling annual bluegrass on the Harding Icefield Trail and common plantain, annual bluegrass, and common chickweed in the Shea Parking Lot in Seward.

No restoration projects were performed in 2018, although restoration sites from 2015 and 2017 were monitored. Species composition was inventoried and photos were retaken at established points to monitor the success of restoration efforts. Native seeds from eight different species were collected from the Exit Glacier area for use in future restoration projects.

Elodea monitoring in KEFJ freshwater lakes continued in 2018. Surveys were performed by Lake Clark National Park and Preserve fisheries staff. Funding for this survey was provided through the Alaska Regional EPMT program with National Park Service project funding to complete Elodea surveys in Lake Clark National Park and Preserve, Katmai National Park and Preserve and Kenai Fjords National Park during 2017 and 2018. Delight and Desire Lakes were visited on September 6, 2018 via float plane. Both rake throw surveys and eDNA sampling was done. Results of eDNA sampling in 2018 are pending, but no Elodea was detected during visual and rake throw surveys of both lakes. The KEFJ EPMT also participated in the gypsy moth monitoring program with the Alaska Division of Agriculture (ADOA) and did not detect any gypsy moths.

The Seward Community Weed Pull was held on June 22nd at Seward Middle School. The event was a collaborative effort among Kenai Peninsula Cooperative Weed Management Area (KP-CWMA) members, which included KEFJ, Chugach National Forest, Homer Soil and Water Conservation District, and the Kenai Watershed Forum. In total, 650 pounds of a combination of common dandelion, bird vetch, and yellow toadflax were hand pulled by 29 participants. Other outreach and educational events include, social media posts, formal talks to park staff and volunteers, and interpretive displays at Exit Glacier which included a boot brush at the Exit Glacier Nature Center orientation sign and at the Harding Icefield Trail register.

Exit Glacier Area

Herman Leirer Road

Chemical treatment of the common dandelion infestation on the Herman Leirer Road began in 2015. In 2018, between June 20th and 25th, 6.425 gallons of Milestone herbicide solution were used to treat .214 acres of common dandelion on the section of the Herman Leirer Road located within the park boundary. Standardized polygons were used to document treatment data for the first time at this site. A second retreatment of common dandelion was performed between July 31st and August 1st and on August 22nd resulting in .061 additional acres treated with 1.84 gallons of Milestone solution.



KEFJ EPMT applying herbicide on Herman Leirer Road.

Ten white clover (*Trifolium repens*) plants were also treated during this time on the south side of the road east of the campground. A new invasive species to the park, stinking chamomile, was documented and this small population of plants was hand pulled on the south side of the road near the park entrance. The only record of this species in the Seward area found in the Alaska Exotic Plants Information Clearinghouse (AKEPIC) statewide database was found along the railroad tracks next to the Seward Airport in 2006. This species may possibly have been brought in on equipment used during a road construction project in 2016. One common timothy (*Phleum pretense*) plant was hand pulled on the road near the entrance to the Exit Glacier campground. Meadow foxtail (*Alopecurus pratensis*) and smooth brome (*Bromus inermis*) have been chemically treated in previous seasons along the north side of the road, but park roadsides were brushed before the KEFJ EPMT could identify these species in 2018.



Stinking chamomile found next to the park road for the first time.

Exit Glacier Parking Area

The Exit Glacier parking area was routinely surveyed throughout the summer for invasive plants in 2018. The sheep sorrel (*Rumex acetosella*), last documented in 2016 near the sound end of the bus unloading and parking zone, was not found in 2018. Common dandelion located in the north section of the parking area, from the entrance road to the vault toilets, were treated with .225 gallons of Milestone solution. This marks the first time chemical treatments have been applied in the Exit Glacier parking area. Common plantain, common dandelion, pineapple weed, and white clover were hand pulled in the remaining sections of the parking area.



SCA Intern and YCC employee hand pulling dandelion in the Exit Glacier parking area.

Campground

Until 2017, the campground remained relatively free of invasive plants (Sniegocki and Kriedeman 2016). Due to the low number of invasive plants, this area was surveyed approximately every three

weeks as time allowed. Four common dandelion plants were manually controlled along with a small patch of annual bluegrass in the camping area. The annual bluegrass population located in the campground parking lot was first treated with 0.25 gallons of AquaMaster herbicide solution in 2017 (Geier and Kriedeman 2018). This year, 0.23 gallons of AquaMaster herbicide solution was used to treat .008 acres of annual bluegrass in the same area.

SNOTEL

Common dandelion has been documented and controlled at the Snowpack Telemetry (SNOTEL) site located near employee housing in the Exit Glacier area since 2013 when one plant was documented and hand pulled. In 2014, the population grew to over 50 plants and was hand pulled (Kainrath and Kriedeman 2014). Chemical treatment with Milestone began in 2015 and 45 common dandelions were treated (Stover and Kriedeman 2015). In 2018, two common dandelion plants were treated with Milestone solution. This site continues to be a strong candidate for complete invasive plant eradication in the near future.

Nature Center Plaza

The Nature Center Plaza was another area routinely surveyed by the KEFJ EPMT. Common dandelion, common plantain, pineapple weed, common chickweed, and annual bluegrass were hand pulled from plaza in 2018. A population of annual bluegrass located behind the Nature Center in the picnic area has continued to spread. It was hand pulled again in 2018.

Annual bluegrass located at the pump house located behind the Nature Center Plaza had been hand pulled for several years and the population continued to increase. In 2018, the decision was made to chemically treat this population. A total of 0.75 gallons of AquaMaster herbicide solution was applied. The initial treatment killed all annual bluegrass on the site, although some new plants sprouted from seed near the end of the season.

Glacier View Loop Trail

Common dandelion, common plantain, common chickweed, and pineapple weed were found scattered along the trail and hand pulled from the Glacier View Loop Trail (formerly named the Trail to the Glacier View). Annual bluegrass populations found primarily on the paved portion of the trail were hand pulled with the SCA crew on August 6th and 7th. It has been hand pulled since 2010, but continues to spread along the trail. In 2014, a small population of common dandelion was documented in a forest clearing located in the middle of the Glacier View Loop Trail and was hand pulled. Chemical treatment began in this area in 2015. In 2018, 0.032 gallons of Milestone herbicide was used to treat 0.001 acres of common dandelion. Twenty-nine plants were hand pulled when the area was resurveyed on August 29th.



SCA crew hand pulling annual bluegrass on the Glacier View Loop Trail.

Glacier Overlook Loop Trail

The Glacier Overlook Loop Trail (formerly named the Trail to the Edge of Glacier) was routinely surveyed by the KEFJ EMPT in 2018. Scattered common plantain, and annual bluegrass plants were hand pulled along the trail. A small common dandelion population continued to persist at a switchback on the north side of the loop even after years of hand pulling. One hundred and eight plants were hand pulled in 2018. One common timothy plant located on the north side of the loop and one red clover (*Trifolium pretense*) plant located on the south side of the loop were hand pulled. This is the first time either of these species have been identified on this trail. A new population of oxeye daisy was documented on August 30th and hand pulled from the north side of the loop. Thirty-six small plants were hand pulled. Oxeye daisy has occurred sporadically in the Exit Glacier area, but has not been documented since 2009 (Kurtz 2009).

Harding Icefield Trail

The invasive plant species found along the Harding Icefield Trail (HIT) in 2019 included annual bluegrass, common dandelion, and common plantain. One common dandelion and one common plantain plant were found in Marmot Meadows at mile 1.4 on the trail. A persistent population of common dandelion located at an old section of trail at mile 0.25 was treated with herbicide for the third year in 2018. This population was initially treated with herbicide in 2016 with 0.039 gallons of Milestone herbicide solution. On June 26th, seven common dandelions were treated with 0.007 gallons of herbicide solution. This marks a significant decline in the common dandelion population in this area. The dandelions that were treated in this area in 2018 were very small rosettes, which could be due to the prolonged cooler temperatures earlier in the season which may have delayed development.

An SCA crew has been assisting in annual bluegrass removal on the HIT since 2010 (Kurtz 2010). In 2018, the SCA crew helped hand pull annual bluegrass between the cliffs section of the trail (mile 1.6) down to a section of trail below the bridge (mile 0.5). In total, 175 pounds of annual bluegrass was removed on August 6th and 8th.



SCA crew hand pulling annual bluegrass on the Harding Icefield Trail.

Nike Stripe

Common dandelion have been documented and controlled since 2004 in the area locally known as the Nike Stripe. Chemical treatments of this population began in 2012 using the herbicide Milestone. In 2018, seven common dandelions were manually removed. Since the population of common dandelion was so low, it was determined that chemical treatment was not necessary. No plants were found during a site revisit in mid-August. This marks a dramatic decrease in the common dandelion population since chemical treatments began, making this site a strong candidate for complete eradication and a success story of the KEFJ EPMT program.

Outwash Plain

Common dandelion has been treated with herbicide in the Outwash Plain since 2011 and standardized polygons have been used to track efficacy of treatment since 2016. Exit Creek remained low enough to safely cross until all known populations were treated in 2018. The KEFJ EPMT spent seven days treating common dandelion and surveying new areas in the Outwash Plain. In total, 1.25 acres of common dandelion were treated using 37.4 gallons of Milestone herbicide solution. Treatment data was recorded using the standardized polygon method for each location, with the exception of a few small outlier populations. Two new standardized polygons (Outwash_10 and Outwash_11) were mapped and treated this summer.



Filling backpack sprayers on the Outwash Plain.

2018 marked the first year that all known common dandelion infestations were chemically treated in the same season on the Outwash Plain. After using standardized polygons for data collection for eight sites over three years, a reduction in area treated and herbicide used was found to be decreasing over each treatment.



SCA Intern mapping invasive plants on the Outwash Plain.

Table 4. Decrease in acres infested with common dandelion on the Outwash Plain calculated by the amount of herbicide mix applied in each standardized polygon since 2016.

Infested Area (acres)					
Standardized Polygon Name	2016	2017	2018	Difference	% Decrease
Outwash 1	0.16	0.05	0.04	0.12	74%
Outwash 2	0.25	0.06	0.03	0.21	86%
Outwash 3	0.10	0.06	0.01	0.09	88%
Outwash 4	0.03	0.02	0.00	0.02	89%
Outwash 5	0.03	0.02	0.01	0.02	71%
Outwash 6	0.29	0.25	0.10	0.19	65%
Outwash 7	0.18	0.13	0.07	0.11	62%
Outwash 8	0.05	0.02	0.01	0.04	74%

Four outlier populations of common dandelion located south of Herman Leirer Road and on the north side of Exit Creek were treated twice in 2018. These areas were accessed by crossing the small creek running parallel to Herman Leirer Road near the Resurrection River Bridge. A total of .015 acres of common dandelion were treated with .466 gallons of Milestone.

Employee Housing

There continued to be small, scattered populations of common dandelion, common plantain, pineapple weed, and annual bluegrass throughout employee housing and the housing parking lot in the Exit Glacier area. This area was routinely surveyed and invasive plants were hand pulled when documented. Common dandelion and annual bluegrass were first documented in the Trail Builder's Camp and on the trail leading to the campsite in 2017 (Geier and Kriedeman 2018). Small patches of common dandelion and annual bluegrass were hand pulled from this area in 2018.

Coastal Areas

Resurrection Bay

Bulldog Cove located in Resurrection Bay was surveyed for invasive plants for the first time since 2016. No invasive plants were found in this location in 2018.

Aialik Bay

All known invasive plant populations in Aialik Bay were surveyed and treated in 2018. This included annual bluegrass populations found at the Aialik Public Use Cabin (PUC), Holgate PUC, Abra Cove, and Pederson Lagoon outer beach.

Annual bluegrass infestations located at Pedersen Beach and Abra Cove were small and sporadic, whereas annual bluegrass located at both PUCs had formed dense mats around the cabins and along access trails. 0.5 square feet was hand pulled at Abra Cove, 10.32 square feet at Holgate PUC, and 60.2 square feet at Aialik PUC. The team pulled 2.4 square feet of annual bluegrass at Pedersen Lagoon outer beach. This site is on private land owned by Port Graham Corporation and leased by Kenai Fjords Glacier Lodge. Although this is private property, control work is performed as a

courtesy and with permission to ensure invasive plants at this site do not spread to surrounding park lands.

Beaches located at Aialik Bay Ranger Station (ABRS), Tooth Cove, Bear Cove, Quicksand Cove, McMullen Cove, and the beach in front of Holgate PUC were surveyed for invasive plants with none found.



Annual bluegrass being hand pulled around Aialik Public Use Cabin.

Northwestern Fjord

In 2018, seven beaches were surveyed in Northwestern Fjord. Surveys focused primarily on beaches with food storage lockers which are frequently used by visitors who kayak and camp in the fjords. The beaches near Southeastern Glacier, Northeastern Glacier, Sunlight Glacier, and the beach located near the moraine on the western shore of Harris Bay were surveyed and no invasive plants were found. One known annual bluegrass infestation located next to a bear food storage locker on a camping spit north of the moraine was also surveyed and treated. In total 5.22 square feet of annual bluegrass was manually controlled at this site.

McCarty Fjord

Common dandelion have been documented and treated on a hillside adjacent to Dinglestadt Glacier since 2006 (Wetherbee 2006). Chemical treatment began in 2013 where 2.5 gallons of herbicide was applied to the common dandelion infestation (Frank 2014). This area continues to be the high priority site in McCarty Fjord for the KEFJ EPMT. In 2018, 151 common dandelions were treated with 0.375 gallons of Milestone herbicide solution. A new standardized polygon was created for this site in 2019. Since it can be difficult to find each infestation in this steep and brushy area, individual plant

infestations within the site were also mapped without treatment data for use in navigating back to them in the future.



Chemically treating common dandelion near Dinglestadt Glacier.

Two other areas in McCarty Fjord were surveyed for invasive plants. The beach outside of James Lagoon was surveyed for invasive plants as well as the site of an old field camp on the beach north of Dinglestadt Glacier. No invasive plants were found at either site.

Nuka Bay

Two known invasive plant populations in Beauty Bay and North Arm of Nuka Bay were surveyed again in 2018. Common timothy and common dandelion have been documented near an old runway at the head of Beauty Bay, but were not found in 2018.

A documented population of common dandelion found on the beach at North Arm was retreated. Two new common dandelion infestations west of the known population were discovered and treated in 2018. In total 0.13 gallons of Milestone herbicide solution were applied to 174.24 square feet of common dandelion in North Arm.



Chemically treating common dandelion in North Arm.

Seward

In 2017, common dandelion, common plantain, annual bluegrass, common chickweed, and pineapple weed were hand pulled with the help of the SCA crew around the Visitor Center located in the Seward Small Boat Harbor (Geier and Kriedeman 2018). Most of the invasive plants found around the building in 2017 were eliminated during a building renovation construction project during the fall of 2017, so no control work was completed here in 2018.



SCA crew hand pulling invasive plants in the Shea Parking Lot.

Invasive plants in the Shea Parking Lot located on 3rd Avenue were manually controlled in 2018. Focus was given to the lower lot where most of the park vehicles were being stored next to the Shea Building. Common plantain, annual bluegrass, and common chickweed, were removed from the site with the help of the SCA crew.

Maintenance Facility

The Maintenance Facility, located on Old Exit Glacier Road, continued to be a high priority for the KEFJ EPMT in 2018. The maintenance yard was treated with herbicide four times over the summer. Treatments occurred on June 8th, June 28th, July 2nd, and July 31st in an effort to control annual bluegrass, common chickweed, big chickweed, common dandelion, pineapple weed, prostrate knotweed, and common plantain. In total 3.34 gallons of Milestone solution and 3.74 gallons of AquaMaster solution were used. A standardized polygon was used to record herbicide use at this site for each treatment.



Chemically treating annual bluegrass in the Maintenance Facility.

Elodea Monitoring

Both Delight and Desire Lakes have been surveyed for the invasive aquatic plant Elodea once by the KEFJ EPM. Delight Lake was surveyed in 2016 and Desire Lake was surveyed in 2017. The lakes were surveyed via pack raft (after traveling by boat from the City of Seward and hiking in to the lakes). The park completed both visual surveys and water sampling for eDNA analysis in both lakes, but were not able to complete the far ends of the lakes due to time constraints.

In 2018, Elodea surveys were performed at Delight and Desire Lakes by Lake Clark National Park and Preserve (LACL) fisheries staff via float plane. The goal was to survey portions of the lakes that the KEFJ EPMT could not reach by pack raft during Elodea surveys conducted in 2016 and 2017. Using a float plane allowed LACL staff to survey both lakes in one day and to access all areas of the lake that are susceptible to Elodea infestation. Funding for 2018 surveys were provided through National Park Service Recreational Fee Public Land Corps (PLC) funding source.

On September 6th, LACL staff collected water samples for eDNA analysis and completed rake throw surveys in both Delight and Desire Lakes. Water samples for eDNA analysis were taken at two sites. One sample was taken at the inlet and one from the outlet of each lake. These samples were pumped through a filter to collect any elodea DNA that may be present in the lake. The filters were sent to the USGS Molecular Ecology Laboratory in Anchorage for analysis. Fifteen rake throw samples were taken at Delight Lake and 10 rake throw samples were taken at Desire Lake. It was reconfirmed from previous surveys that there is no aquatic vegetation (native or non-native) growing in the lakes at this time.

Results from eDNA sampling in 2016 are negative for Elodea in Delight Lake. Results from eDNA sampling at Desire Lake in 2017 and sampling in 2018 for both Delight and Desire Lakes are pending at this time.



LACL staff doing Elodea surveys on Delight Lake from a float plane.

Outreach and Education

The KEFJ EPMT hosted the annual Seward Community Weed Pull at Seward Middle School on June 22nd in cooperation with members from the Kenai Peninsula Cooperative Weed Management Area which included Chugach National Forest, Homer Soil and Water Conservation District, and the Kenai Watershed Forum. A total of 29 participants manually controlled 650 pounds of a combination of bird vetch, common dandelion, and yellow toadflax (*Linaria vulgaris*).



Participants in the Seward community weed pull.

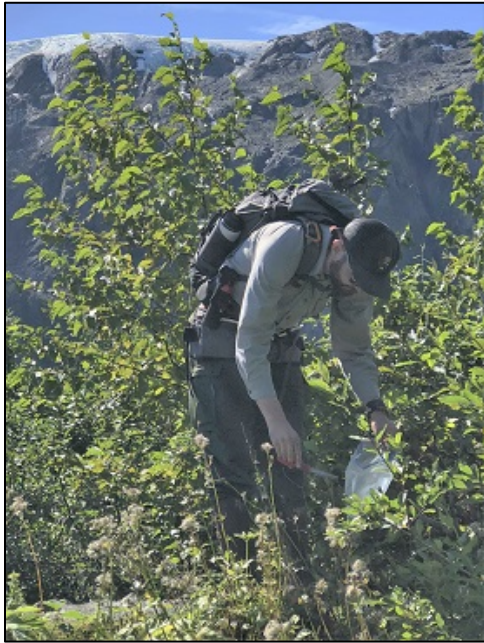
Social media updates were posted by the EPMT on topics that included the Seward Community Weed Pull, lichens, native seed collection, common dandelion and Elodea. Informative talks related to invasive plant management and prevention were given to park staff during Interpreter training in the spring, to the SCA trail crew and to the general public. New in 2018, boot brushes were installed next to the orientation sign in the Nature Center Plaza and the Harding Icefield Trail register with interpretive displays on how to clean boots to prevent the spread of invasive species into the park.



Boot brush in front of the Exit Glacier Nature Center.

Restoration and Prevention

Native seeds were collected from the Exit Glacier area throughout August and September as seeds ripened. Seeds were sent to the Alaska Division of Agriculture, Alaska Plant Material Center for processing and cleaning and will be stored for use in future restoration projects. No reseeding projects were completed in 2018.



Collecting native seeds near Marmot Meadows on the Harding Icefield Trail.

Monitoring was completed for revegetation projects seeded in 2017 along Herman Leirer Road and in 2014 on the Glacier View Loop Trail. The success of the projects were assessed using photo points and documenting plant recruitment from seeds. In the three revegetation sites on Herman Leirer Road, lupine (*Lupinus nootkatensis*), columbine (*Aquilegia formosa*), and alpine bluegrass (*Poa alpina*) planted from seed in 2017 were growing in each of the three revegetation plots. There were also several grass species that had germinated from seed, but could not be identified due to their small size. Sitka alder (*Alnus viridis*), black cottonwood (*Populus balsamifera*), Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*), dwarf fireweed (*Chamerion angustifolium*), horsetail (*Equisetum arvense*), and a couple of native grasses including red fescue (*Festuca rubra*) and tufted hairgrass (*Deschamsia caespitosa*), recruited naturally from surrounding areas.

Four sites along the Glacier View Loop Trail that experienced heavy social trail use along the bank of Exit Creek were revegetated in 2014. These sites were monitored in 2015 and photo points along with a plant inventory were taken. In 2018, species documented in the restoration sites that were part of the native seed mix included lupine, alpine timothy (*Phleum alpinum*), spiked trisetum (*Trisetum spicatum*), and meadow barley (*Hordeum brachyantherum*). Sitka alder (*Alnus viridis*) was also successfully recruited onto these sites.

Gypsy Moth Monitoring

The KEFJ EPMT continued to participate in the gypsy moth monitoring program in partnership with Alaska Department of Agriculture. Five gypsy moth pheromone traps were placed in the Exit Glacier area from June until September and monitored each month throughout the summer field season. The traps were located behind the Nature Center, in the Exit Glacier parking area, in the picnic area, in the employee parking lot, and near the campground parking lot. These sites were selected based on their proximity to parking lots where recreational vehicles coming from infested states could potentially carry gypsy moth egg masses on the underside of the vehicle, or on other gear or firewood. No gypsy moths were detected in any of the five traps in 2019.



Installing gypsy moth traps in the Exit Glacier area

Discussion and Recommendations

Exit Glacier Area

The Exit Glacier area is the highest priority area for invasive plant work in the park for the KEFJ EPMT. The goal to revisit and retreat all known invasive plant populations should continue to be a priority. The only road into the park ends here and the most visitor use in the park occurs here as well. Trails in the Exit Glacier area have been relatively free of invasive plants, but in recent years there has been an increase in the number of species and they have spread farther down the trails where there were none before. An increasing number of visitors coming to the park each year and more invasive plants populating the roads and highways leading to the Exit Glacier area both increase the chances for more invasive plants to spread into the park. An early detection/rapid response strategy needs to continue to be a priority for addressing invasive plant management efforts in this area to locate and control new invasive plant populations quickly and efficiently.

Herman Leirer Road

The use of standardized polygons along the roadside proved to be an easier and more accurate system of recording treatment data and tracking the efficacy of herbicide use over time. This documentation technique also allowed for treatment to be completed in a much timelier manner since only one data point was taken in each of the eight standardized polygons. The individuals applying herbicide no longer had to wait while each infested area was mapped and treatment information was entered into the GPS unit for each small infestation. Because this method reduced the amount of time needed to treat the entire roadside, retreatment later in the season was made possible. The use of standardized polygons should continue in the future for these reasons and to track treatment efficacy over time.

Early season communication with maintenance staff should also be a priority. The roadside was brushed in July before the KEFJ EPMT staff could relocate invasive grass populations. The KEFJ EPMT should flag these areas in June and communicate with the maintenance staff to let them know the locations of invasive grasses targeted for treatment and to avoid these areas during brushing projects.

During a revegetation monitoring survey, an unidentified species of timothy grass (*Phleum spp.*) was collected on the moraine on the south side of Herman Leirer Road that was reseeded in 2017. The specimen exhibited traits of both the native *Phleum alpinum* and the invasive *Phleum pratense* and was sent to the University of Alaska Anchorage for identification and it was found to be the native *Phleum alpinum*. These two species can be difficult to tell apart especially if the non-native *Phleum* is small, and care should be taken in identification of these plants to avoid confusing them.

Exit Glacier Parking Area

The north side of the parking area at Exit Glacier was chemically treated for the first time in 2018. Consideration should be made to chemically treat a larger portion of the edge of the parking lot and roads in 2019. Common dandelion have been hand pulled in this area since 2004 and continue to persist. To avoid conflicts with visitor use of this area, herbicide treatment should be timed to occur when the fewest visitors are using the area.

Exit Glacier Nature Center

A population of annual bluegrass and common chickweed found behind the Nature Center in the picnic area should be a candidate for chemical treatment. This site has been hand pulled since 2012 and the infestation continues to spread at this location. This area is not used by visitors as frequently now since a picnic area was created next to the south side of the parking area, so herbicide treatment would not impact visitor access to this facility.

Annual bluegrass was chemically treated at the pump house for the first time in 2018. Manual control of this infestation in previous years has shown little efficacy and the population has continued to spread. Chemical treatment and data collection took a total of 15 minutes with one individual completing the work. All the annual bluegrass treated around the pump house died after one application. The KEFJ EPMT should monitor the area treated in 2018 and retreat any new plants that germinate from seeds in 2019.

Glacier View Loop Trail

The Glacier View Loop Trail used to be fairly free of invasive plants other than the paved portion of the trail, but now more of the common invasive plant species are starting to be more prevalent along the portion of the trail that parallels Exit Creek. Surveys of the trail should be completed throughout the summer so that invasive plant species that mature at different times during the summer can be identified and hand pulled.

The annual bluegrass populations found along the paved portion of the trail is expanding even after 8 years of hand pulling. The seed bank has become established and plants germinate from seed after the population has been hand pulled. Treatment of this population with herbicide should be considered to control annual bluegrass at this location and reduce the seed source that may be spreading to other sites along the trails. Herbicide application timing should be planned to cause the least impacts to park visitors using the trail.

The small common dandelion population found in a forest clearing in the middle of the Glacier View Loop Trail should continue to be a priority for herbicide application. It has responded well to herbicide treatment and should be resurveyed throughout the summer to insure that plants are not allowed to go to seed.

Glacier Overlook Loop Trail

Increased attention should be taken to survey the Glacier Overlook Loop Trail throughout the summer in 2019. This is another trail that has had few invasive plants in the past, but has seen an increase in recent years. In 2018, two invasive plant species new to this trail were discovered and treated. It is especially of concern that a population of oxeye daisy seedlings were found next to the trail. This is an invasive plant that has spread widely along roadsides in the Seward area. Red clover (*Trifolium pretense*) has only ever been found along the park roadside in the past, but was found on this trail in 2018. This trail is the gateway to areas with disturbed soil that has been left unvegetated by the impact of Exit Glacier and changes in stream morphology. There are large areas for invasive plants to easily populate without competition from native plants.

Campground

Small scattered populations of annual bluegrass and common dandelion continue to infest the campground. Hand pulling is still effective in these areas since the populations are small. However, the larger annual bluegrass infestation in the parking lot should continue to be treated with herbicide. The campground itself should continue to be routinely surveyed for invasive plants and manually controlled accordingly.

Nike Stripe

The Nike Stripe should continue to be a priority for survey and control work by the KEFJ EMPT. This site represents a major success story for the program when considering much of this area was covered in common dandelion when initially documented in 2004. After six years of treating this site with herbicide, there were only seven common dandelions hand pulled in 2018, representing an almost complete eradication. Follow up visits to the Nike Stripe should be completed each field season to ensure continued success.

Outwash Plain

Collecting data utilizing standardized polygons has proven to be a very effective method of both recording herbicide treatment information and delineating treatment areas since they were first utilized in 2016. After 3 years of consistently treating common dandelion in 8 standardized polygons in the Outwash Plain, there has been a steady reduction in the common dandelion population and each summer it has been necessary to apply less herbicide to these populations. The herbicide applied to each polygon has been reduced by an average of 76 percent between 2016 and 2018.

Standardized polygons should continue to be used in future treatments to track the efficacy of herbicide use over time. Tasking two or three team members with flagging treatment areas and pulling flower heads ahead of herbicide applicators continued to work well in 2018. Flagging was used to divide the polygons into smaller subsections to help applicators keep track of areas they already sprayed. This was a new method that worked well in 2018 and should be considered for future treatments on the Outwash Plain.

Surveying areas outside of the standardized polygons for invasive plant infestations should continue to be a priority. As common dandelion populations continue to decline after treatment, more time can be allotted to scouting other areas on the Outwash Plain. Any new infestations should be mapped as standard polygons since this has worked well to track treatment progress over time.

Dry bags were utilized to fill back pack sprayers with water to mix herbicide solution in areas of the Outwash Plain where water was available. Special precaution was taken to only fill from clear, moving streams to avoid filling the sprayers with silt and debris. This method should be utilized during future treatments to reduce the chances of injuries to individuals carrying extra water and weight in backpacks while hiking and crossing Exit Creek. Having water available to use in this remote area increases the KEFJ EPMTs daily herbicide treatment capacity since it will no longer be limited by the amount of water that can be carried onto the site in containers.

Harding Icefield Trail

Annual bluegrass has been manually removed from the Harding Icefield Trail since 2010. Annual bluegrass populations have been contained, but have not been reduced in size after hand pulling along the trail for 8 years. This has been a project that typically utilizes an SCA crew in addition to the KEFJ EPMT to hand pull patches of annual bluegrass found along the edge of the trail. Consideration should be given to chemical application to this annual bluegrass population to increase efficacy of treatment and to reduce the amount of labor and time needed for this project.

Coastal Areas

The KEFJ EMPT employs an early detection/rapid response strategy when combating invasive plants. Coastal surveys best represent this practice where small infestations are documented and controlled before they spread into surrounding areas and create a larger management problem. Surveying areas to search for unknown invasive plant populations on the coast should continue to be a priority of the EPMT. Documented invasive plant populations should continue to be resurveyed and controlled on an annual basis to ensure these populations remain at an easily managed level. Areas along the coast should be systematically surveyed each year where no known infestations occur in order to detect any invasive plants populations while they are still small and to maximize the area covered in a limited amount of time.

A spreadsheet was created in 2018 to track which areas of the coast have been surveyed, and the year and frequency of visits to each site. This spreadsheet should be utilized in the future when planning coastal operations for invasive plant surveys to take a more systematic approach to surveys efforts.

Maintenance Facility

The maintenance facility should continue to be a priority for chemical treatments. Park vehicles entering and exiting this area act as potential vectors for the spread of invasive plants into the park boundary. Utilizing a standardized polygon to record treatment information proved to be a much easier and efficient way of tracking herbicide use on each species and should be used in future seasons. Two complete retreatments were made at this site in 2018. Resurveys and retreatments should continue to be completed to ensure all invasive plants are treated as they emerge throughout the summer.

Seward

Shea Parking Lot

A portion of the Shea Parking Lot invasive plant population was manually controlled in 2018. This practice has shown very little efficacy in previous seasons due to the large scale of the infestation and its location in Seward where invasive plant seed sources surround the property. Control work in the parking lot has traditionally been done with the assistance of an SCA crew due to the amount of time needed to manually control only a small portion of the parking lot. Park maintenance workers weed wack the parking lot throughout the season, which helps eliminate flowering heads from common dandelion and other species, but does not reduce the invasive plant population overall. Consideration should be made to finding alternative methods to control invasive plants in this area. Herbicide treatments would be the most efficient and cost effective, however this may not be desirable due to

the proximity of privately held property adjacent to the parking lot. Paving the parking lot would be the best solutions, but would be expensive to install and maintain.

Elodea

Elodea surveys and eDNA sampling have been performed twice at both Delight and Desire Lakes. The only other freshwater lake large enough to accommodate float planes inside the park boundary is Addison Lake near Pedersen Lagoon. This lake has yet to be surveyed for Elodea and it is unclear if float planes are accessing this lake. Surveying this lake and determining the level of float plane use should be a priority in 2019. The park should continue to monitor these three lakes on a cyclical basis to detect Elodea infestations while they are still small and easier to control.

Prevention

Any future contracts related to construction in Kenai Fjords National Park should include language concerning the prevention of the spread of invasive plants. Language should include instructions on cleaning any equipment prior to arriving in the park and removal strategies if invasive plants are found after construction is complete. Frequency of invasive plant surveys should be increased around road construction sites since these areas have a high likelihood of invasive plant introduction.

Each SCA crew should continue to be given an informal talk about how to help prevent the spread of invasive plants while working in the park.

Restoration

No restoration projects were performed in 2018, however possible sites should be evaluated each season. In 2017 portions of the Herman Leirer Road were reseeded using a seed mix that was collected from several previous years. This only amounted to a small section of roadside coverage. Due to the limited quantity of seeds available, large areas can only be reseeded a small section at a time. Use of seeds can also be utilized for small scale construction projects or social trails in the Exit Glacier area. Photo points taken of restoration sites on Herman Leirer Road in 2018 should be revisited and retaken in 2019 to track the success of past restoration projects.

Only a limited number of plant species have proven effective for reseeding in restoration projects and occur in small populations in the Exit Glacier area. Native seed should continue to be collected each year in order to build up the park's seed bank for future restoration projects. The Alaska Division of Agriculture, Alaska Plant Materials Center should continue to be utilized to process and clean native seeds collected in the park.

Outreach and Education

The KEFJ EPMT should continue to partner with members of the Kenai Peninsula Cooperative Weed Management Area to involve the local community in the Seward community weed pull, public workshops, and other outreach and education activities. Participation in quarterly KP-CWMA meetings throughout the year should be attended in person or by conference call. This organization includes a variety of federal agencies and non-governmental organizations that work together across boundaries to control invasive plants on the Kenai Peninsula and is an important collaborator across the peninsula.

Updates and successes about the status of invasive plant control projects should continue be communicated to staff during interpretive training presentations and through park emails. Updates on the status of projects increases understanding about what invasive plant work is being completed in the park and how it has been successful.

Efforts should be expanded to educate park staff on what they can do to reduce the chances that they will become a vector to the spread of invasive plants while working in the park. Park staff often hike off trail and accesses some of the more remote areas in the park where invasive plants could be spread. Park employees' preventative actions, like using boots brushes before they hike the trails at Exit Glacier, can also provide opportunities to educate visitors about they can do to reduce the spread of invasive plants.

An interpretive display and boot brush were installed in the Nature Center Plaza to help inform the public about the spread of invasive plant species. An additional boot brush and sign is scheduled to be installed at the Harding Icefield Trail register. These boot brushes should be maintained in future seasons to both help educate visitors and to prevent the spread of invasive plants further up the trail system.

The KEFJ EPMT should continue to contribute to the park's social media presence with informative posts related to invasive plant management and other science related topics. Participation in invasive species workshops and conferences should be a priority. These events help build relationships with other land management agencies and foster cooperative effort to address invasive plants across administrative boundaries. These events also provide the opportunity to learn about and share information about new management strategies and techniques.

Gypsy Moth Monitoring

Gypsy moth monitoring in partnership with the Alaska Division of Agriculture should be continued since it is an important monitoring effort and takes few resources to complete. The Alaska Division of Agriculture manages the program, provides traps for monitoring, and does all the data management for the project. Deploying traps in the Exit Glacier area is an important contribution to the state-wide monitoring effort for invasive moths.

Youth Involvement

The KEFJ EPMT should continue to engage youth through YCC and SCA partnerships. This is the perfect place to house the Resource Management division youth program because it allows high school and college youth to be introduced to the National Park Service mission while gaining valuable hands on experience and job related skills. Youth are introduced to a wide range of activities including invasive plant management, trail maintenance, native plant restoration, and public interaction. They also provide the KEFJ EPMT assistance with field and data management activities.

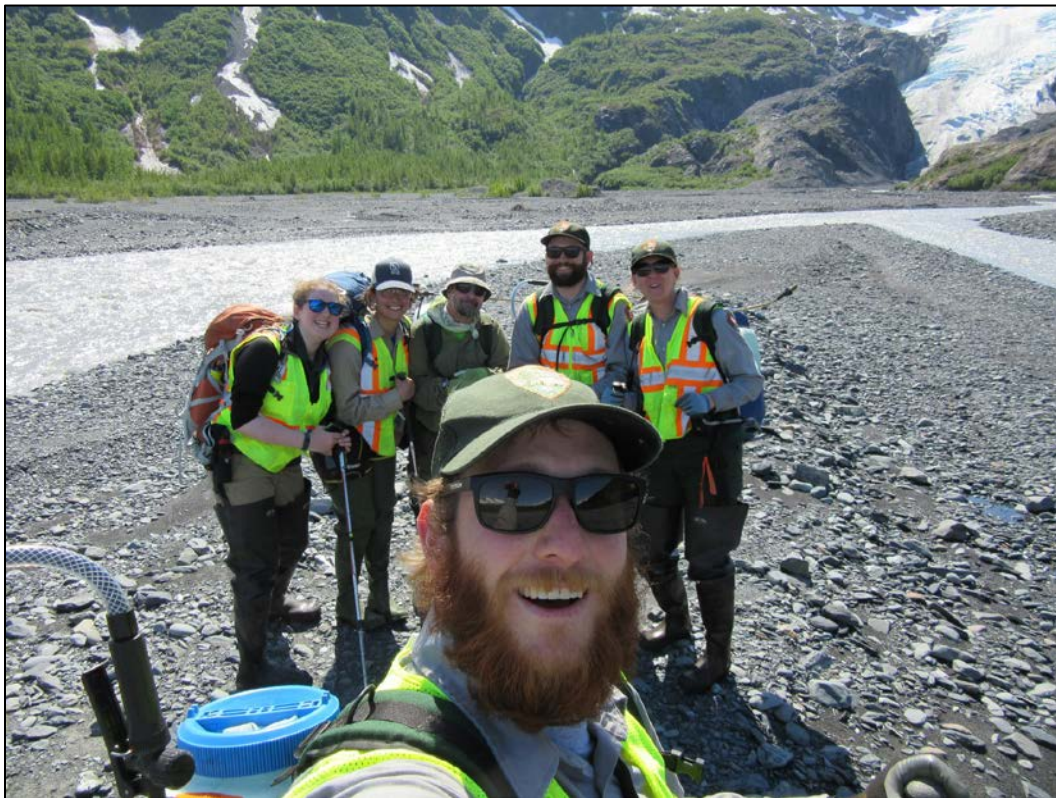
Personnel

The Biological Science Technician should continue to start earlier in the season before other personnel begin. This allows enough time to complete all required NPS training, to review and

understand field activities performed in previous seasons, and to prepare a monthly work plan for field work in the upcoming season.

In 2018 the KEFJ EPMT was made up of a three person field crew, consisting of the Biological Science Technician, SCA intern, and 1 YCC employee. There are typically 2 YCC employees working on the crew, but because the Alaska EPMT Data Manager worked out of the KEFJ office this summer, only 1 YCC employee was hired. There is limited access to vehicles to travel to and from the Exit Glacier area and the number of seats in the vehicle limits the number of people on the crew. A second YCC employee should be hired in 2019 to provide the extra help needed in the field.

Large scale herbicide projects, such as the Outwash Plain, need additional assistance in the field. A request for assistance with herbicide application should continue to be submitted to the Alaska EPMT Liaison for 2019. The SCA crew was invaluable for large scale hand pulling projects and should be utilized again if the decision is made to continue hand pulling sites such as the Shea Parking Lot and Harding Icefield Trail.



KEFJ EPMT, AK regional EPMT Liaison and regional EPMT Data Manager returning from a day in the field doing invasive plant control work in the Exit Glacier area

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Appendix A: Invasive Plant Surveys Site Specific Maps

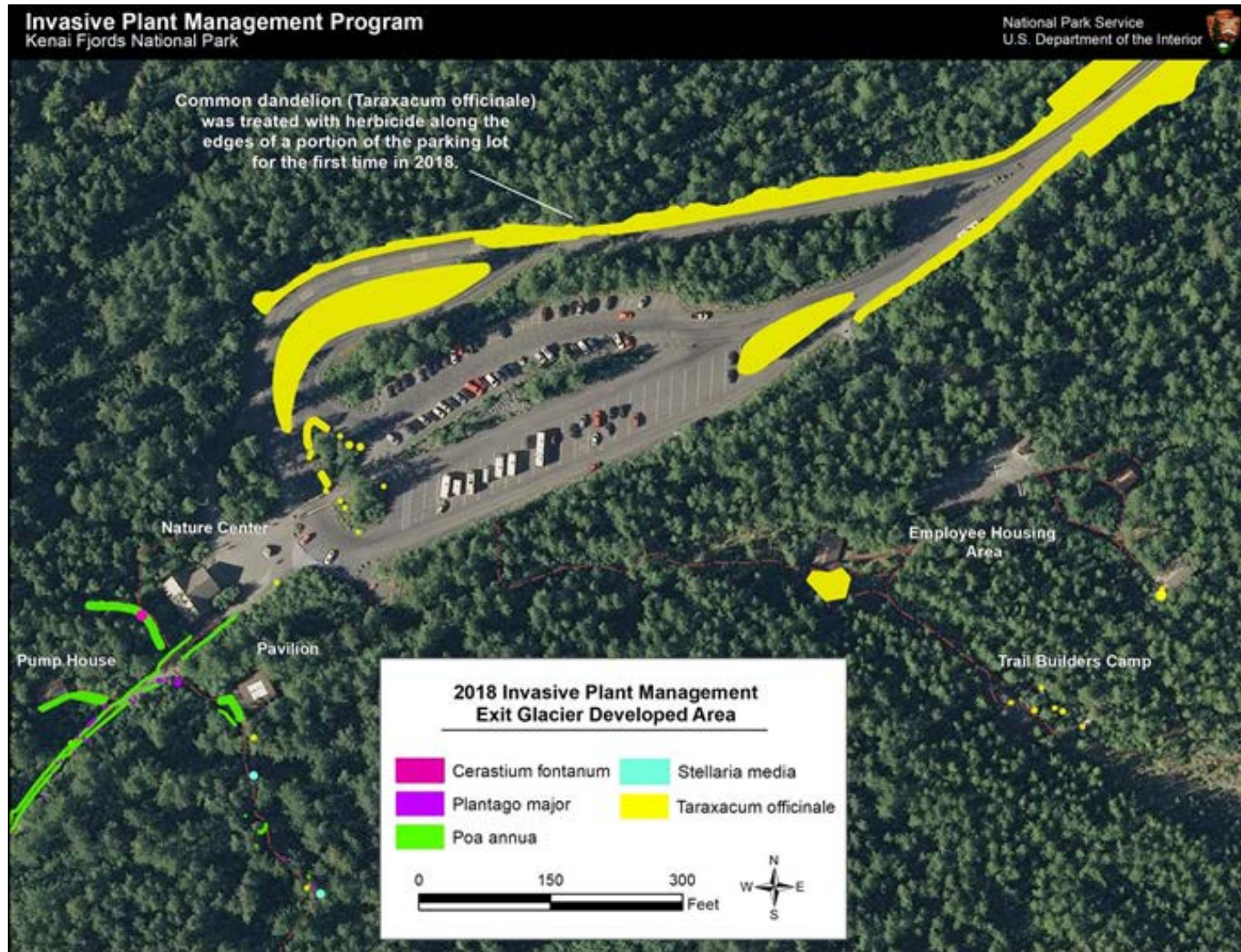


Figure A-1. Invasive plant surveys in the Exit Glacier developed area.

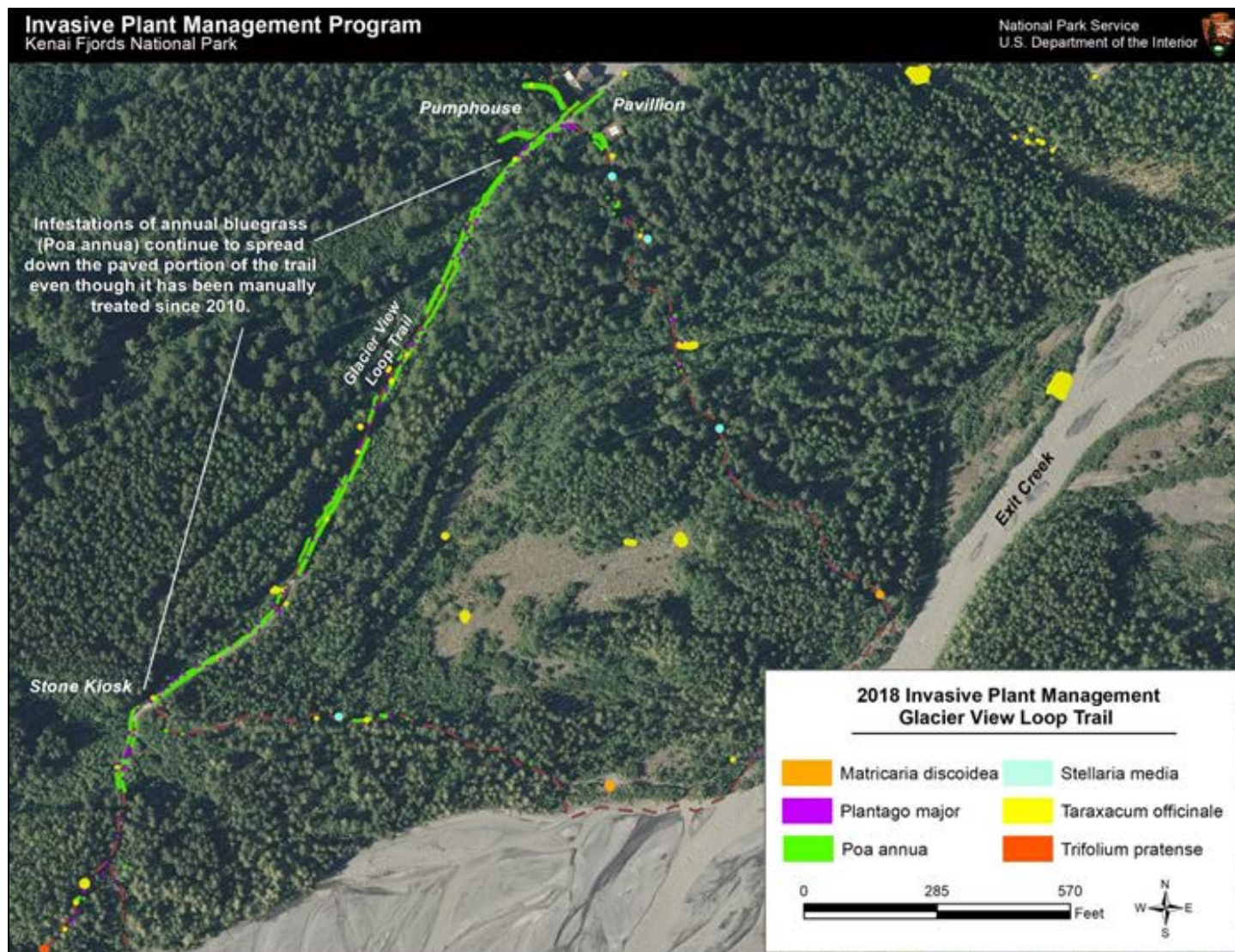


Figure A-2. Invasive plant surveys along the Glacier View Loop Trail.

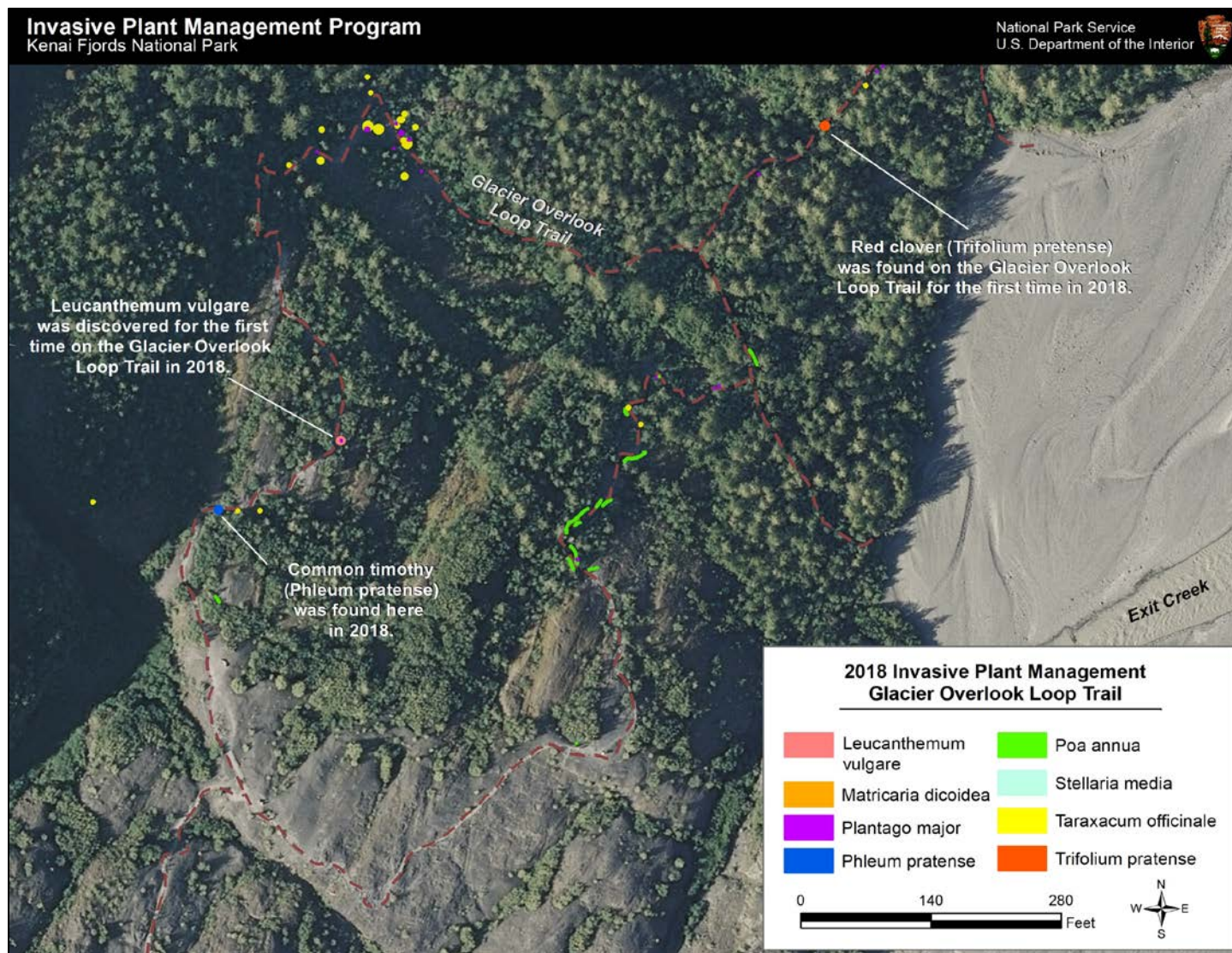


Figure A-3. Invasive plant surveys along the Glacier Overlook Loop Trail.

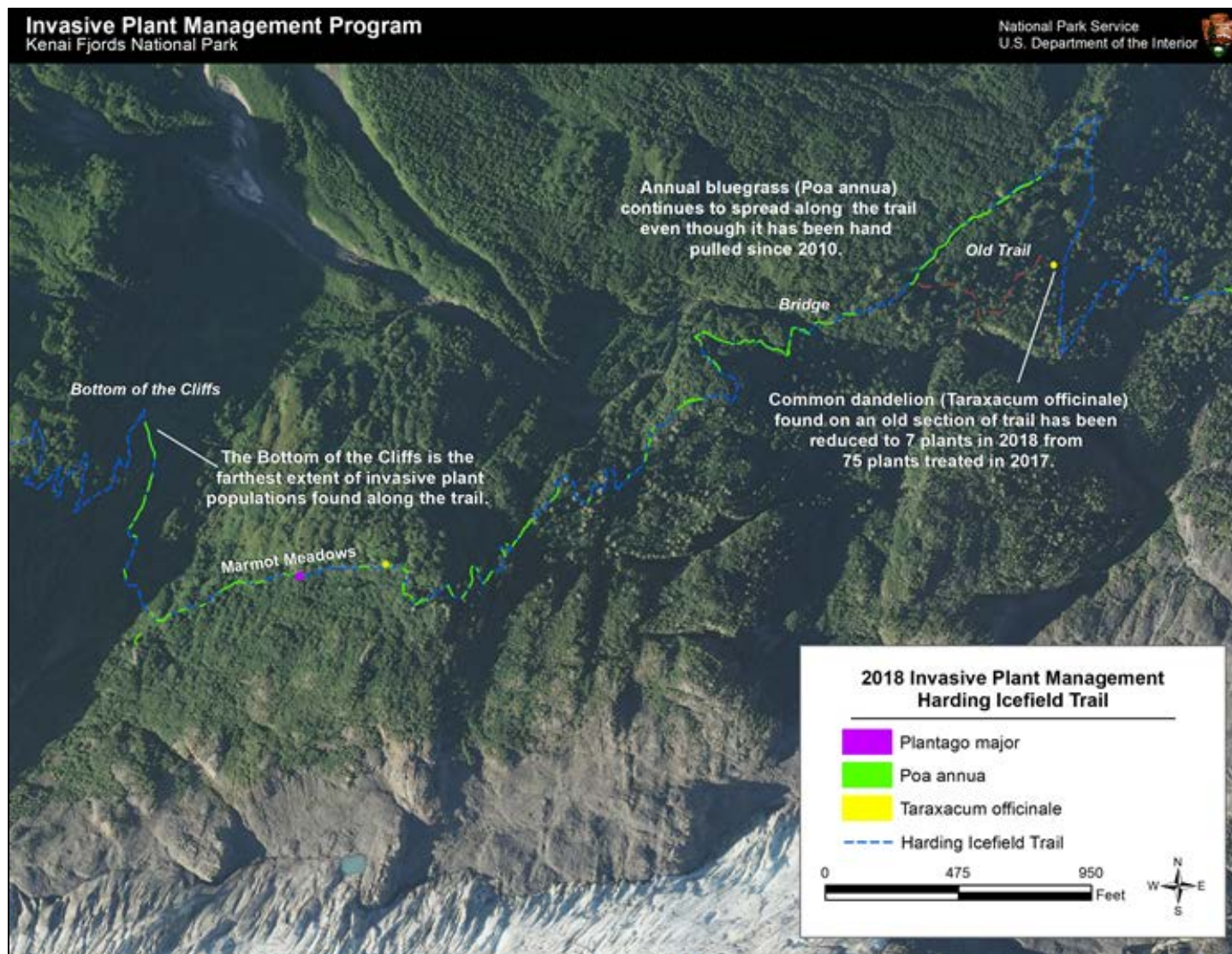


Figure A-4. Invasive plant surveys along the Harding Icefield Trail.

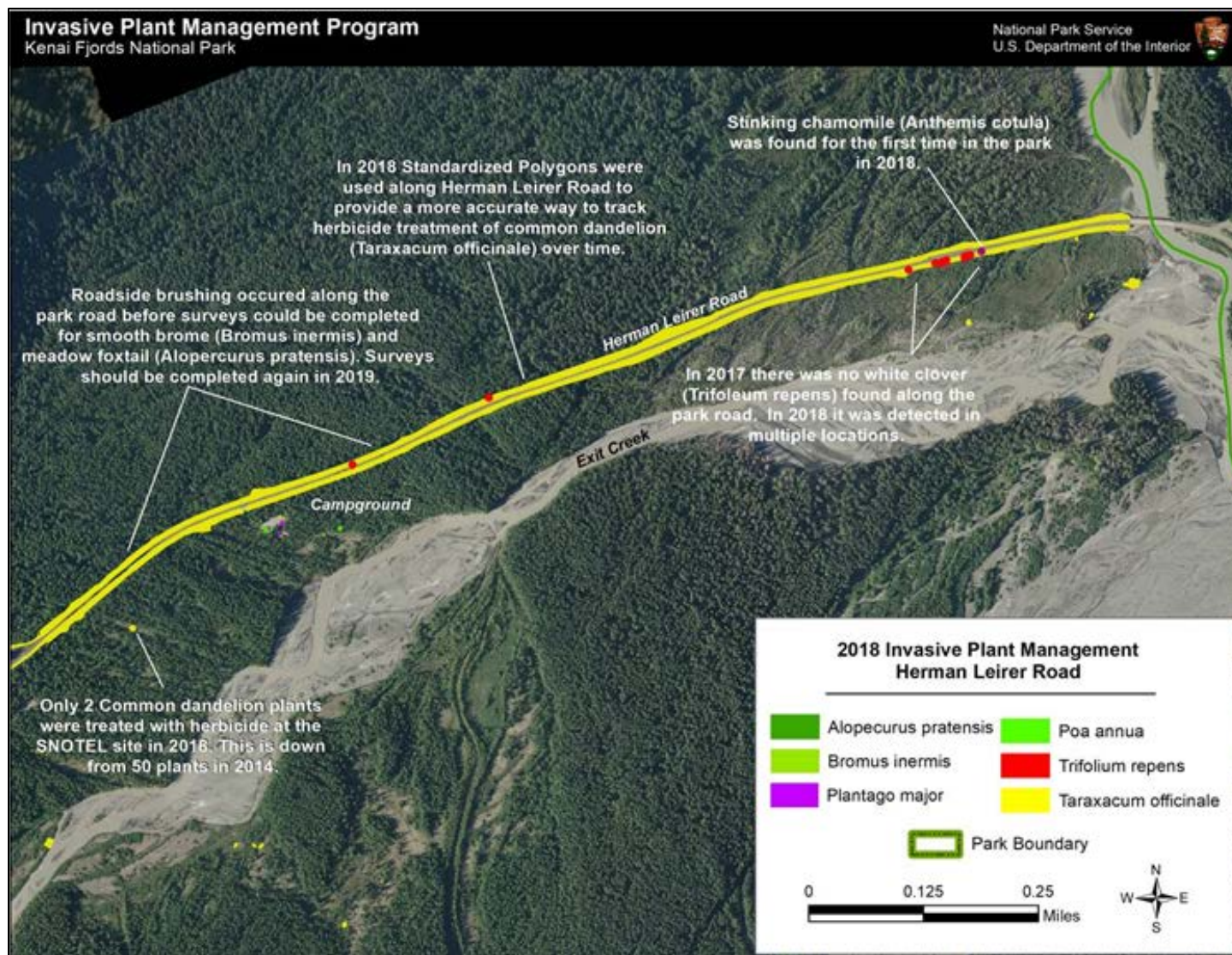


Figure A-5. Invasive plant surveys along Herman Leirer Road.

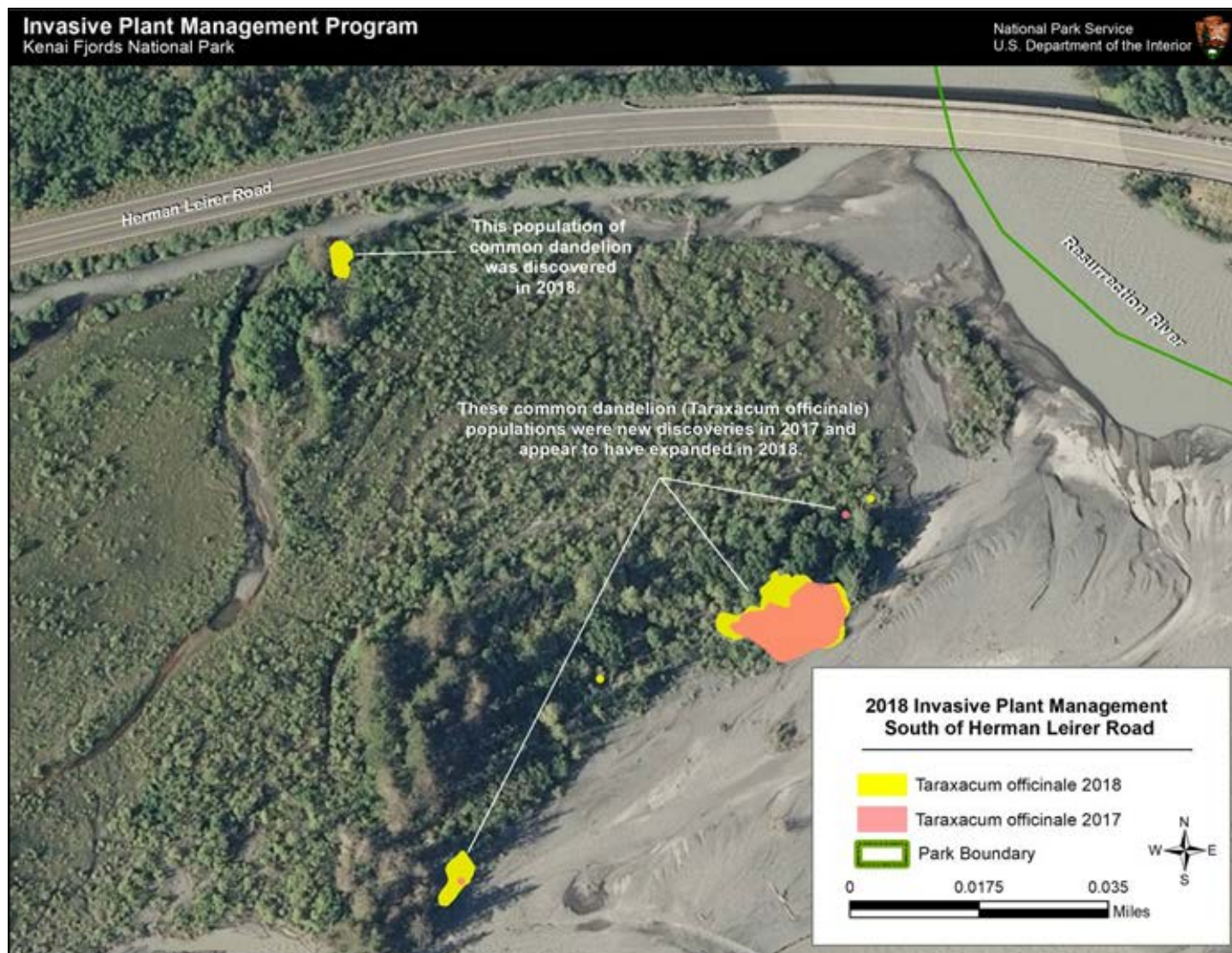


Figure A-6. Invasive plant surveys south of the park road.

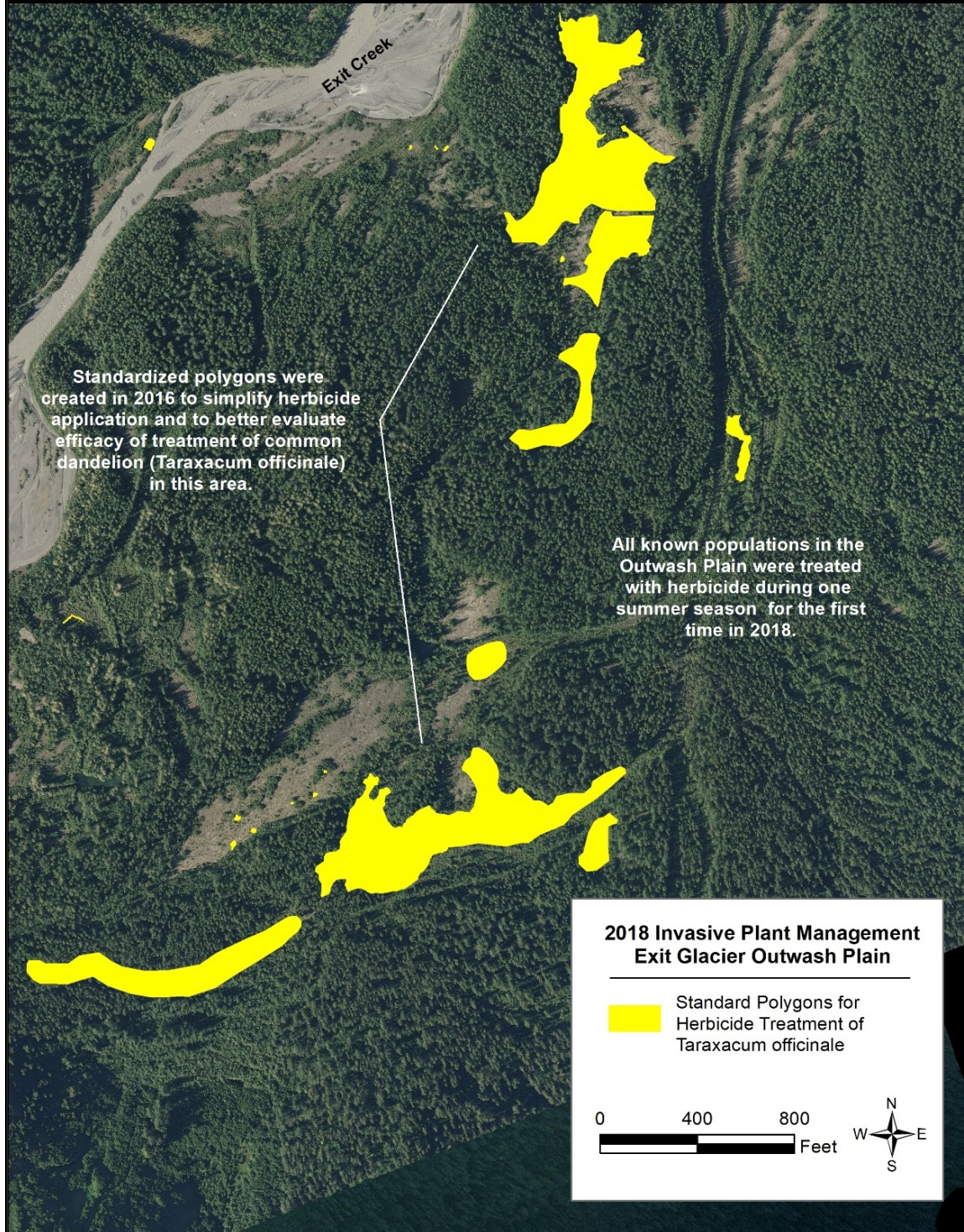


Figure A-7. Invasive plant surveys in the Outwash Plain.

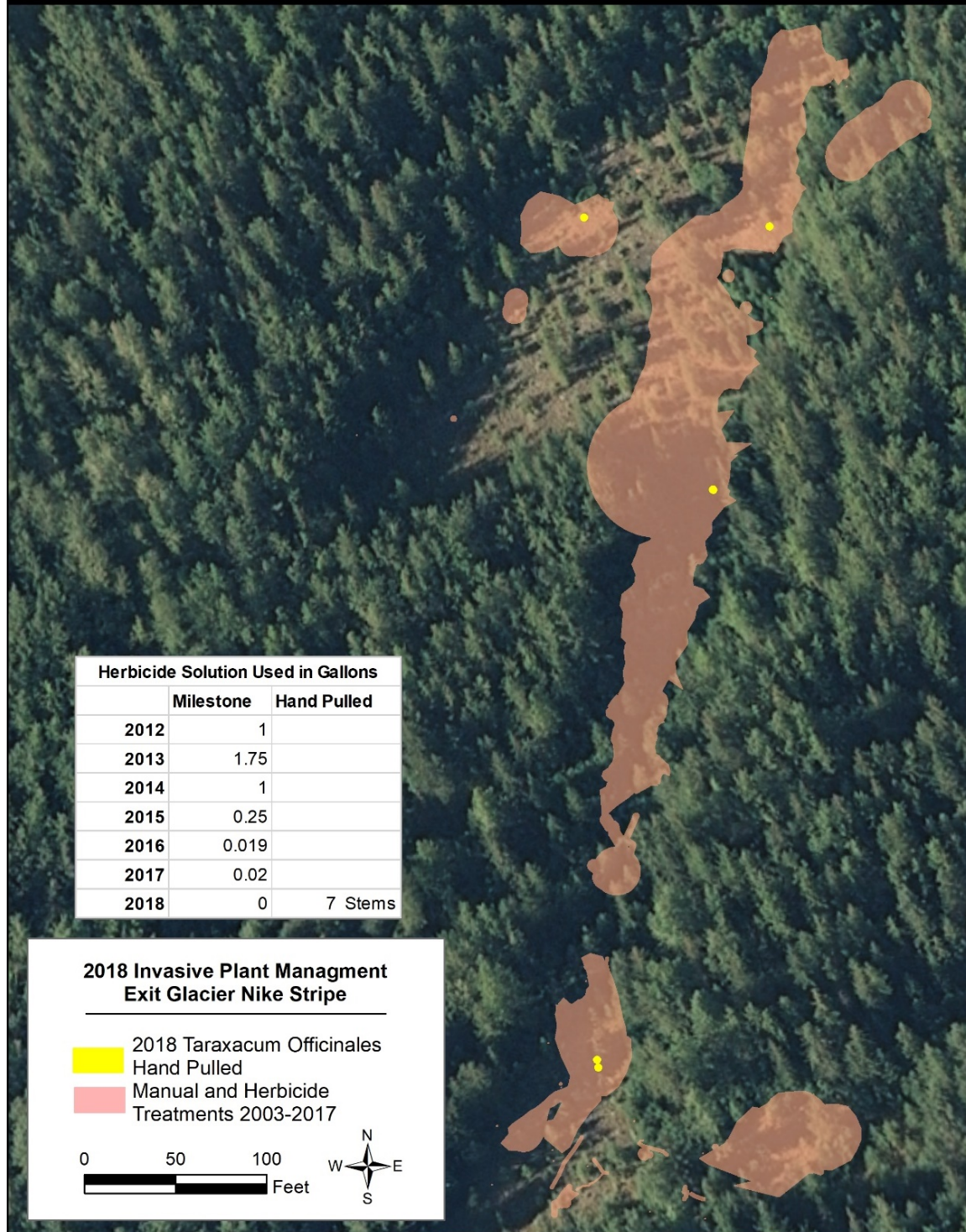


Figure A-8. Invasive plant surveys in the Nike Stripe.



Figure A-9. Invasive plant surveys in the Maintenance Facility.



Figure A-10. Invasive plant surveys in Aialik Bay.

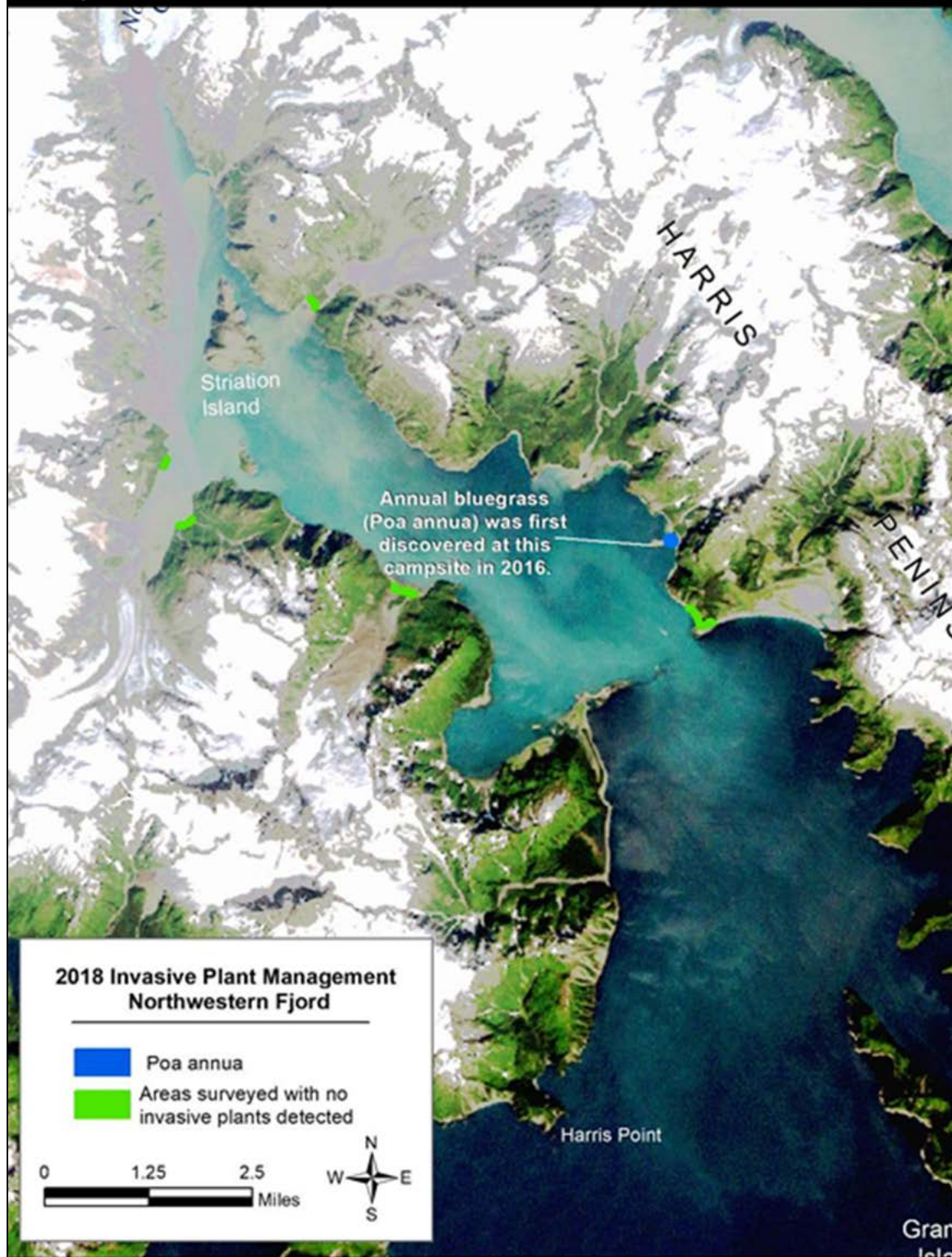


Figure A-11. Invasive plant surveys in Northwestern Fjord.

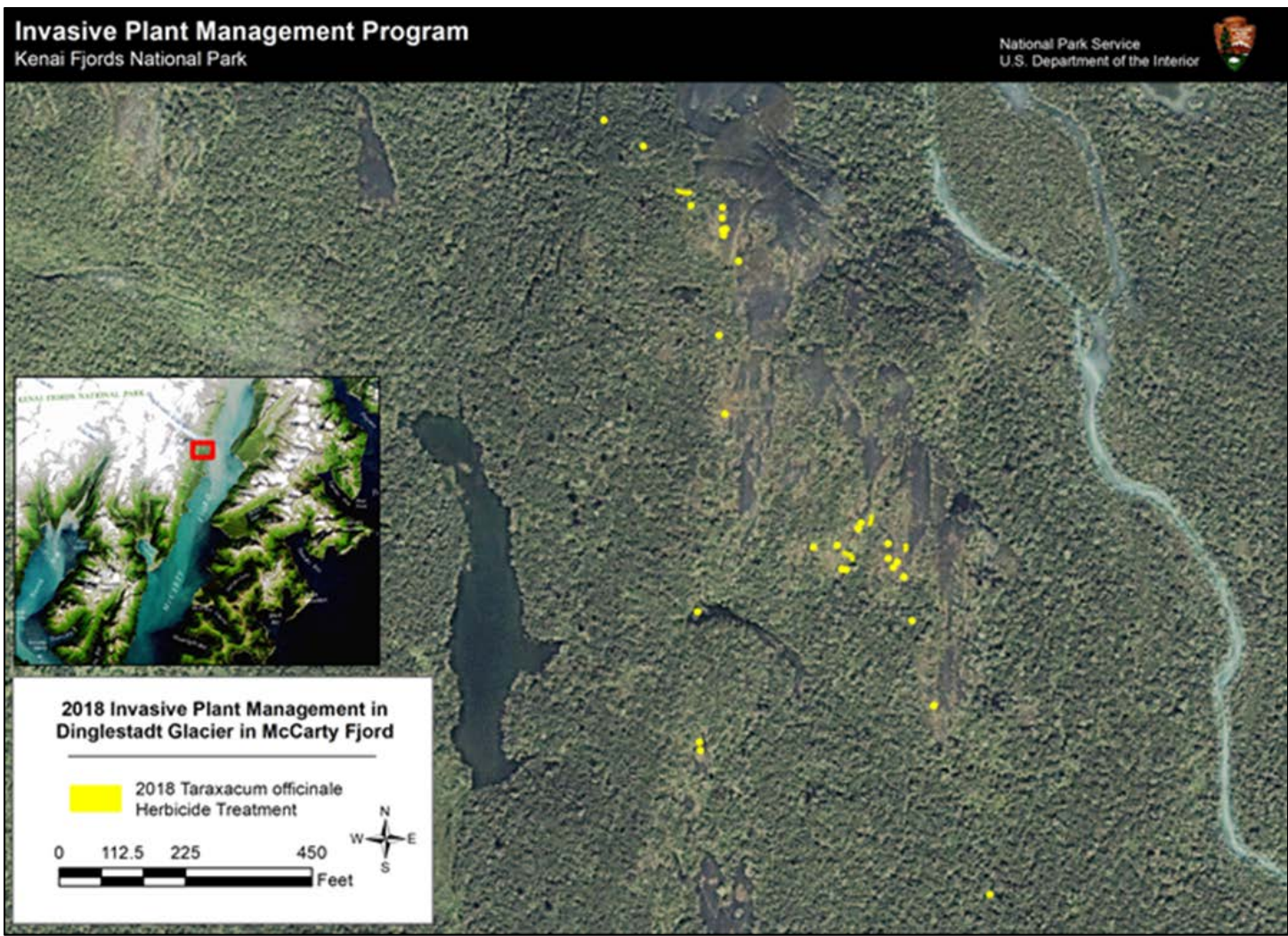


Figure A-12. Invasive plant surveys in McCarthy Fjord.

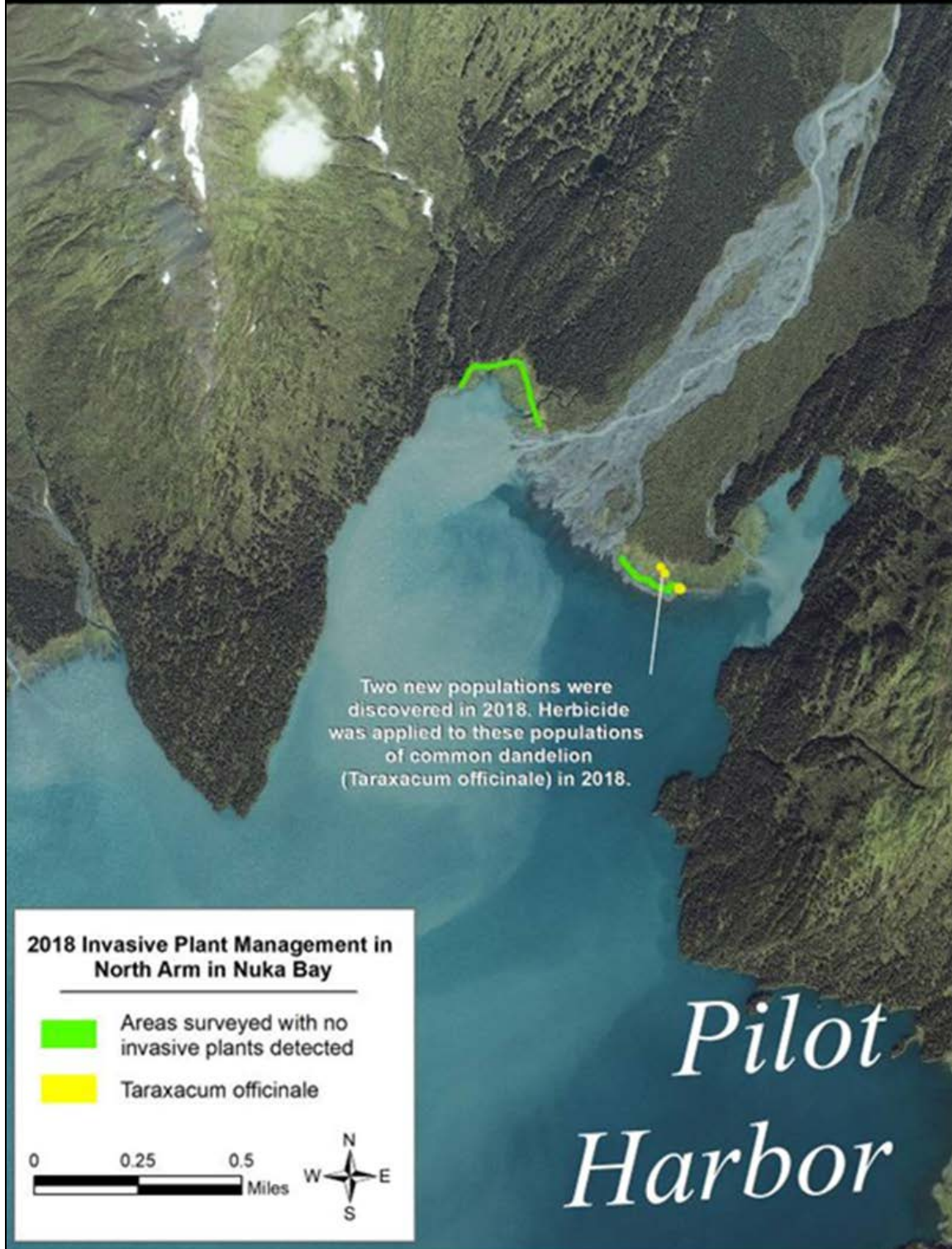


Figure A-13. Invasive plant surveys in North Arm.

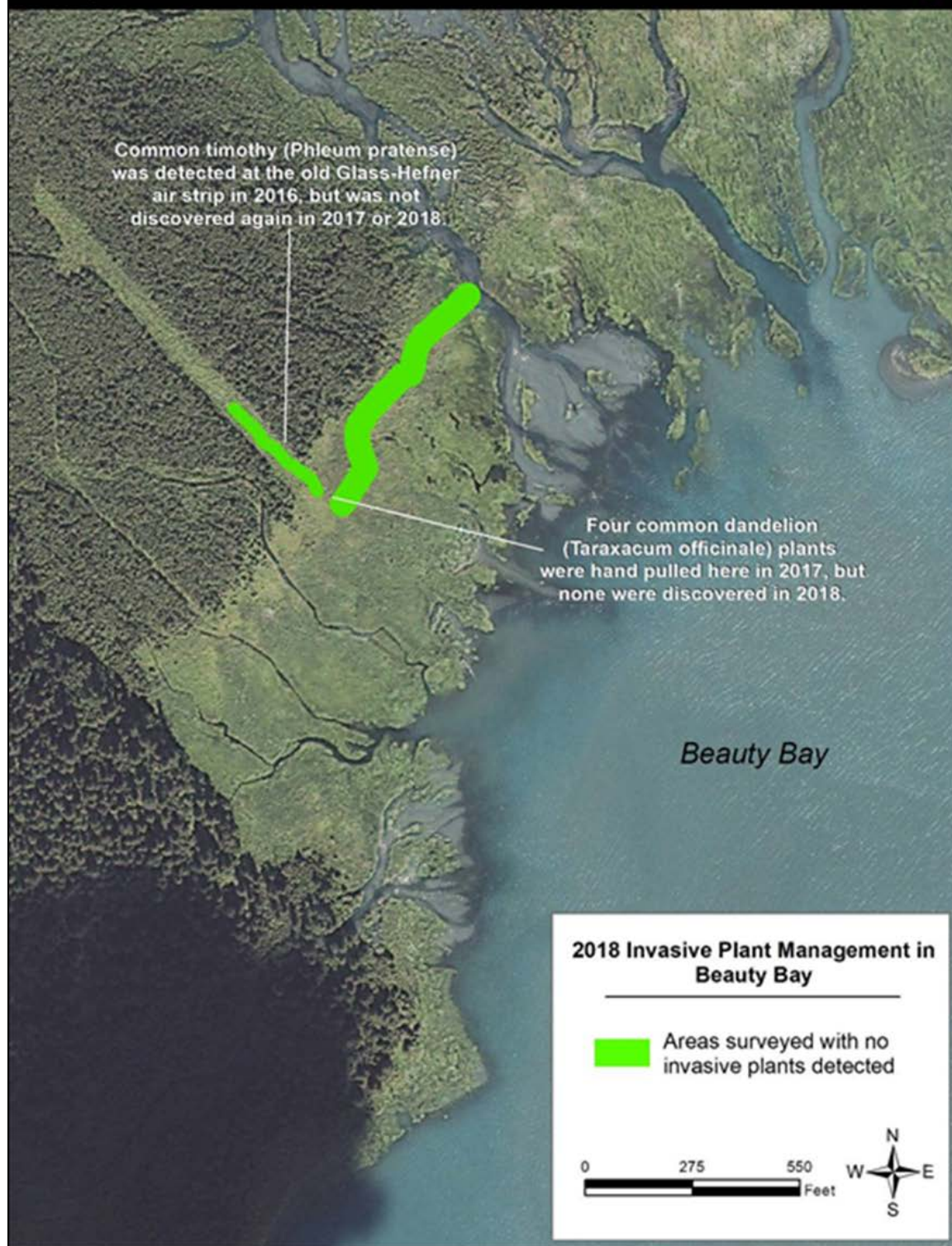


Figure A-14. Invasive plant surveys in Beauty Bay.



Figure A-15. Elodea surveys in Delight Lake.

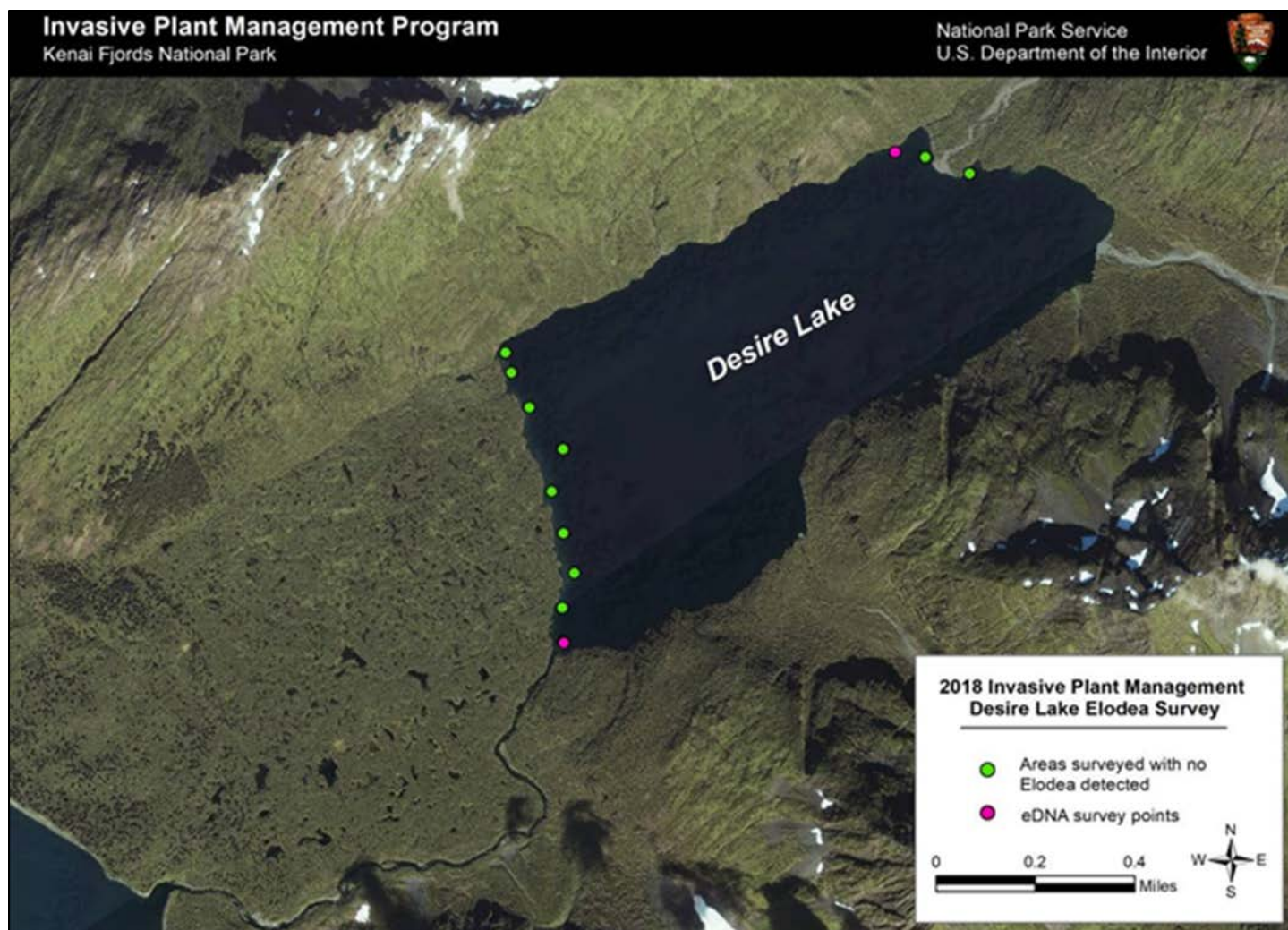


Figure A-16. Elodea surveys in Desire Lake.

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