National Park Service
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Natural Resource Stewardship and Science

Invasive Plant Management in Kenai Fjords National Park

2015 Summary Report

Natural Resource Report NPS/KEFJ/NRR—2015/1097



ON THE COVER
Clockwise from top: Kenai Fjords National Park Exotic Plant Management Team scouting Exit Creek crossing locations; Exotic Plant Management Team with Student Conservation Association Trail Crew; bunchberry on the Harding Icefield Trail
Photographs by Christina Kriedeman and Aaron Stover

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Contents

Page

Figures v
Tables v
Abstract vi
Acknowledgments vii
List of Acronyms vii
Introduction 1
Methods 3
    Control Methods 4
        Manual Treatment 4
        Chemical Treatment 4
    Mapping 4
    Personnel 5
Results 6
    2015 Season Overview 6
    Exit Glacier Area 9
        Herman Leirer Road 9
        Exit Glacier Parking Area 10
        Campground 10
        SNOTEL 10
        Nature Center Plaza and Main Trail 10
        Trail to the Glacier View 11
        Trail to the Edge of the Glacier 11
        Harding Icefield Trail 12
        Nike Stripe 12
        Outwash Plain 13
        Employee Housing 13
    Coastal Areas 13
        Nuka Bay 14

Contents (continued)

Page

McCarty Fjord 14
Northwestern Fjord 14
Aialik Bay 15
Resurrection Bay 16
Seward 16
Outreach and Education 17
Elodea Monitoring 18
Restoration and Prevention 18
Gypsy Moth Monitoring 19
Discussion and Recommendations 20
Literature Cited 23
Appendix A: Site Specific Maps 23

Figures

Page

Figure 1. Park staff participating in the community weed pull event. vi

Figure 2. Overview of Kenai Fjords National Park 2

Figure 3. YCC intern hauling annual bluegrass off the trail. 4

Figure 4. Park staff chemically treating smooth brome on Herman Leirer Road 9

Figure 5. SCA Intern mapping invasive plants in the Exit Glacier parking lot. 10

Figure 6. Before and after photo of the edge of the Main Trail where annual bluegrass was hand pulled by the KEFJ EPMT and SCA crew. 11

Figure 7. SCA crew working on the Harding Icefield Trail 12

Figure 8. NPS staff mapping common dandelion at the head of the North Arm in Nuka Bay 14

Figure 9. NPS staff monitoring at upper Pedersen Lagoon 15

Figure 10. KEFJ EPMT and SCA crew hand pulling common chickweed in the Maintenance Facility. 16

Figure 11. Before and after shot at the Shea parking lot 17

Figure 12. Forest Service interns at the community weed pull event. 18

Figure 13. SCA intern and YCC staff mapping and controlling invasive plants 22

Tables

Page

Table 1. Comparison of average snow depth at Exit Glacier between the last 15 year average and the winter of 2014/2015 3

Table 2. 2015 project areas 3

Table 3. Summary of Kenai Fjords National Park Invasive Plant Work. 7

Table 4. Invasive plant species and locations 8

Abstract

This report describes the work performed by the Exotic Plant Management Team (EPMT) at Kenai Fjords National Park (KEFJ) during the 2015 field season. This marks the 12th season KEFJ has monitored and controlled invasive plants in accordance with the Alaska Exotic Plant Management Team protocol. The 2015 KEFJ EPMT conducted the majority of field work in the Exit Glacier area. We also performed control efforts at coastal visitor use areas in Nuka Bay, McCarty Fjord, Northwestern Fjord, Aialik Bay, and Resurrection Bay. The 2015 EPMT further monitored and controlled invasive plants at all KEFJ leased and owned properties in the town of Seward. We surveyed a total of 13.80 acres containing 3.97 acres of invasive plants, all of which were treated manually or chemically. EPMT staff chemically treated 3 areas in the park for the first time in 2015; common dandelion (*Taraxacum officinale*) on the Herman Leirer Road, common dandelion at the Exit Glacier snowpack telemetry (SNOTEL) site, and smooth brome (*Bromus inermis*) on the north side of Herman Leirer Road. We treated a total of 9 invasive species in KEFJ and 15 outside park boundaries in 2015. EPMT staff identified hemp nettle (*Galeopsis spp.*), a new invasive species to Kenai Fjords, in the Shea parking lot. Invasive plant management at KEFJ is an ongoing effort to prevent introduction of new invasive species, reduce current infestations, and restore native plant communities.



Figure 1. Park staff participating in the community weed pull event.

Acknowledgments

The Kenai Fjords National Park Exotic Plant Management Team would like to thank all of those who contributed to making the 2015 season a success including; Student Conservation Association Intern Kaley Aposporos, Youth Conservation Corps members Elena Hamner and Megan Koster, NPS employees Travis Fulton, Chris Overbaugh, Peter Frank, Sharon Kim, Melissa Knight, Jennifer Pletz, and Aaron Vachowski. Thank you also to the Student Conservation Association trail crew and those that participated in the 2015 community weed pull including representatives from the Chugach National Forest.

List of Acronyms

AKEPIC Alaska Exotic Plants Information Clearinghouse

EPMT Exotic Plant Management Team

KEFJ Kenai Fjords National Park

M/V Motor Vessel

NPS National Park Service

PUC Public Use Cabin

SCA Student Conservation Association

SNOTEL Snowpack Telemetry

YCC Youth Conservation Corps

Introduction

Kenai Fjords National Park (KEFJ) contains 669,983 acres on the southeastern coast of the Kenai Peninsula. It was established by the Alaska National Interest Lands Conservation Act of 1980 to "maintain unimpaired the scenic and environmental integrity of the Harding Icefield, its outflowing glaciers, and coastal fjords and islands in their natural state". The Harding Icefield dominates the park covering roughly 528 square miles, or approximately 51% of the park. The weight and movement of the Harding Icefield and its outflowing glaciers have shaped and carved the current landscape of KEFJ.

KEFJ can be divided into two areas of visitor use, the Exit Glacier area and the coastal fjords. The Exit Glacier area, accessed by Herman Leirer Road, is the only area of the park accessible by car. Because of this, the Exit Glacier area receives by far the most visitation of any area of the park. 161,550 people visited the Exit Glacier area between May and September. High visitation has subjected the Exit Glacier area to unintentional establishment of invasive plants by visitors, researchers, and park staff. This is demonstrated by the fact that the Exit Glacier area contains the largest and most diverse invasive plant infestations found in the park. In the coastal fjords, the 545 mile coast of KEFJ is composed of rugged, glacially carved fjords bordering the Gulf of Alaska. Though most of the coast remains free of invasive plants, visitor use at beaches and camping areas has led to the establishment of isolated invasive plant populations. Regular monitoring of these and other coastal sites is necessary to effectively control invasive plant populations in these remote environments.

Invasive plants pose a serious threat to biodiversity by threatening the genetic integrity of native plants, out-completing native plants for resources, and disturbing the structure and function of ecosystems. Geographic isolation and cold climate has limited the introduction of invasive plant species to KEFJ compared to other parks and regions. Because of this, KEFJ is in a rare position to be able to control or contain invasive plants populations within the park. KEFJ has been controlling invasive plants as part of the Alaska Regional Exotic Plant Management Team (EPMT) since 2004. The KEFJ EPMT aims to prevent introductions of new invasive species, reduce current infestations, and restore native plant communities. This is done through inventorying and monitoring, treatment and control, outreach and education, and revegetation projects. The KEFJ EPMT employs a control strategy in which the Exit Glacier area is regularly monitored and treated for invasive species. For more remote sites, an early detection, rapid response approach is utilized to locate and treat infestations before they establish themselves beyond the point in which containment or eradication is feasible.

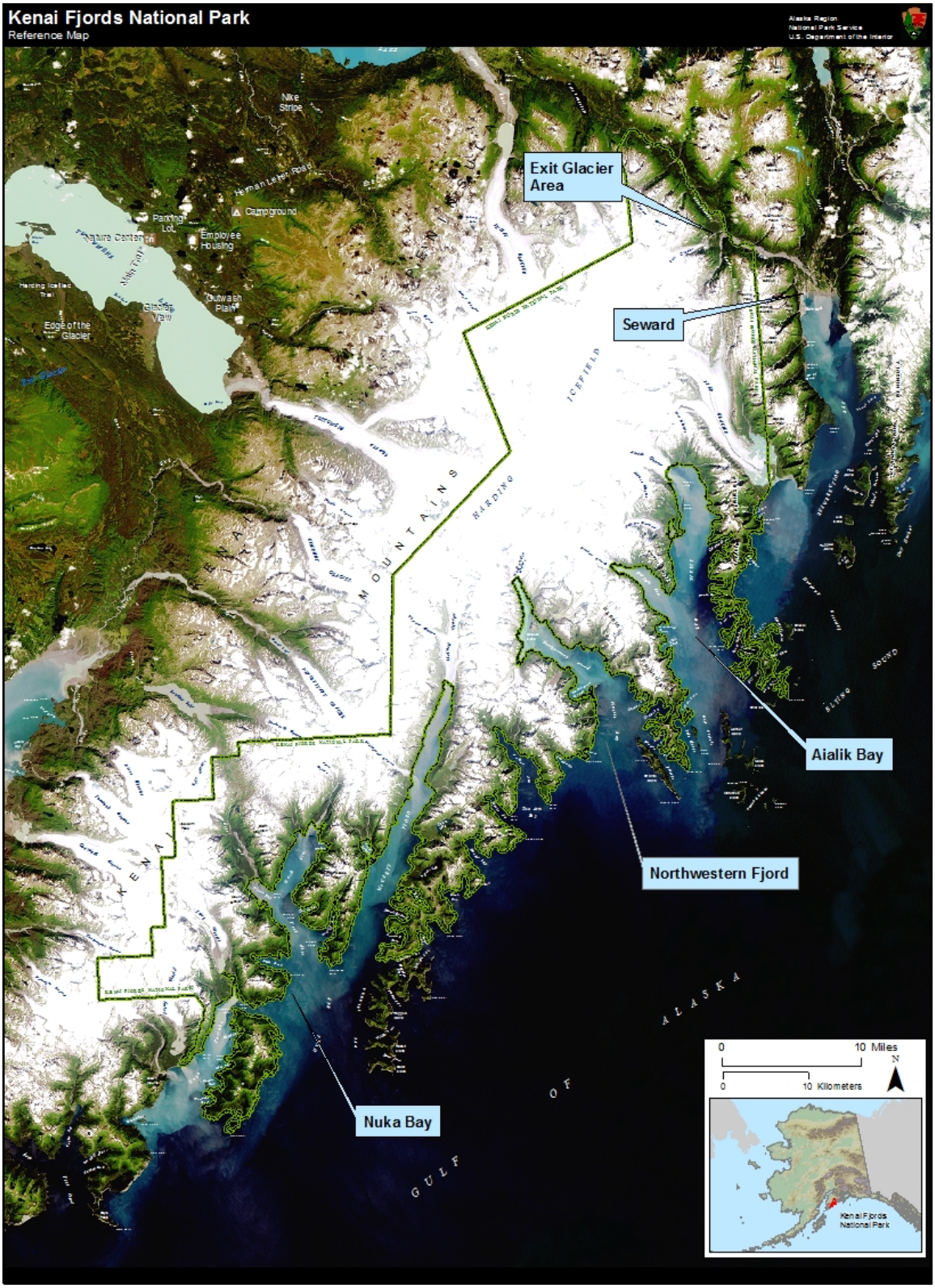


Figure 2. Overview of Kenai Fjords National Park

Methods

The KEFJ EPMT performed fieldwork during the 2015 season following the Alaska Exotic Plant Management Team 2015 Field Protocol (Million et al. 2015). The 2015 KEFJ EPMT aimed to prevent introduction of new invasive species, reduce current infestations, and restore native vegetative communities. The majority of our fieldwork occurred between May 26th and August 28th. Field work consisted of surveying and treating invasive plants while collecting geospatial data. Geospatial data collected from past years was used to return to all previous infestations to survey for the presence or absence of invasive species and to complete any control work.

Prioritization of field work was done with consideration to geographic location, weather, available personnel, availability of resources such as watercraft for transportation, and plant phenology. The Exit Glacier area received below average snowfall during the 2014-2015 winter season, impacting phenology of the vegetation. Common dandelion around the Exit Glacier area reached maturation sooner than historically typical, making manual treatment of infestation sites in this area an early season priority to control plants before they went to seed.

Table 1. Comparison of average snow depth at Exit Glacier between the last 15 year average and the winter of 2014/2015. (NPS Data)

	December	January	March	April	May
2014-2015 snow depth in inches	8.7	4.8	7.4	#N/A	0
Average snow depth in inches of the previous 15 years	15.14	31.66	39.38	47.42	36.55

Areas of invasive plant control work in 2015 can be placed into 3 general locations: the Exit Glacier area, coastal areas, and the town of Seward. The Exit Glacier area is the most accessible and contains the majority of invasive plants found in the park, so more time was spent surveying and controlling invasive plants in this area. To most effectively and efficiently survey more remote coastal areas in the park, we prioritized sites we visited based on higher chance of visitor use, amount of time since the area was last surveyed and previously documented presence of invasive plants. Each site in the Exit Glacier area was surveyed a minimum of 3 times in 2015. We surveyed sites located on the coast and in the town of Seward once during the 2015 field season.

Table 2. 2015 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, Nike Stripe, Outwash Plain
Coastal	Nuka Bay, McCarty Fjord, Northwestern Fjord, Aialik Bay, Resurrection Bay
Seward	Maintenance Facility, Information Center, Park Headquarters Building

Control Methods

Manual Treatment

Manual treatment consists of the physical removal of invasive plants. Depending on the species, hand tools are used to remove either individual plants, or dense vegetation mats of interconnected rhizomes. All removed vegetative material was put in plastic bags and taken to the Seward Transfer Facility where it is then transported to the Central Peninsula Landfill located in Soldotna, AK.

Chemical Treatment

Eight locations in KEFJ were selected for herbicide application using the integrated pest management decision tree in the Alaska Region Invasive Plant Management Plan (NPS, 2010). The KEFJ EPMT applied 2 herbicides in 2015; Milestone, a broadleaf herbicide with aminopyralid as the active ingredient, and AquaMaster, a non-selective herbicide with the active ingredient glyphosate. All pesticide treatments were completed by staff that are licensed by the State of Alaska. Herbicide applicators used calibrated backpack sprayers to spot spray target species.

The KEFJ EPMT used Milestone to treat common dandelion in 5 locations within the park: Herman Leirer Road, the Outwash Plain, the Nike Stripe, the SNOTEL site, and an open area next to the Trail to the Glacier View. Milestone was also intended to be used to treat common dandelion populations at the North Arm of Nuka Bay and Dinglestadt Glacier in McCarty Fjord but rainy and wet conditions prohibited herbicide application. We applied Milestone as a solution of 6 ml of Milestone per gallon of water, with a photodegrading blue dye to mark treated areas.

The KEFJ EPMT used AquaMaster for the first time to treat small populations of smooth brome on the north side of Herman Leirer Road, just inside the park boundary. We applied 0.5 gallons of solution at an application rate of 30 ml of AquaMaster per gallon of water with blue dye over two applications.



Figure 3. YCC intern hauling annual bluegrass off the trail.

Mapping

For all populations of invasive plants surveyed and monitored during the 2015 field season, park personnel collected geospatial data using handheld Trimble GPS units. Attributes collected include disturbance type, taxon, phenology, % cover, stem count, control effort, action, % treated, and control person hours. Data was transferred and edited, using the computer software Pathfinder Office. This GPS data was sent every two weeks to the Alaska Regional EPMT for final analysis and converted into GIS data. This data will be submitted to two other databases including the National Park Service's National Invasive Species Information Management System (NISIMS) and the Alaska Natural Heritage Program's Alaska Exotic Plant Information Clearinghouse (AKEPIC).

Personnel

The 2015 KEFJ EPMT consisted of: Christina Kriedeman, Environmental Protection Specialist; Aaron Stover, Biological Science Technician; Kaley Aposporos, Student Conservation Association (SCA) Intern; Megan Koster, Youth Conservation Corps (YCC); and Elena Hamner, YCC. Christopher Overbaugh, Alaska Regional EPMT liaison and Peter Frank, EPMT Technician and Data Manager, provided training and technical assistance throughout the 2015 field season. Travis Fulton, KEFJ Backcountry Ranger, and Chris Overbaugh provided additional assistance with herbicide application. A 6 person SCA crew helped with invasive plant removal from August 3rd to August 7th.

Results

2015 Season Overview

The focus of the 2015 field season was to revisit all previously surveyed infestations and to survey new areas determined to be susceptible to invasive plant establishment. The 2015 KEFJ EPMT revisited most known sites, with the exception of the Outwash Plain. For the 2015 field season, we surveyed a total of 13.77 acres. A total of 3.96 acres were infested, and manually or chemically treated. Park staff and volunteers removed an estimated total of 650 pounds of invasive plant material, mainly common dandelion and annual blue grass (*Poa annua*) from the Exit Glacier area. We conducted herbicide application at 5 sites; the Herman Leirer Road, the Nike Stripe, the SNOTEL site, a portion of the Outwash Plain, and an open area between the Main Trail and the Trail to the Glacier View. 2015 marked the first year common dandelion at Herman Leirer Road and the SNOTEL site received chemical treatment. This was also the first year that KEFJ EPMT used the herbicide AquaMaster to treat populations of smooth brome on the roadside. Four NPS staff members administered a total of 19.17 ounces of Milestone and 1.64 ounces of AquaMaster during the 2015 season.

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

Year	Invasive GPS Data NPS Lands (non-NPS lands)		
	Species Acres Surveyed[1]	Species Acres Infested[2]	Acres Treated[3]
2004	2.8 (0.5)	1.7 (0.5)	0.5 (0.5)
2005	9.7 (0.1)	2.8 (0.01)	2.3 (0.01)
2006	42.7 (0.3)	5.4 (0.3)	4.8 (0.2)
2007	23.5 (1.8)	5.2 (0.01)	1.9 (0.01)
2008	24.0 (0.2)	3.4 (0)	1.7 (0)
2009	26.1 (3.2)	2.7 (0.01)	2.3 (0.01)
2010	55.9 (5.9)	5.5 (0.01)	3.4 (0.01)
2011	27.6 (9.3)	7.5 (0.8)	6.1 (0.8)
2012	21.4 (5.5)	7.1 (0.2)	5.5 (0.2)
2013	13.4 (0.4)	3.4 (0.1)	3.2 (0.1)
2014	14.38 (1.9)	7.05 (0.1)	4.95 (0.1)
2015	13.77 (0.8)	3.96 (0.01)	3.96 (0.01)

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

1. Acres 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.

Invasive species documented in 2014 but not detected during the 2015 field season include common timothy (*Phleum pratense*) at Beauty Bay, common plantain (*Plantago major*) at Abra Cove, and shepherd's purse (*Capsella bursa-pastoris*) at the Maintenance Facility. NPS staff identified an invasive hemp nettle at the Shea parking lot. This is the first time hemp nettle has been documented on park property.

Table 4. Invasive plant species and locations.

X = present in 2015, H = historically present

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

Exit Glacier Area

The KEFJ EPMT spent a large part of the season in the Exit Glacier area. The Exit Glacier area receives the vast majority of visitation to KEFJ and hosts the majority of invasive species in the park. The Exit Glacier area is divided into 10 high priority sites where staff monitored and controlled invasive plants. These sites include Herman Leirer Road, the Exit Glacier parking lot, the campground, employee housing, the Nature Center plaza and Main Trail, the Trail to the Glacier View, the Trail to the Edge of the Glacier, the Harding Icefield Trail (HIT), the Nike Stripe, and the Outwash Plain.

Herman Leirer Road

Herman Leirer Road extends for approximately 1 mile into the park and is densely infested with common dandelion. 2015 was the first year KEFJ staff conducted chemical control efforts for common dandelion on the park road. On 7 days between June 16th and June 25th, 3 NPS employees applied 95.5 gallons of solution containing 19 ounces of Milestone to 3.18 acres of roadside common dandelion populations. Three staff members who were not certified to apply herbicide removed flowers and seed heads prior to herbicide application to prevent mature individuals from reproducing.



Figure 4. Park staff chemically treating smooth brome on Herman Leirer Road

2015 marked the first year that two small populations of smooth brome were chemically treated with AquaMaster, a non-discriminating herbicide with the active ingredient glyphosate. These populations were discovered along the road in 2013 and confirmed in 2014 (Kainrath 2014). 0.85 gallons of solution containing 1.64 ounces of AquaMaster was applied to 2 small roadside smooth brome populations on June 24th and July 9th.

The KEFJ EPMT also located, mapped and manually treated 11 meadow foxtail (*Alopecurus pratensis*), 3 common timothy, and 1 small population of white clover (*Trifolium repens*) on Herman Leirer Road.

Invasive control efforts were also performed on Herman Leirer Road outside of park boundaries. The KEFJ EPMT manually treated yellow sweet clover (*Melilotus officinalis*) found on the road during vehicular surveys on a number of occasions during the field season. The 2015 KEFJ EPMT also coordinated a community weed pull event on June 28th focusing on manually treating invasive plants at a number of pullouts along Herman Leirer Road.

Exit Glacier Parking Area

The Exit Glacier parking area was the first area treated in 2015. The KEFJ EPMT conducted 3 rounds of manual treatment on a total of 218 square feet of infestations in the parking lot throughout the field season. The main species of focus was common dandelion. The KEFJ EPMT also mapped and manually treated 2 individual common timothy plants located on the south side of the parking lot. Other species in the parking area include annual bluegrass (*Poa annua*), white clover, common plantain (*Plantago major*), pineapple weed (*Matricaria discoidea*), and common sheep sorrel (*Rumex acetosella*). The KEFJ EPMT mapped and manually treated common sheep sorrel, first documented in 2012, on the west side of the parking lot, next to the bus loading and unloading zone. On August 4th, a 6 person SCA crew assisted in pulling 33 lbs. of annual bluegrass on the south side of the parking lot.



Figure 5. SCA Intern mapping invasive plants in the Exit Glacier parking lot.

Campground

KEFJ has one maintained campground containing 12 walk-in tent sites, a well pump, bathrooms, and a food cooking and storage facility. The 2015 KEFJ EMPT continued routine monitoring and manual treatment in the campground. Due to the diligence of past and present EPMT crews, the campsites continue to be free of invasive species. In the campground parking lot, a small population of annual bluegrass was mapped and manually treated as well as a few individual occurrences of common dandelion, common plantain, and pineapple weed.

SNOTEL

The Snowpack Telemetry (SNOTEL) site is situated in a natural opening in the tree canopy a short distance northeast of the employee housing area. The 2013 KEFJ EPMT discovered common dandelion here, mapping and manually treating 1 individual plant. In 2014, over 50 individuals were mapped and hand pulled (Kainrath 2014). As these are small, disjunct occurrences that can feasibly be eradicated, chemical treatment was deemed a suitable course of action for the first time in the 2015 field season. On June 12th the KEFJ EPMT applied an estimated .009 ounces of Milestone to 25 common dandelions. The SNOTEL site was monitored 3 times after herbicide application and less than 20 individual plants were manually treated.

Nature Center Plaza and Main Trail

The 2015 KEFJ EPMT surveyed the Nature Center plaza and Main Trail (the paved trail that begins south of the Nature Center) 4 times throughout the field season. Isolated populations of common dandelion, common plantain, and pineapple weed were mapped and manually treated around the Nature Center and along the Main Trail. Significant populations of annual bluegrass found in front of the pump house and along a section of the Main Trail near the Nature Center were both hand

pulled and mapped. An individual common timothy plant in the picnic area behind the Nature Center was hand pulled. On August 4th, the 6 person SCA crew assisted for half of a day in pulling 33 pounds of annual bluegrass along the Main Trail.



Figure 6. Before and after photo of the edge of the Main Trail where annual bluegrass was hand pulled by the KEFJ EPMT and SCA crew.

Trail to the Glacier View

The KEFJ EPMT monitored and treated the Trail to the Glacier View 4 times throughout the 2015 field season. Annual bluegrass occurs in small pockets throughout the trail. Other species are almost entirely located in front of the Pavilion, directly off of the Main Trail where KEFJ EPMT mapped and hand pulled pineapple weed, common plantain, and common dandelion. 5 common dandelions were mapped and treated on the south side of the 1917 moraine next to the Pavilion. Between the Main Trail and the Trail to the Glacier View there is a natural opening in the tree canopy that can be accessed from a social trail near the east end of the Trail to the Glacier View. The KEFJ EPMT visited this site on June 12th to chemically treat common dandelion using an estimated 8 oz. of solution containing 012 ounces of Milestone. Occurrences of common dandelion were small, sparsely populated, and tended to the east side of the clearing. This site was monitored 4 more times throughout the season, mapping and manually treating less than 15 dandelions. A total area of 87 square feet was treated at this site during the field season.

Trail to the Edge of the Glacier

The 2015 KEFJ EPMT monitored the Trail to the Edge of the Glacier 4 times during the 2015 field season. Small clumps of annual bluegrass were found throughout the trail, typically in the lower elevations. A significant population of common dandelion and a few common plantain plants occur on the north side of the loop of the Trail to the Glacier View, specifically on the right side heading up the trail. Because there was very little snowpack this season, this site was visited early in the 2015

field season to treat dandelions before they were able to go to seed. A total of 20 individual common dandelions and 4 common plantain plants were mapped and manually treated over 3 visits to this site.

Harding Icefield Trail

The Harding Icefield Trail is a steep, 4.1 mile trail leading to an overlook that peers out over a vast expanse of the 800 square mile Harding Icefield. The trail begins in a cottonwood-alder forest and then climbs into sub-alpine and alpine zones. The 2015 KEFJ EPMT identified small, isolated populations of common dandelion and common plantain, as well as large, dense populations of annual bluegrass between the trailhead and the bottom of the cliffs. One noteworthy common dandelion population is located at an old section of trail 0.25 miles from the trailhead. The KEFJ EPMT mapped, and manually treated around 20 individuals between 2 visits in the 2015 field season. This site was originally intended to receive chemical treatment in 2015 but initial investigation showed small populations therefore manual treatment was determined to be the best method of control. Only 4 individual common dandelions and 3 common plantains on the entire HIT were mapped and manually treated on the rest of the trail. The low number of common dandelion and common plantain found on the HIT in 2015 is a great example of how successful control efforts in the past have been in reducing the spread invasive plants up the trail.



Figure 7. SCA crew working on the Harding Icefield Trail

The most abundant invasive species on the HIT is annual bluegrass. It occurs in small isolated pockets as well as dense vegetative mats that can extend on either side of the trail. Populations currently extend sporadically from the beginning of the trail to the "Bottom of the Cliffs," located 1.8 miles from the trailhead. All occurrences of annual bluegrass were manually treated on the HIT. An estimated 150 pounds of annual bluegrass was removed from the HIT. On August 8th the 6 person SCA crew assisted in removing 91 pounds of the total 150 pounds of annual bluegrass from some of the more dense infestations along the trail. A total of 697 square feet of annual bluegrass was treated on the HIT during the 2015 field season.

Nike Stripe

Named for a swoosh-shaped opening in the tree canopy north of Herman Leirer Road, common dandelion populations were manually treated at the Nike Stripe from 2004 to 2011, and have been chemically treated since 2012. On June 11th, donning hip waders and eye protection, the 2015 KEFJ EPMT bushwhacked north from the park road to the Nike Stripe to perform herbicide application.

.25 gallons of solution containing .05 ounces of Milestone was used to treat 22 common dandelions in the Nike Stripe, 3 at a site southwest of the Nike Stripe, and 5 common dandelions at a site southeast of the Nike Stripe on the way back to the vehicle pullout by the park entrance sign.

Outwash Plain

As Exit Glacier receded, it left behind a patchwork of sparsely vegetated areas that hosts large common dandelion populations. This area was manually treated from 2006 to 2010 with little success. Chemical treatment was used for the first time 2011 and dandelion populations at this site have been controlled using the herbicide Milestone through 2014. Access to the Outwash Plain is dictated by the speed, volume, and height of the main channel of Exit Creek. On June 12th, the KEFJ EPMT scouted possible stream crossing locations in anticipation of the following 2 weeks scheduled assistance from the Alaska Regional EPMT Liaison with herbicide applications. The creek was low enough to cross near the Exit Glacier campground and Milestone was used to chemically treat some of the smaller, outlying infestations in an effort to streamline treatment efforts the following 2 weeks. We were unable to return to the site over the next two weeks because the creek had risen to levels that were too high to safely cross. In fact, the creek was never low enough to cross safely throughout the summer, so the majority of the site was never treated in 2015. On June 23rd the 2015 KEFJ EPMT mapped and chemically treated the few common dandelion populations that occur on the north side of Exit Creek.

Employee Housing

Located south of the Exit Glacier parking area is a small parking lot, 3 employee cabins, and a trail builder's camp. The KEFJ EPMT visited and controlled invasive plants 3 times in this area during the 2015 field season. Invasive plants located and manually treated at this site include annual bluegrass, common plantain, common dandelion, and pineapple weed, mostly occurring in the housing parking lot. A few small populations of annual bluegrass were controlled on connecting trails between the cabins and the parking lot. Pineapple weed, common plantain and annual bluegrass were mapped and controlled in front of the Alder Cabin. Two common dandelions were mapped and treated in the trail builder's camp for the first time in 2015. The 2015 KEFJ EPMT located a new common dandelion population on the trail between employee housing and the Exit Glacier parking lot. Less than 10 common dandelions were mapped and manually treated at this location.

Coastal Areas

KEFJ has 585 miles of rugged and scenic coastline that is only accessible by boat or floatplane. Despite the remote character of this area of the park, invasive plants have managed to become established at a number of sites. The 2015 KEFJ EPMT conducted three coastal trips in 2015; a 5 day trip, June 27th - July 1st, based from the park's M/V Serac, a 3 day trip, July 13th – 15th, based out of the Aialik Bay Ranger Station (ABRS), and a single day trip in Resurrection Bay on August 25th. The KEFJ EPMT surveyed a total of 8.39 acres and treated 218 square feet of infestations on the coast during the 2015 field season.

Nuka Bay

On June 28th the KEFJ EPMT deployed from the M/V Serac to perform invasive plant control at Beauty Bay and the North Arm of Nuka Bay. At Beauty Bay the KEFJ EPMT surveyed the coastline, the airstrip, and used legacy data to revisit previously infested sites. Common timothy has been manually treated at this site since 2006, when an initial 150 pounds of vegetation was extracted (Wetherbee 2007). In 2015, the KEFJ EPMT found no occurrences of common timothy. Three common dandelions were mapped and hand pulled near the abandoned airstrip. The coastline at the head of North Arm was monitored and a common dandelion infestation initially detected in 2013 was revisited. Five square feet of common dandelions were mapped and manually treated. The original plan was to chemically treat this site for the second year, but rainy weather conditions prevented herbicide application.



Figure 8. NPS staff mapping common dandelion at the head of the North Arm in Nuka Bay

McCarty Fjord

The only known occurrences of invasive plants within McCarty Fjord are common dandelion located along a series of cliffs and rocky outcrops directly south of Dinglestadt Glacier. This site was manually treated from its discovery in 2006 until 2012. Showing little reduction in extent from manual treatment, and considering the remoteness of the site, it was determined in 2013 that chemical treatment would be more a more effective treatment strategy (Frank 2013). Chemical treatment continued in 2014. On June 29th the 2015 KEFJ EPMT revisited previously documented infestations in this vicinity. Due to rainy conditions herbicide could not be applied, so all common dandelions were hand pulled. One new infestation of common dandelion was found on an east facing rock outcrop. A total of 61 square feet of common dandelion was treated in this area.

Northwestern Fjord

On June 30th, 5 locations were visited within Northwestern Fjord. Sites visited include the camping beach just inside the moraine on the east side of the fjord, Northeastern Glacier camping beach, Southwestern Glacier camping beach, and Sunlight Glacier camping beach. The entire extent of each beach was monitored, paying special attention to areas with high visitor use such as locations with bear food storage lockers and campsites. No invasive plants were found at any of these sites.

Aialik Bay

July 13th through 15th, the KEFJ EPMT traveled to Aialik Bay to complete monitoring and control work at 5 locations; Holgate Public Use Cabin (PUC), Aialik PUC, Abra Cove, Verdant Cove, and the Pedersen Lagoon area.

Two occurrences of annual bluegrass were mapped and manually treated in the camping area of Abra Cove. There were fewer individual plants than when the population was first documented in 2013. A total of 0.5 square feet of annual bluegrass was treated. The KEFJ EPMT also mapped and treated 113 square feet of annual bluegrass at the Aialik PUC and the trail that connects it to the beach. Twenty-six square feet of annual bluegrass were mapped and controlled around the Holgate PUC. Annual bluegrass continues to be persistent at both cabins, but the density appears to have been reduced and it is not spreading beyond the original infestations.



Figure 9. NPS staff monitoring at upper Pedersen Lagoon

Verdant Cove, located at the south end of Aialik Bay, was surveyed and no invasive species were found on this popular camping beach.

An extensive survey was completed in the Pedersen Glacier area including Pedersen outer beach, the Pedersen Lagoon camping easement, and the trail providing access to the upper lagoon from Kenai Fjords Glacier Lodge. Kenai Fjords Glacier Lodge is located on the lower lagoon and is on a private Port Graham Corporation inholding leased by Alaska Wildland Adventures. KEFJ EPMT works in cooperation with the lodge to control and monitor invasive plants on both park and lodge lands. Permission was granted by the lodge manager to use a trail they built to access the upper lagoon and to access and manually treat invasive plants at their landing beach where they drop off clients. The lodge trail receives daily foot traffic from guided hikes based out of Kenai Fjords Glacier Lodge and has a high potential for invasive plant establishment, but no invasive plants were found along the trail. The trail accesses the upper lagoon, which is within the park boundary. No invasive plants were found along the shore of the upper Pedersen Lagoon. Brushy vegetation density has increased at the upper lagoon which has reduced the area that visitors want to access.

Five individual pineapple weed plants and 9 square feet of annual bluegrass was mapped and manually controlled on the lodge landing beach. This population was discovered and has been manually controlled by the KEFJ EPMT since 2011. The park has a camping easement with a bear food storage locker and campsites located on the inside of the lower lagoon. The area was monitored and no invasive plants were found in the easement.

Resurrection Bay

On August 25th the KEFJ EPMT embarked on a day trip to 2 sites located within Resurrection Bay. Porcupine and Bulldog Coves were both found to be free of invasive plants. Both beaches showed impacts from visitation including a buoy decorated tree at Porcupine Cove, campfire rings, and a substantial man made shelter at Bulldog Cove, all of which were documented and deconstructed.

Seward

The KEFJ EMPT and visiting SCA crew carried out invasive plant control efforts over 3 days at the Information Center by the Seward Small Boat Harbor, the Maintenance Facility located on Old Exit Glacier Road, and the Shea parking lot on 3rd Avenue.



Figure 10. KEFJ EPMT and SCA crew hand pulling common chickweed in the Maintenance Facility.

The Information Center is a leased building that serves as the in-town visitor center. On August 7th the KEFJ EMPT and the 6 person SCA crew dedicated 2 hours to manually treat 35 pounds of invasive species around the building. Because it is a leased property, and the extents of treatment are somewhat arbitrary, mapping of these treatment areas is unnecessary at this time.

The Maintenance Facility is located north of Herman Leirer Road and is infested with invasive plants. The facility receives heavy park vehicle traffic travelling to and from the park. This increases the likelihood of vehicles spreading invasives into the park. On August 5th and 6th, the KEFJ EPMT and the 6 person SCA crew hand pulled 68 pounds of invasive vegetation from the maintenance yard. Invasive plants manually treated include annual bluegrass, common dandelion, common plantain, common chickweed (*Stellaria media*), pineapple weed and prostrate knotweed (*Polygonum aviculare*).

The Shea parking lot, where staff working in Park Headquarters park their vehicles, hosts significant populations of invasive plants found in the Seward area. On August 7th the KEFJ EPMT and the 6 person SCA crew mapped and pulled 98 pounds of invasive vegetation from the Shea parking lot. A

large patch of quackgrass (*Elymus repens*) was mapped and mechanically treated at the southeast corner of the lot with a weed whacker. Species manually treated include shepherd's purse, quackgrass, common timothy, common plantain, common dandelion, white clover, pineapple weed, common chickweed, and a species of hemp nettle (*Galeopsis spp.*) yet to be identified to the species level. The hemp nettle occurs in a few locations on the sloped terrain between the lower and upper



Figure 11. Before and after shot at the Shea parking lot

parking areas. Specimens thus far have been mapped and manually treated before characteristics, particularly flowering parts which can distinguish differences between *Galeopsis bifida* and *Galeopsis tetrahit*, have been allowed to develop. According to the Alaska Exotic Plants Information Clearinghouse (AKEPIC), there are 9 records of *Galeopsis bifida* and no record of *Galeopsis tetrahit* in the town of Seward. The 2016 KEFJ EPMT will allow the *Galeopsis spp.* to flower to aid in identification.

The 2015 KEFJ EPMT spent half a day treating the alley that borders the west side of the Park Headquarters Building. Control efforts were not mapped as KEFJ does not own the alley. Species treated include common dandelion, pineapple weed, yellow toadflax (*Linaria vulgaris*), common plantain, and curly dock (*Rumex crispus*).

Outreach and Education

Outreach and education are inexpensive, preventative efforts that can reduce future treatment efforts which tend to be far more expensive and resource dependent. Because of this, outreach was a significant focus throughout the 2015 field season.

KEFJ EPMT staff delivered a presentation to the interpretive staff during their spring training session to educate them about the invasive plant program and what projects the KEFJ EPMT would be completing in 2015. Two presentations were given to SCA trail crews on how to mitigate the spread of invasive plants while working and living in the park. The KEFJ EPMT also discussed the

importance of sequencing operations appropriately, such as working in pristine areas prior to infested locations, reducing the likelihood of invasive seed dispersal. Both KEFJ maintenance staff and SCA trail crews were reminded about the importance of pressure washing equipment, such as weed wackers and other hand tools that have been used in other areas that may have been exposed to invasive plants before being used in the park.

The KEFJ EPMT reinstalled a boot brush and informational sign outside of the Exit Glacier Nature Center to educate visitors about the how invasive plant seeds can be spread on shoes and clothing.



Figure 12. Forest Service interns at the community weed pull event.

A community weed pull event was organized for the 12th year on Friday, June 26th. A total of 11 people including staff from KEFJ, Chugach National Forest, and a local volunteer participated in the event. Fewer Forest Service staff were available for the event due to a particularly busy fire season in Alaska. The event focused on pullouts along the Herman Leirer Road, particularly outside KEFJ at the parking lot and trail head of the Resurrection River Trail and at the pull out next to the Chugach National Forest Service entrance sign. Species manually treated include white clover, oxeye daisy (*Leucanthemum vulgare*), common dandelion, common timothy, yellow sweetclover, fall dandelion (*Leontodon autumnalis*), alfalfa (*Medicago sativa*) and bird vetch (*Vicia cracca*).

KEFJ EPMT posted 3 blog posts, 2 to the park website and 1 to the park's Facebook page, updating the public on EPMT activities during the 2015 field season.

Elodea Monitoring

The Southwest Alaska Network (SWAN) Inventory and Monitoring Program Aquatic Ecologist planned to conduct elodea (*Elodea spp*.) monitoring opportunistically during the 2015 field season. She was going to sample sites for Elodea as time allowed, in both Delight and Desire Lakes in conjunction with a water quality monitoring project. Time restraints and flight scheduling conflicts prevented her from flying to these sites in 2015 and she was unable to take any samples.

Restoration and Prevention

In August and September the KEFJ EPMT collected native seeds to be used for revegetation purposes. Species collected include arctic lupine (*Lupinus arctica*), alpine timothy (*Plheum*

alpinum), meadow barley (*Hordeum brachyantherum*), bluejoint reedgrass (*Calamagrostis canadensis*), western columbine (*Aquilegia formosa*), spike trisetum (*Trisetum spicatum*), Merten's sedge (*Carex mertensii*), and alpine bluegrass (*Poa alpina*). Seeds will be sent to the Alaska Department of Agriculture, Plant Material Center in Palmer to be cleaned. Native seeds collected in the park will be used to revegetate the roadside after a construction project on Herman Leirer Road, planned for 2016, is completed.

Prevention is the most important way to reduce the spread of invasive plants into the park. KEFJ staff continued to take mitigation measures to prevent the spread of invasive plants while working in the park. The maintenance staff cleaned heavy equipment after working in the Shea parking lot, located in the town of Seward and infested with a wide variety invasive plant species. Mitigation measures were included in the contract for construction work being completed along Herman Leirer Road in 2016. Contractor equipment was required to be cleaned before coming into the park and weed-free erosion control products were required.

Gypsy Moth Monitoring

From 2009 to 2014, KEFJ has participated in the gypsy moth monitoring program of the Alaska Division of Agriculture. The 2015 KEFJ EPMT contacted Alaska Division of Agriculture representatives who stated that the division was in a transition period and gypsy moth traps were not sent out to parks in 2015. No gypsy moths have been observed in KEFJ in previous monitoring efforts, but continued monitoring is essential as part of an early detection and rapid response management strategy. Little time and effort is required to complete this monitoring effort and should could continue if the Alaska Division of Agriculture continues to manage this data.

Discussion and Recommendations

The invasive plant management team at KEFJ has been preventing introduction of new invasive species, reducing current infestations, and restoring native plant communities for 12 years. The geographic isolation and cold climate of KEFJ has limited the introduction of invasive plant species into the park. As long as the EPMT continues operations, KEFJ continues to be in a unique position in which we can significantly limit the extent of invasive plant establishment. The following are recommendations from the 2015 EPMT for ways to improve invasive plant management at KEFJ.

There has been an increase in the number of invasive plant species and size of some of the infestations at the Maintenance Facility over the last 5 years. The population of common chickweed has continued to expand and has not responded to hand pulling. In an effort to reduce the spread of invasive plants from the Maintenance Facility into the park, it is recommended that these invasive plant populations be controlled with herbicide until populations are reduced to levels that can be managed by hand pulling again.

The speed, volume, and height of the main channel of Exit Creek prohibited park staff from crossing the creek and treating the extensive populations of common dandelion in the Outwash Plain. Common dandelion in the Outwash Plain, first documented in 2002, was manually treated from 2007 to 2010 and chemically treated from 2011 to 2014 (Frank 2013). 2015 was the first year since its discovery that the outwash plain has not been treated. The Outwash Plain should be given high priority for treatment with herbicide in 2016. Each year that the area is not treated plants have the opportunity spread seed, increasing the population extent and density and making past treatment efforts futile.

Delays in the hiring process prohibited the 2015 EPMT Biological Science Technician from becoming a State of Alaska certified pesticide applicator. The seasonal Biological Science Technician should be hired early enough for there to be time to study for, and take the pesticide applicator test. Doing this will significantly increase the ability of the KEFJ EPMT to complete herbicide application goals.

As more populations of Elodea are found in lakes frequented by float planes around the state, the more urgent it becomes to complete baseline surveys in the park's freshwater lakes. Elodea can spread vegetative and it only takes a small piece of the plant to be stuck on a plane float to transfer it to another lake. At this time the park does not have the funding and resources to complete extensive baseline surveys. The Alaska Regional EPMT has submitted a proposal for funding for Elodea surveys in parks around the state, but funding has not been secured at this time. The Southwest Network agreed to complete opportunistic elodea surveys during a freshwater lake monitoring project in 2015, but due to time constraints and flight scheduling conflicts they were unable to fly to these sites to complete field work.. The KEFJ EPMT should continue to coordinate with the Southwest Alaska Network in an effort to complete opportunistic elodea surveys in freshwater lakes in KEFJ, but should also examine the feasibility of the KEFJ EPMT completing surveys by foot and pack raft as time and resources allow.

A species of hemp nettle found between the lower and upper parking areas of the Shea lot has yet to be distinguished between *Galeopsis bifida* and *Galeopsis tetrahit*. These are the first occurrences of hemp nettle discovered on park property. Individuals have been mapped and manually treated before flowering parts had developed. The 2015 KEFJ EPMT suggests that these populations be diligently monitored in 2016 to collect specimens after flowering and before going to seed so it can be identified to the species level. This population should also be manually treated while it is small and to prevent it's spread into the park.

Native seed collection should continue to occur on a yearly basis to add to the number of native seeds available for restoration needs. There is a road construction project planned for the summer of 2016 and native seeds will be needed to revegetate along an approximately 1/4 mile long section of along the roadside when the project is completed.

Partnering and outreach should continue to be an important component of the invasive plant program into the future. The community weed pull is a great opportunity to work with the Chugach National Forest and community volunteers. Working with other agencies and organizations provides opportunities to create partnerships and share resources. The Homer Soil and Water Conservation District had an invasive plant crew working on the Kenai Peninsula during the summer of 2015, but because of schedule conflicts the KEFJ EPMT was unable to work with them on projects in the Seward area. This crew has funding to continue work in 2016 and it should be a priority to schedule time to work with this crew next summer.



Figure 13. SCA intern and YCC staff mapping and controlling invasive plants.

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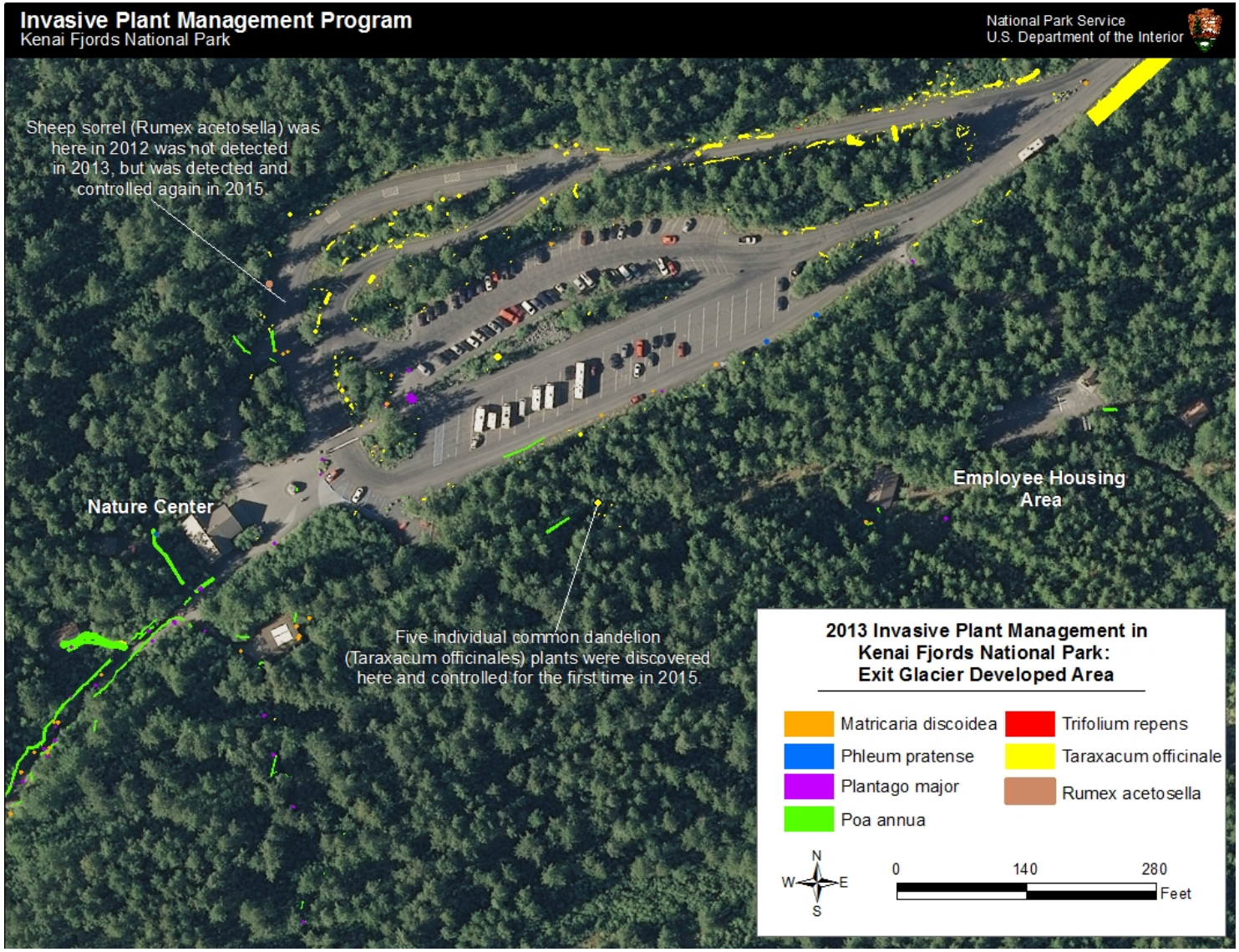
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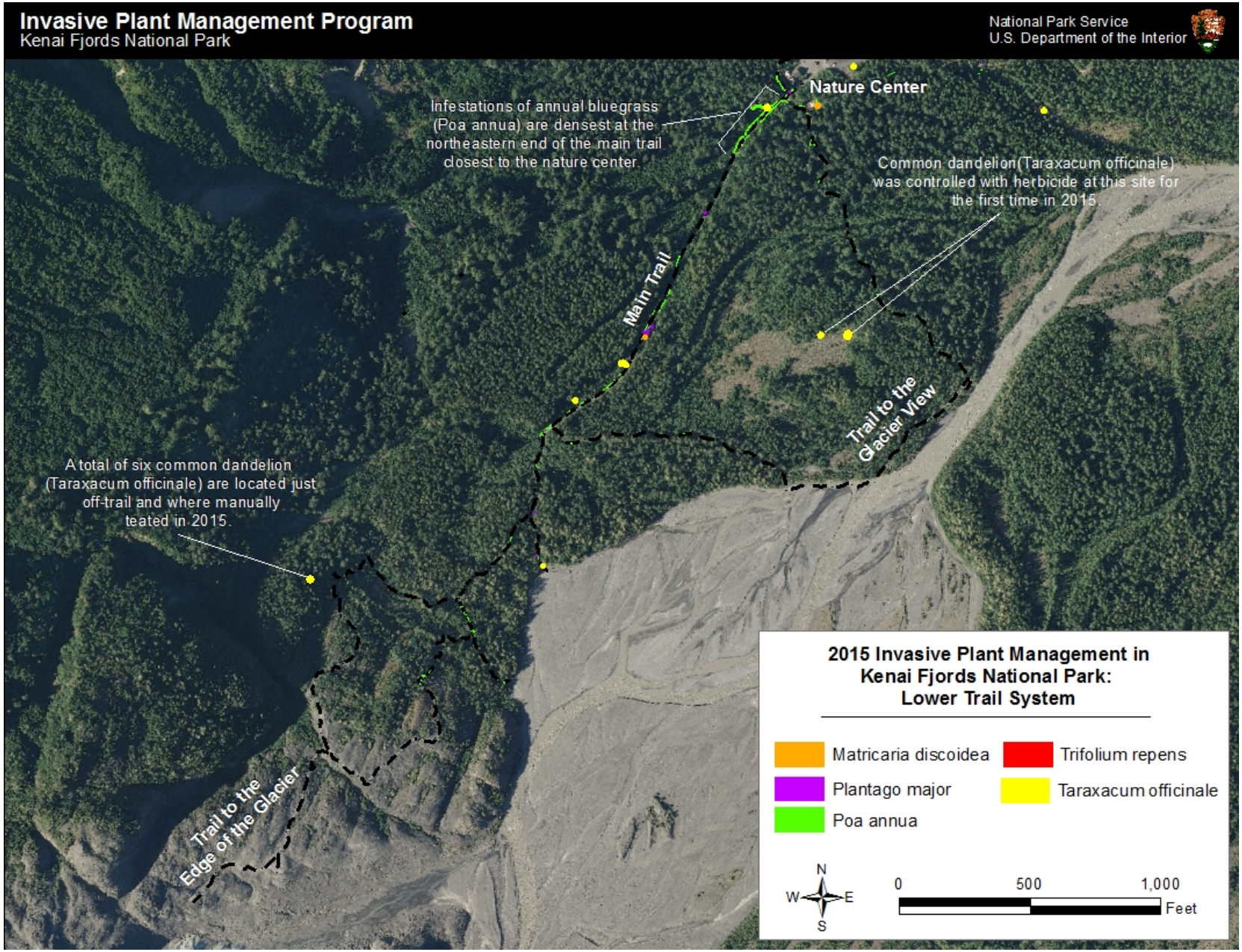
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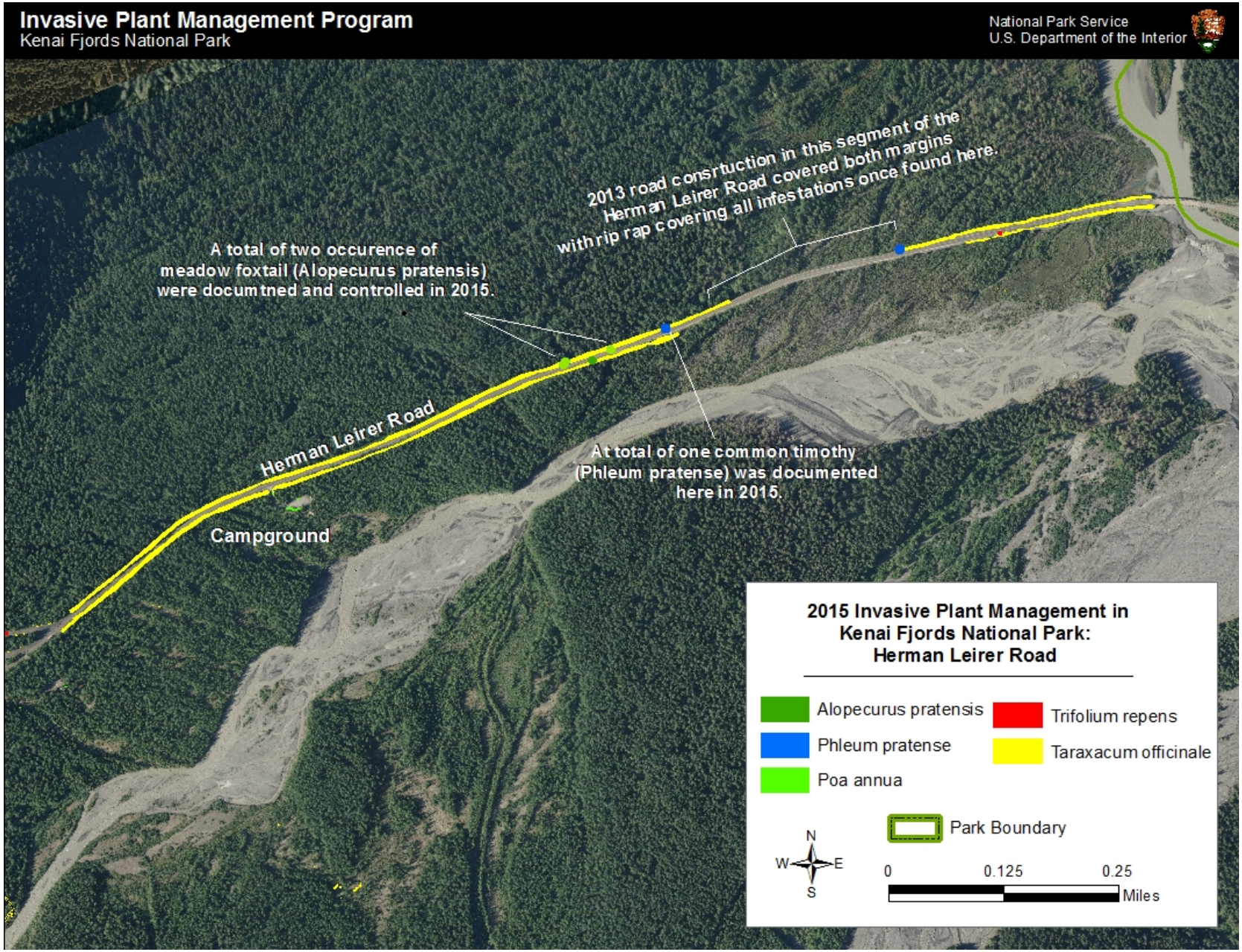
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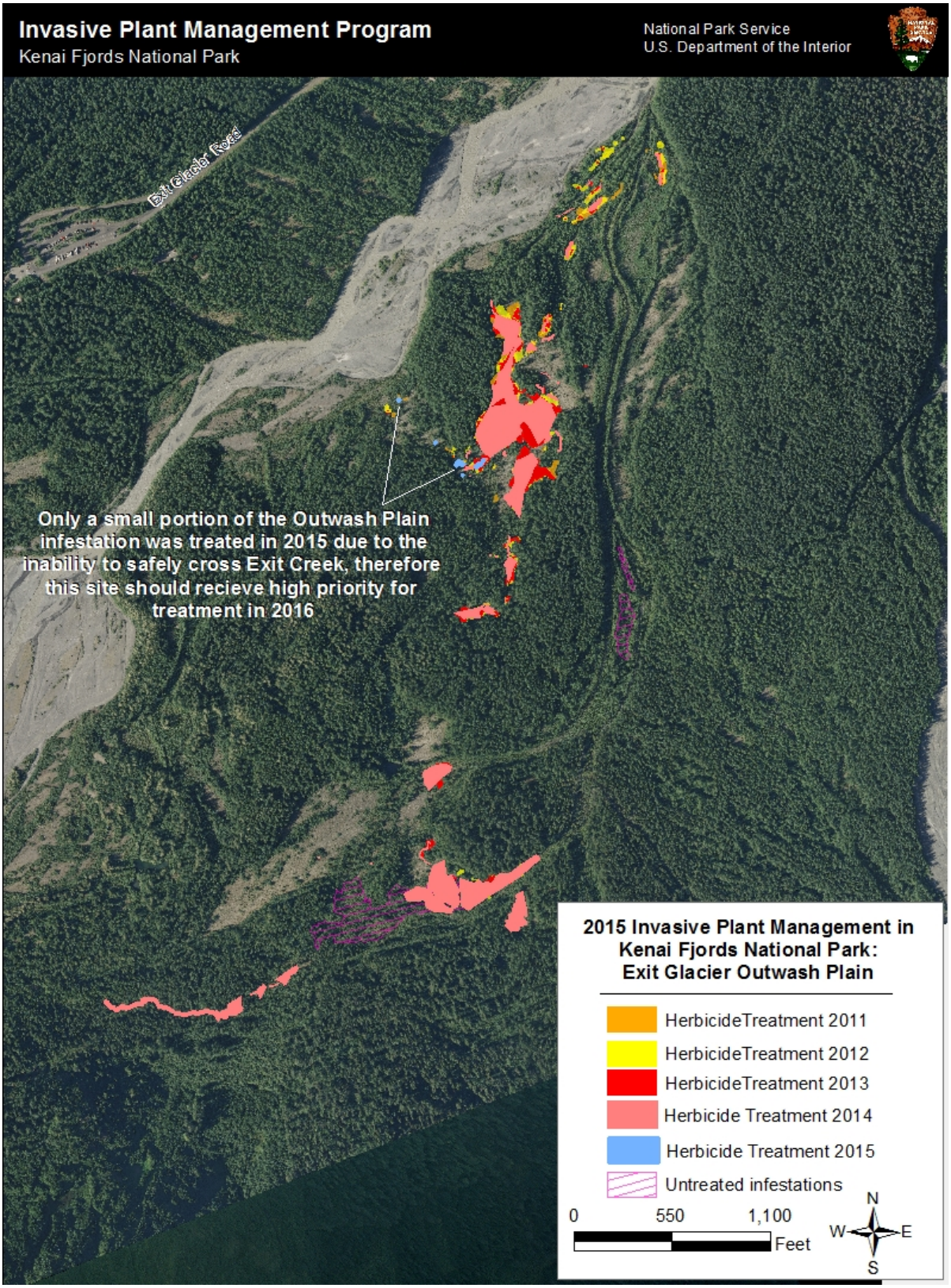
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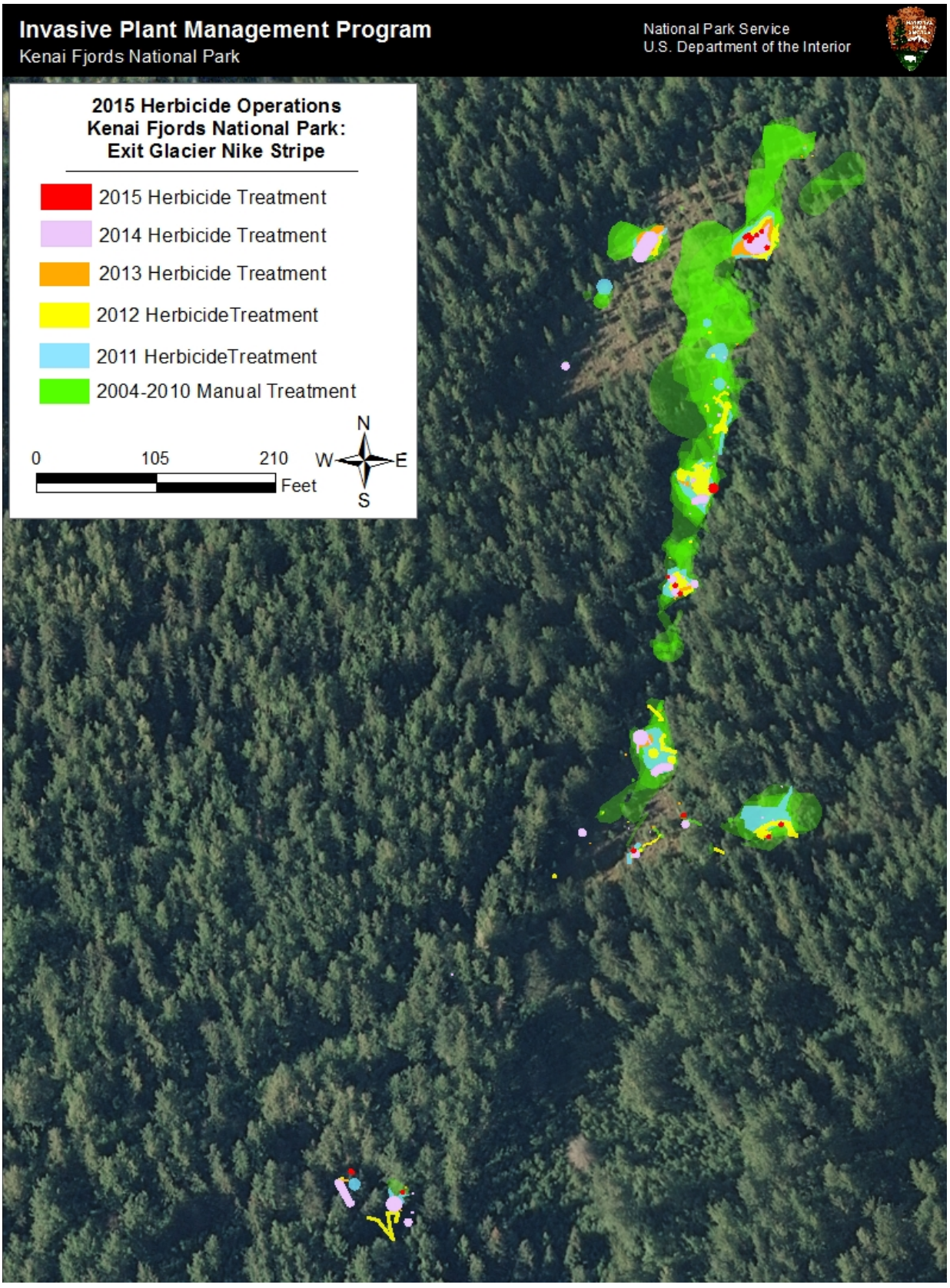
Appendix A: Site Specific Maps

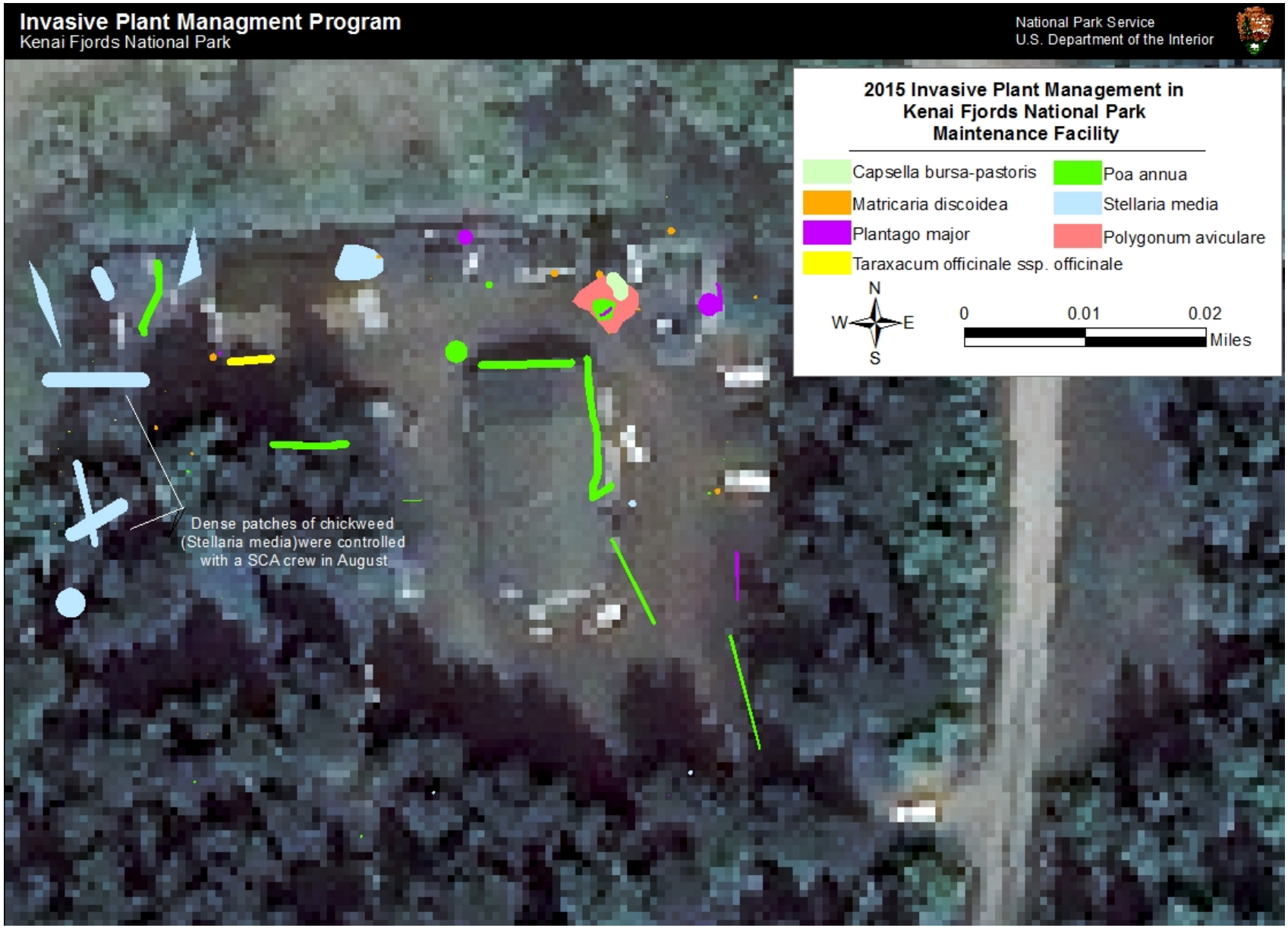


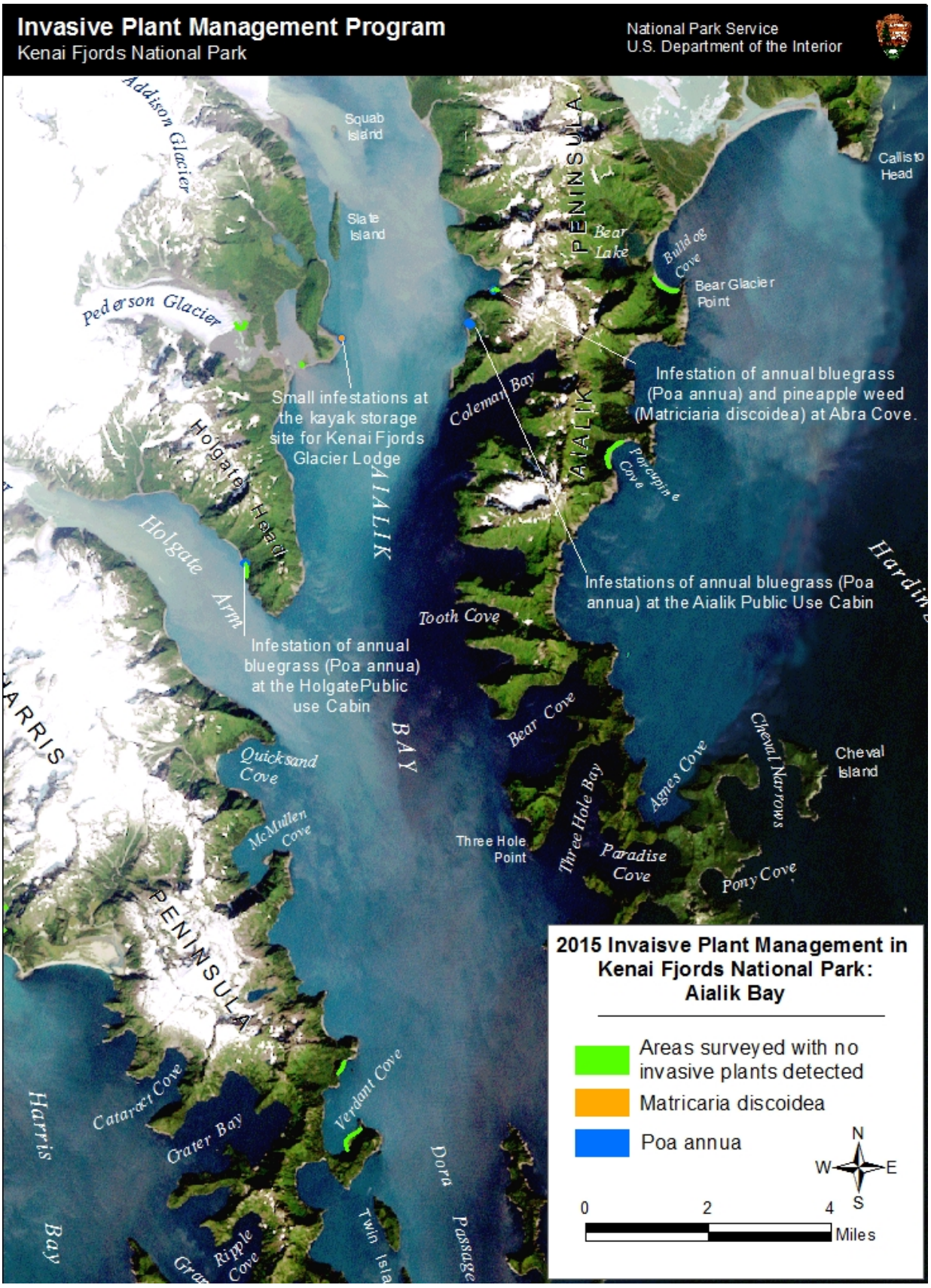

Invasive Plant Management Program
Kenai Fjords National Park
National Park Service
U.S. Department of the Interior
Nature Center
Infestations of annual bluegrass (Poa annua) are densest at the northeastern end of the main trail closest to the nature center.
Common dandelion(Taraxacum officinale) was controlled with herbicide at this site for the first time in 2015.
Main Trail
Trail to the Glacier View
A total of six common dandelion (Taraxacum officinale) are located just off-trail and where manually teated in 2015.
Trail to the Edge of the Glacier
2015 Invasive Plant Management in Kenai Fjords National Park: Lower Trail System
Matricaria discoidea
Trifolium repens
Plantago major
Taraxacum officinale
Poa annua
N
W
E
S
0
500
1,000
Feet

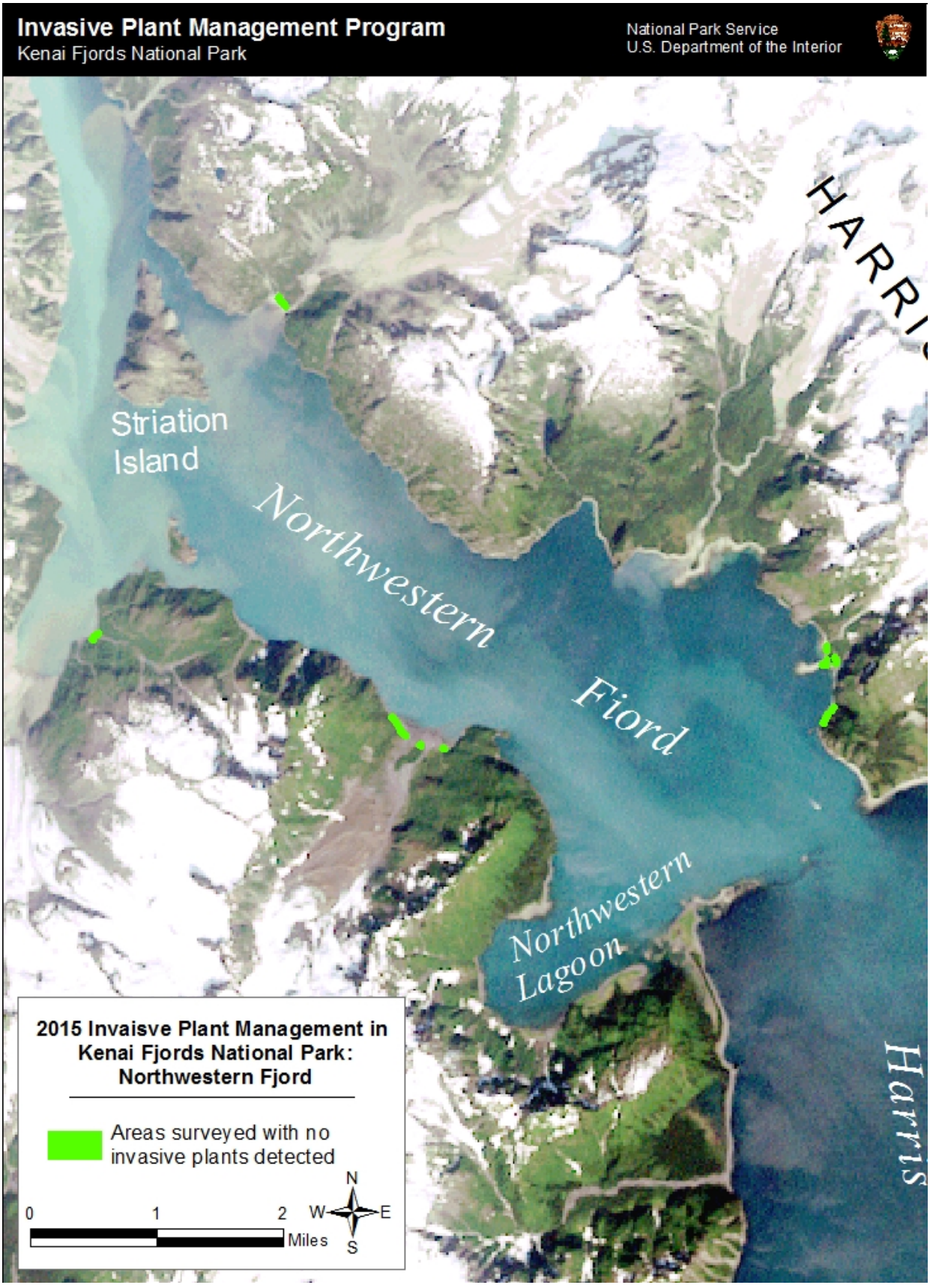

Invasive Plant Management Program
Kenai Fjords National Park
National Park Service
U.S. Department of the Interior
2013 road consrtuction in this segment of the Herman Leirer Road covered both margins with rip rap covering all infestations once found here.
A total of two occurence of meadow foxtail (Alopecurus pratensis) were documtned and controlled in 2015.
Herman Leirer Road
At total of one common timothy (Phleum pratense) was documented here in 2015.
Campground
2015 Invasive Plant Management in Kenai Fjords National Park: Herman Leirer Road
Alopecurus pratensis
Phleum pratense
Poa annua
Trifolium repens
Taraxacum officinale
Park Boundary
N
W
E
S
0
0.125
0.25
Miles

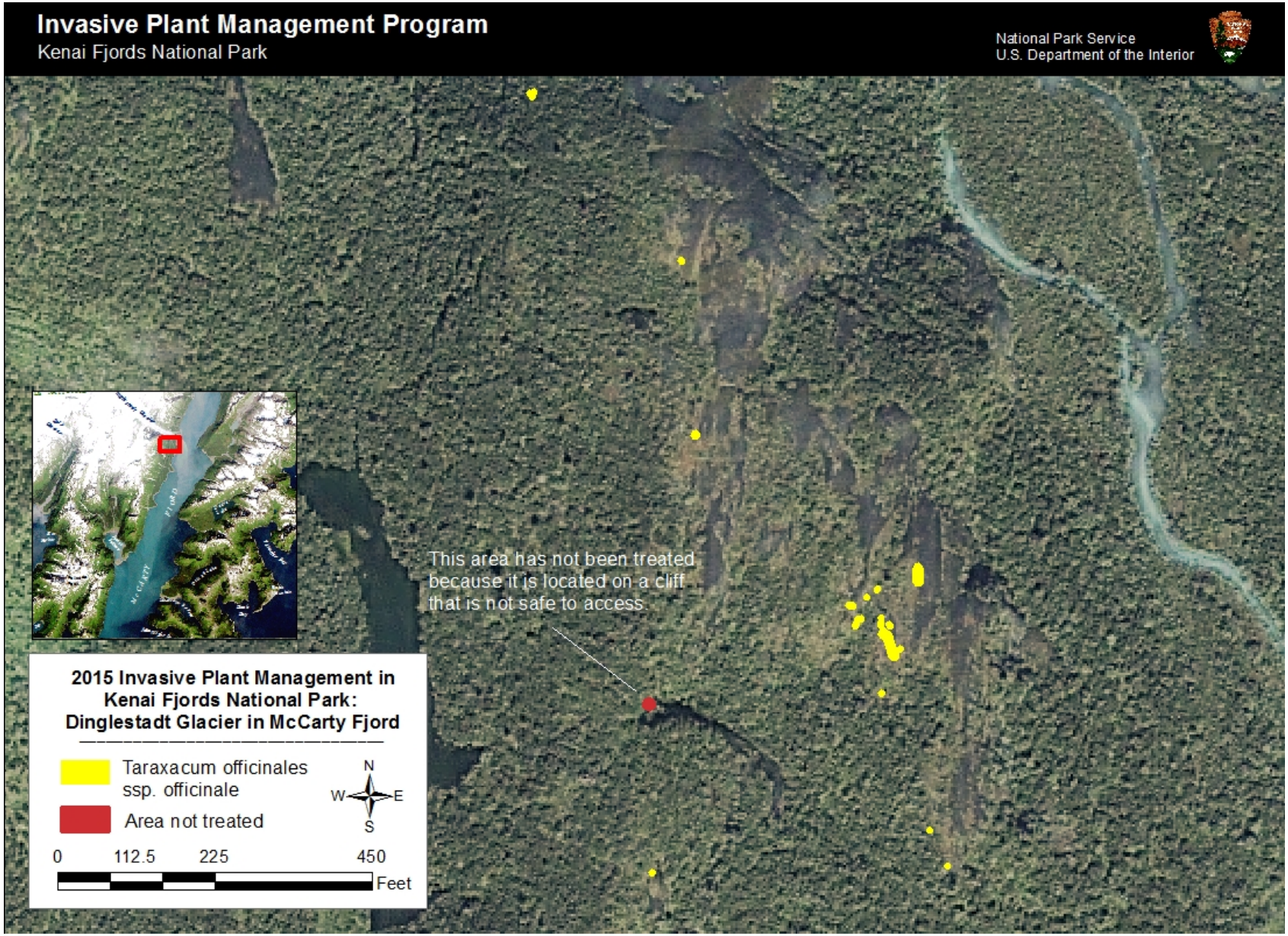

Invasive Plant Management Program
Kenai Fjords National Park
National Park Service
U.S. Department of the Interior
Exit Glacier Road
Only a small portion of the Outwash Plain infestation was treated in 2015 due to the inability to safely cross Exit Creek, therefore this site should recieve high priority for treatment in 2016
2015 Invasive Plant Management in Kenai Fjords National Park: Exit Glacier Outwash Plain
HerbicideTreatment 2011
HerbicideTreatment 2012
HerbicideTreatment 2013
Herbicide Treatment 2014
Herbicide Treatment 2015
Untreated infestations
0
550
1,100
Feet
N
W
E
S

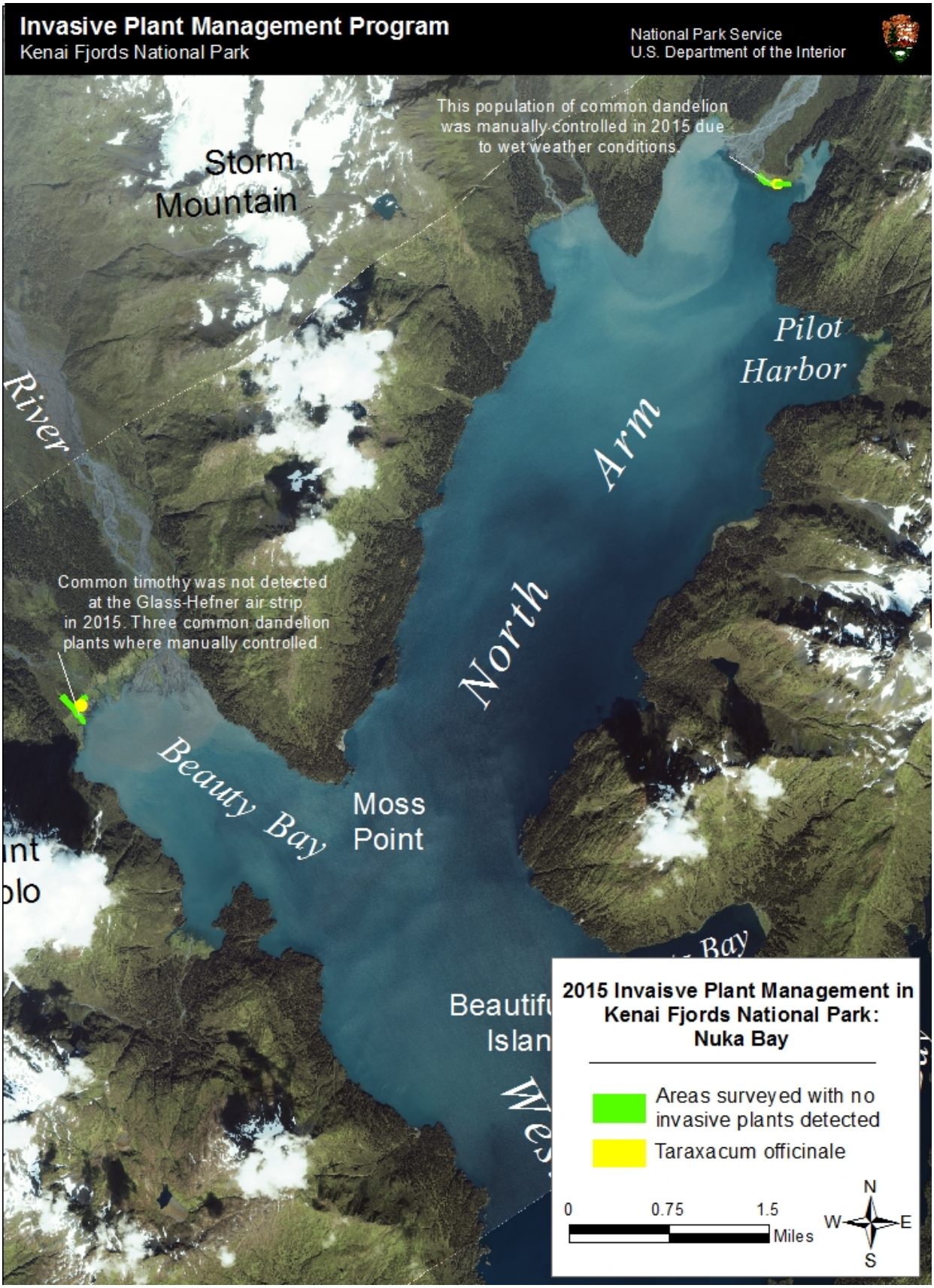

Invasive Plant Management Program
Kenai Fjords National Park
National Park Service
U.S. Department of the Interior
2015 Herbicide Operations
Kenai Fjords National Park:
Exit Glacier Nike Stripe
2015 Herbicide Treatment
2014 Herbicide Treatment
2013 Herbicide Treatment
2012 HerbicideTreatment
2011 HerbicideTreatment
2004-2010 Manual Treatment
0
105
210
Feet
N
W
E
S


Invasive Plant Managment Program
Kenai Fjords National Park
National Park Service
U.S. Department of the Interior
2015 Invasive Plant Management in
Kenai Fjords National Park
Maintenance Facility
Capsella bursa-pastoris
Matricaria discoidea
Plantago major
Taraxacum officinale ssp. officinale
Poa annua
Stellaria media
Polygonum aviculare
N
W
E
S
0
0.01
0.02
Miles
Dense patches of chickweed
(Stellaria media)were controlled
with a SCA crew in August


Invasive Plant Management Program
Kenai Fjords National Park
National Park Service
U.S. Department of the Interior
Addison Glacier
Squab Island
Slate Island
Pederson Glacier
PENINSULA
Bear Lake
Bulldog Cove
Bear Glacier Point
Callisto Head
Small infestations at the kayak storage site for Kenai Fjords Glacier Lodge
Holgate Arm
Holgate Beach
AIALIK
Coleman Bay
A'IALIK
Porcupine Cove
Infestation of annual bluegrass (Poa annua) and pineapple weed (Matriciaria discoidea) at Abra Cove.
Infestations of annual bluegrass (Poa annua) at the Aialik Public Use Cabin
Tooth Cove
Infestation of annual bluegrass (Poa annua) at the HolgatePublic use Cabin
Bear Cove
Agnes Cove
Cheval Narrows
Cheval Island
Three Hole Bay
Three Hole Point
Paradise Cove
Pony Cove
Quicksand Cove
McMullen Cove
BAY
PENINSULA
Cataract Cove
Verdant Cove
Crater Bay
Dora Passage
Ripple Cove
2015 Invaisve Plant Management in Kenai Fjords National Park: Aialik Bay
Areas surveyed with no invasive plants detected
Matricaria discoidea
Poa annua
N
W
E
S
0
2
4
Miles


Invasive Plant Management Program
Kenai Fjords National Park
National Park Service
U.S. Department of the Interior
Striation Island
Northwestern Fiord
Northwestern Lagoon
Harris
2015 Invaisve Plant Management in Kenai Fjords National Park: Northwestern Fjord
Areas surveyed with no invasive plants detected
0
1
2
Miles
N
W
E
S


Invasive Plant Management Program
Kenai Fjords National Park
National Park Service
U.S. Department of the Interior
This area has not been treated because it is located on a cliff that is not safe to access
2015 Invasive Plant Management in Kenai Fjords National Park: Dinglestadt Glacier in McCarty Fjord
Taraxacum officinales ssp. officinale
Area not treated
N
W
E
S
0
112.5
225
450
Feet


Invasive Plant Management Program
Kenai Fjords National Park
National Park Service
U.S. Department of the Interior
This population of common dandelion was manually controlled in 2015 due to wet weather conditions.
Storm Mountain
Pilot Harbor
River
North Arm
Common timothy was not detected at the Glass-Hefner air strip in 2015. Three common dandelion plants where manually controlled.
Beauty Bay
Moss Point
2015 Invaisve Plant Management in Kenai Fjords National Park: Nuka Bay
Areas surveyed with no invasive plants detected
Taraxacum officinale
0
0.75
1.5
Miles
N
W
E
S

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.

NPS 186/130811, December 2015

National Park Service
U.S. Department of the Interior



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