National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Invasive Plant Management in Kenai Fjords National Park

2020 Summary Report

Natural Resource Report NPS/KEFJ/NRR—2021/2227





ON THIS PAGE
KEFJ IPMT at the upper lagoon in front of Pedersen Glacier.
Photo by Christina Kriedeman/NPS

ON THE COVER
Clockwise from top left: Biologist identifies grass along Herman Leirer Road. Biological science technician collects data at Pedersen Lagoon. Biological science technician in front of the park entrance sign. Biologist clips the seed heads of reed canary grass.
Photos by Christina Kriedeman and Hannah Gage/NPS and Megan Pike

Invasive Plant Management in Kenai Fjords National Park

2020 Summary Report

Natural Resource Report NPS/KEFJ/NRR—2021/2227

Hannah M. Gage and Christina L. Kriedeman

Kenai Fjords National Park
411 Washington Street
PO Box 1727
Seward, AK 99664

February 2021

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Report Series is used to disseminate comprehensive information and analysis about natural resources and related topics concerning lands managed by the National Park Service. The series supports the advancement of science, informed decision-making, and the achievement of the National Park Service mission. The series also provides a forum for presenting more lengthy results that may not be accepted by publications with page limitations.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available in digital format from the Natural Resource Publications Management website. If you have difficulty accessing information in this publication, particularly if using assistive technology, please email irma@nps.gov.

Please cite this publication as:

Gage, H. M., and C. L. Kriedeman. 2021. Invasive plant management in Kenai Fjords National Park: 2020 summary report. Natural Resource Report NPS/KEFJ/NRR—2021/2227. National Park Service, Fort Collins, Colorado. https://doi.org/10.36967/nrr-2284598.

NPS 186/175072, February 2021

Contents

Page

Figures....vi

Tables....vi

Abstract....vii

Acknowledgments....viii

List of Terms....ix

Introduction....1

Methods....3

Prioritizing Treatment....3

Control Methods....4

Manual Treatment....4

Chemical Treatment....4

Data Collection and Analysis....4

Personnel....5

Results....7

2020 Season Overview....7

Notable Weather Conditions....9

Exit Glacier Area....10

Herman Leirer Road....10

Exit Glacier Parking Area....11

Campground....13

SNOTEL Site....13

Employee Housing....14

Nature Center Plaza....14

Picnic Area....14

Glacier View Loop Trail....15

Glacier Overlook Loop Trail....17

Contents (continued)

Page

Harding Icefield Trail 17
Nike Stripe 20
Outwash Plain 20
Coastal Areas 23
Aialik Bay 23
Northwestern Fjord 25
McCarty Fjord 25
Nuka Bay 25
Seward 25
Maintenance Facility 25
Elodea Monitoring 26
Prevention 26
Restoration 27
Outreach and Education 27
Partnerships 27
Gypsy Moth Monitoring 28
Discussion and Recommendations 29
Annual Bluegrass 29
Standardized Polygons 29
Retreatment 29
Roadside Brushing 29
Coastal Monitoring 29
Shea Parking Lot 30
Prevention 30
Partnerships 30
Personnel 31

Contents (continued)

Page

Literature Cited 33

Appendix A: Exit Glacier Parking Lot Standardized Polygons 34

Appendix B: Herman Leirer Standardized Polygons 35

Figures

Page

Figure 1. Overview of Kenai Fjords National Park. 2

Figure 2. New and historic invasive plant species found in the Exit Glacier Area in 2020. 13

Figure 3. Common dandelion (yellow), annual bluegrass (green), and big chickweed (pink) treatments along the Glacier View Loop Trail in 2020. 16

Figure 4. New common dandelion populations found north of Glacier View Loop Trail in 2020. 17

Figure 5. Common dandelion populations along the Harding Icefield Trail at mile 0.25. 18

Figure 6. Common dandelion population along Harding Icefield Trail mile 1.1 19

Figure 7. Common dandelion populations near Resurrection River Bridge. 21

Figure 8. Common dandelion populations near the Trail Builder's Camp and Exit Creek. 22

Figure 9. Annual bluegrass chemical treatments in Aialik Bay in 2020. 23

Tables

Page

Table 1. KEFJ 2020 Project Areas. 3

Table 2. Summary of Kenai Fjords National Park Invasive Plant Work in 2020. 7

Table 3. KEFJ Invasive plant species and locations 2020. 8

Table 4. 2020 Monthly snow depths at Exit Glacier compared to the previous 15-year averages 10

Abstract

This report is an overview of Kenai Fjords National Park's (KEFJ) Invasive Plant Management Team's (IPMT) 2020 season. Because of the impacts of COVID-19 on staffing and travel, we surveyed and treated a portion of known invasive species populations in the park, focusing primarily on the Exit Glacier Area. We surveyed a total of 83.5 acres, chemically treated 1.34 acres with herbicide and manually treated 19.77 square feet. This season, we used 15 gallons of Milestone herbicide solution and 32.5 gallons of Roundup Custom herbicide solution on invasive plant populations in the Exit Glacier Area, at the Maintenance Facility, and in Aialik Bay. We documented 19 invasive plant species in the park and on park properties outside the park boundary. Outreach activities were limited by COVID-19 and we were not able to coordinate the Seward Community Weed Pull with Kenai Peninsula Cooperative Weed Management Area (KP-CWMA). We were not able to complete surveys in Nuka Bay since extended coast trips were limited. We did not treat the area known as the Outwash Plain due to limited staff. We did not complete any revegetation projects this year. Gypsy moth (*Lymantria dispar* (L.)) pheromone traps were deployed around the Exit Glacier Developed Area as part of the Alaska Division of Agriculture monitoring program. We detected no gypsy moths in the five traps that we deployed. The KEFJ IPMT was made up of the Kenai Fjords biologist and a biological science technician.

Acknowledgments

We would like to thank the following individuals for their contributions to a successful 2020 field season during a COVID-19 pandemic: Resource Management Logistics Coordinator Nathan Bawtinhimer for providing logistical support on the M/V Couloir; Alaska Regional GIS Data Coordinator and Lead GIS Data Manager Angie Southwould for post-processing all our data; and Deborah Kurtz for providing helpful comments on a draft of this paper.

List of Terms

ABRS Aialik Bay Ranger Station

AKEPIC Alaska Exotic Plants Information Clearinghouse

ANILCA Alaska National Interest Lands Conservation Act

DNR Alaska Department of Natural Resources

EPMT Exotic Plant Management Team

GIS Geospatial Information System

GPS Global Positioning System

IPMT Invasive Plant Management Team – formerly known as Exotic Plant Management Team (EPMT)

KEFJ Kenai Fjords

KP-CWMA Kenai Peninsula Cooperative Weed Management Area

M/V Motor Vessel

NISIMS National Invasive Species Information Management System

NPS National Park Service

PUC Public Use Cabin

PUPS Pesticide Use Proposal System

RV Recreational Vehicle

SCA Student Conservation Association

SNOTEL Snow Telemetry

VRP Visitor and Resource Protection

YCC Youth Conservation Corps

Introduction

Kenai Fjords National Park is located on the eastern side of Kenai Peninsula in south-central Alaska. The park was established in 1980 by the Alaska National Interest Lands Conservation Act (ANILCA) and includes over 670,000 acres and is recognized for its rugged coastline, temperate rainforest, jagged mountain peaks, and the Harding Icefield with its outflowing glaciers.

The KEFJ Invasive Plant Management Team (formerly known as the Exotic Plant Management Team (EPMT)) has monitored, mapped, and treated invasive plants in the park since 2004. A strategy of early detection and rapid response is used to detect and control invasive plants in the park. Invasive plant management within the park is divided into three primary areas: Exit Glacier area, the coast, and the Seward area, which includes park property outside the park's boundary (Figure 1). The Exit Glacier Area is a high priority for the park since it includes the only road and established trails found in the park and has the highest number of visitors each summer. This area has the largest populations and the highest diversity of invasive plant species in the park. The coast receives fewer visitors and has no developed areas or trails but remains a high priority for the KEFJ IPMT. Access to coastal areas of the park is limited to aircraft and boats, but despite the remote location, small and isolated invasive plant populations are found in areas used by visitors, highlighting the need for continued monitoring in the coastal areas of KEFJ. The Seward area includes the Maintenance Facility, Shea Parking Lot and Visitor Center. These sites are located near roads and properties that are infested with invasive plants and are staging areas for park vehicles. These park properties are a focus of control efforts to prevent park vehicles from becoming vectors for the spread of invasive plants into the park.

In 2020, COVID-19 health and safety concerns brought about big changes to KEFJ summer operations. Park staffing was reduced by 40 percent of its normal level and all operations and services were limited. KEFJ IPMT priorities had to be changed and survey and control efforts were limited primarily to the Exit Glacier Area with a few day trips to survey and treat invasive plant populations on the coast.

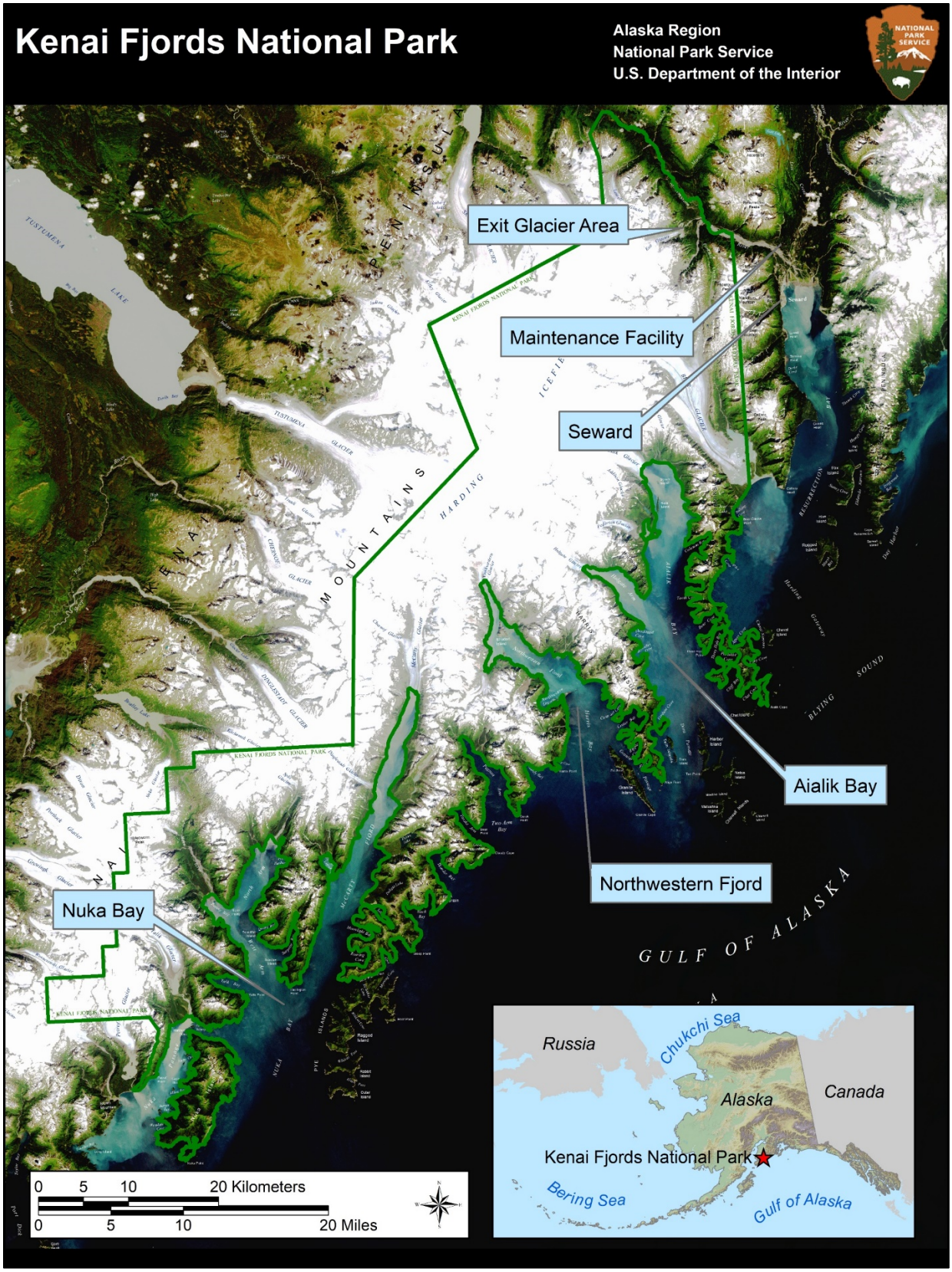


Figure 1. Overview of Kenai Fjords National Park.

Methods

Methods for data collection and processing followed the Alaska EPMT Field Protocol and the Alaska EPMT Office Protocol (Overbaugh and Frank 2020) developed by the Alaska Regional IPMT program. These protocols outline methods for data collection and processing, and control work. We created a schedule for survey and treatment for the season based on recommendations from the previous year's final report and on a timeline based on previous year's weekly field work summaries. Priorities that were originally established had to be changed because of restrictions to work and travel, and a reduction in staff due to COVID-19. Instead of planning to resurvey and treat all known invasive plant populations, we gave priority to working primarily in the Exit Glacier Area with limited coastal work as conditions allowed. The park is divided into three primary management areas: Exit Glacier Area, the coast, and Seward.

Table 1. KEFJ 2020 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, Visitor Center, Park Headquarters Building, Shea Parking Lot

Prioritizing Treatment

Because resources for managing invasive plants are limited, planning and prioritizing invasive plant treatment is guided by a variety of factors including population size, invasiveness ranking, geographic location, and ease of access. Invasiveness ranking is based on a 0 to 100 scale, with a plant ranked as 0 being no threat to native ecosystems and a plant ranked as 100 having a very high threat to native ecosystems. The invasiveness ranking system for non-native plants in Alaska was based on an initial climate screening and an evaluation of ecologic impacts, biological characteristics and dispersal ability, ecological amplitude and distribution, and feasibility of control (Carlson et al. 2008). Invasive plants with a medium to high invasiveness ranking are a high priority for control efforts for KEFJ IPMT across the park. In the Exit Glacier Area, the primary goal is to reduce the populations of invasive plants in the developed areas and prevent their spread out to undeveloped areas. Invasive plant populations found away from trails and development are a high priority for control and containment to reduce their spread across areas that have been naturally disturbed by the dynamic, glacier-fed hydrology in the area. These areas commonly have little native vegetative cover and invasive plants do not have to compete with native plants for space. Invasive plant populations in coastal and other remote areas of the park are also a high priority for treatment. If invasive plant populations can be identified while they are small and easy to treat, there is a good chance that they can be completely eradicated or contained to reduce their spread.

Control Methods

Manual Treatment

Manual treatment involved removing a plant or plant parts by hand pulling or by digging up the plant using hand tools. We used this method on invasive plant populations that were small and could be removed relatively easily or on species that were easy to pull or dig and didn't have rhizomatous roots. Flower heads were removed from invasive plants before herbicide applications to prevent plants from developing viable seeds after they were treated. All plant parts that were manually controlled were put in bags and disposed of at the Seward Waste Transfer Facility. Biodegradable bags were used as much as possible to reduce the amount of plastic going into the landfill.

Chemical Treatment

We used two types of herbicides to chemically treat invasive plants in the park in 2020. Milestone (Aminopyralid) was applied to broadleaf plants at a rate of 6 ounces per acre. Roundup Custom (Glyphosate) was applied to grasses and broadleaf plants at a rate of 48 ounces per acre. Herbicide was spot sprayed using backpack sprayers. A calibration rate of 30 gallons per acre was used to calculate the area treated for each herbicide. The biological science technician applied herbicide under the Alaska pesticide applicator license of the KEFJ biologist. We documented herbicide use using the National Park Service (NPS) Pesticide Use Proposal System (PUPS).



Chemical treatment on annual bluegrass.

Data Collection and Analysis

Data collection and processing methods followed guidelines provided in the 2020 Alaska Exotic Plant Management Team Field and Office Protocols (Overbaugh and Frank 2020 a and b). We collected data using a Trimble 7X and Trimble XT6000 Global Positioning System (GPS) using TerraSync software. We post-processed data using Pathfinder Office software and submitted it to the Alaska Region IPMT on a weekly basis. Finalized data was post-processed into a Geospatial Information System (GIS) geodatabase by the Alaska regional GIS specialist. The AK regional IPMT

submitted data to both the Alaska Exotic Plants Information Clearinghouse (AKEPIC) and the National Invasive Species Information Management System (NISIMS) databases.



KEFJ biologist collects data using a Trimble Geo7X GPS

We also documented use in an herbicide treatment spreadsheet. Weekly field reports were completed to document invasive plant work and timing of control activities. All paper copy notebook pages and data sheets were scanned and stored on the KEFJ network drive.

The KEFJ IPMT utilized standardized polygons to collect herbicide treatment data on Herman Leirer Road, Exit Glacier parking area, the Harding Icefield Trail 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 polygon can be compared to the previous years' data to determine efficacy of treatments and to track herbicide use more accurately over time. It is only necessary to collect a single GPS point along with herbicide use information for each standardized polygon, allowing for efficient data collection in the field.

The KEFJ IPMT used handheld tally counters to calculate the amount of herbicide used when we applied small amounts of herbicide in standardized polygons or treated small populations. We used a standard herbicide amount per squirt applied to each plant to calculate the number of gallons sprayed when collecting data. Each squirt is equivalent to 0.001 gallons of herbicide solution. This number multiplied by the tally count gave us our total gallons of herbicide used.

Personnel

The KEFJ IPMT had two members in 2020. Both the Alaska Region IPMT Liaison and the Alaska Region IPMT Data Manager positions remained unfilled this summer. Since there was no Alaska Region Data Manager to process park data, the Alaska Regional GIS Coordinator completed all the post-processing of data collected in 2020. The KEFJ biologist managed the invasive program in the

park including completing all planning and herbicide applications, compliance requirements, and supervising the biological science technician. The biological science technician applied herbicide and pulled invasive plants throughout the season, recorded data, and kept track of herbicide use totals. There were no Student Conservation Association (SCA) interns or Youth Conservation Corps (YCC) employees.



2020 KEFJ IPMT crew.

Results

2020 Season Overview

The 2020 KEFJ IPMT completed several projects during the season despite having a smaller than normal staff and reduced capacity due to COVID-19. These projects included invasive plant surveys and treatments, seed collection, invasive gypsy moth (*Lymantria dispar* (L.) monitoring, and collaborative work with Kenai Peninsula Cooperative Weed Management Area (KP-CWMA) partners. We treated most known populations of invasive plants in the Exit Glacier Area during the summer, except for the large population of common dandelion (*Taraxacum officinale*) found south of Exit Creek in a site known as the Outwash Plain.

In the 2020 season, the KEFJ IPMT used chemical and manual treatment methods to control the spread of 19 invasive plant species in the park. We treated a total of 0.49 acres with 15 gallons of Milestone herbicide solution and a total of .85 acres with 32.5 gallons of Roundup Custom herbicide solution. We also manually treated 19.77 square feet using manual control methods.

Table 2. Summary of Kenai Fjords National Park Invasive Plant Work in 2020. The January 2018 NPS Land Status geodatabase was used to delineate NPS lands in acreage calculations.

Invasive Plant GPS Data NPS Lands			
Year	**Species Acres Surveyed[1]**	**Species Acres Infested[2]**	**Acres Treated[3]**
2020	83.5	1.36	1.34

[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.

During previous seasons, the IPMT was comprised of five team members, including a biologist, biological science technician, SCA intern and two YCC employees. However, this season the biologist and the biological science technician made up the entire team. We developed this season's work plan with the decrease in staffing in mind and determined that we did not have the capacity to treat all invasive plant populations this summer. We gave priority to surveying and treating populations along the park road, the Exit Glacier parking lot and trails, and at the Maintenance Facility.

Taking advantage of lower visitor numbers this year, we experimentally treated annual bluegrass (*Poa annua*) with herbicide for the first time on a portion of the Harding Icefield Trail to determine the feasibility of this method.

The IPMT found several new invasive plant species in the Exit Glacier Area and at the Maintenance Facility that had not been previously identified. New species identified in the park included fall

dandelion (*Leontodon autumnalis*), lambsquarters (*Chenopodium album*), prostrate knotweed (*Polygonum aviculare*) and pink shepherd's purse (*Capsella rubella*)

The IPMT rediscovered two species that were historically present in the Exit Glacier Area but had not been detected recently. We found narrowleaf hawksbeard (*Crepis tectorum*) in scattered populations south of the Recreational Vehicle (RV) parking lot and four stems of common sheep sorrel (*Rumex acetosella*) on the north side of the parking lot.

Table 3. KEFJ Invasive plant species and locations 2020. Key: X=Present, H=Historically Present.

Species			Location			
Latin Name	**Common Name**	**AKNHP Ranking**	**Exit Glacier**	**Coast**	**Shea Lot**	**Maintenance**
Alopecurus pratensis	meadow foxtail	52	X	–	–	–
Anthemis cotula	stinking chamomile	41	H	–	–	–
Bromus inermis	smooth brome	62	X	–	–	–
Capsella bursa-pastoris	shepherd's purse	40	H	–	X	H
Capsella rubella	pink shepherd's purse	–	–	–	–	X
Chenopodium album	lambsquarters	37	X	–	–	–
Cerastium fontanum	big chickweed	36	X	–	X	X
Crepis tectorum	narrowleaf hawksbeard	56	X	–	–	–
Elymus repens	quackgrass	59	–	–	X	–
Galeopsis spp.	hemp nettle	50	–	–	X	–
Hordeum jubatum	foxtail barley	63	X	–	–	–
Leontodon autumnalis	fall dandelion	51	X	–	–	–
Leucanthemum vulgare	oxeye daisy	61	X	–	X	H
Linaria vulgaris	yellow toadflax	69	H	–	–	–
Matricaria discoidea	pineapple weed	32	X	H	X	X
Papaver croceum	Icelandic poppy	39	H	–	–	–
Phleum pratense	common timothy	54	X	H	H	–
Plantago major	common plantain	44	X	H	X	X
Poa annua	annual bluegrass	46	X	X	X	X
Poa pratensis	Kentucky bluegrass	52	H	–	–	–

Table 3 (continued). KEFJ Invasive plant species and locations 2020. Key: X=Present, H=Historically Present.

Species		AKNHP Ranking	Location			
Polygonum aviculare	prostrate knotweed	45	X	–	X	X
Ranunculus acris	tall buttercup	54	H	–	–	–
Rumex acetosella	common sheep sorrel	51	X	–	X	–
Rumex crispis	curly dock	48	H	H	X	–
Stellaria media	common chickweed	42	H	–	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	X

Boat travel was limited because of COVID-19 health and safety concerns, so we only treated a small portion of invasive plant populations in coastal areas this year. The IPMT was able to make two day trips to Aialik Bay during the season. The first trip we made was to both Aialik and Holgate Public Use Cabins (PUC). Reservations for the PUCs were not accepted during the summer due to COVID-19 and we chemically treated populations of annual bluegrass around them for the first time. On the second trip we surveyed park land at upper Pedersen Lagoon. We did not complete any surveys or treatments in Nuka Bay or the Northwestern Fjord. Working and living in close quarters on the M/V Serac, the park's 53 foot live-aboard boat, was not deemed safe. This made trips to work in more distant coastal areas of the park not feasible.

Because of reduced capacity we did not repeat revegetation photo monitoring at any established restoration sites this summer and we collected fewer native seeds than we do in a typical year.

The IPMT placed five gypsy moth traps around the Exit Glacier Developed Area as part of the Alaska Division of Agriculture's state-wide monitoring program. We detected no gypsy moths.

The Seward Community Weed Pull outreach event which typically occurs annually in partnership with the Kenai Peninsula Cooperative Weed Management Area (KP-CWMA) was cancelled this summer due to safety concerns related to COVID-19. The IPMT helped coordinate the installation of two boot brushes and invasive plant interpretive signs at the Seward Boat Harbor. These signs were funded through grants acquired by KP-CWMA partners as part of a larger outreach effort on the Kenai Peninsula.

Notable Weather Conditions

The IPMT started chemical treatment in the Exit Glacier Area early in the season. The snow depth was lower than average for the winter and snow did not persist on the ground into June. This

provided the conditions for invasive plants to start growing earlier in the season. The IPMT removed flowering heads from common dandelion by mid to late May along Herman Leirer Road and in the Exit Glacier Area. In recent years snow depth has been below normal and the Exit Glacier Area has been snow-free earlier in the spring, lengthening the growing season for invasive plants species and allowing them to flower and go to seed earlier in the season than in previous years.

Table 4. 2020 Monthly snow depths at Exit Glacier compared to the previous 15-year averages.

Snow Course	December	January	February	March	April	May
2019/2020 monthly snow depth (in)	6.25	N/A	24.8	32.9	30.7	4.2
15-year monthly average snow depth (in) (2005–19)	12.02	N/A	32.01	42.56	46.65	22.08

Exit Glacier Area

Herman Leirer Road

We treated common dandelion along Herman Leirer Road on June 5, June 10, and June 11. We applied a total of 2.32 gallons of Milestone herbicide solution. Herman Leirer Road is divided into eight standardized polygons (see Appendix A), which we use to document herbicide use.

We applied 0.122 gallons of Roundup Custom herbicide solution to sixteen scattered populations of meadow foxtail (*Alopecurus pratensis*) and one population of smooth brome (*Bromus inermis*) on June 12, June 29, and July 27.



KEFJ biologist applies herbicide to common dandelion on Herman Leirer Road.

We manually pulled six stems of foxtail barley (*Hordeum jubatum*) and one common timothy (*Phleum pratense*) stem along the roadside on July 14. This was the first year that multiple foxtail barley plants were discovered and treated in the Exit Glacier Area.

We found one oxeye daisy (*Leucanthemum vulgare*) stem along the park road on June 26 and manually pulled it.

To reduce the spread of invasive species into the park, we surveyed the roadsides outside the park boundary for high ranking species. The road crosses both Alaska Division of Natural Resources (DNR) and Chugach National Forest lands. We surveyed from about mile 2 to the Resurrection River Bridge. We hand pulled populations of oxeye daisy, yellow sweet clover (*Melilotus officinalis*), and yellow toadflax (*Linaria vulgaris*) on July 13 and July 20.

Exit Glacier Parking Area

The IPMT chemically and manually treated nine different invasive plant species in the parking area in 2020. A total of 1.2 gallons of Milestone herbicide solution was applied during herbicide treatments in the parking area throughout the summer. We used nine standardized polygons to document and track herbicide use (see Appendix B).

The IPMT applied Milestone to common dandelion on June 2–4. We applied a total of 0.725 gallons of solution across all nine standardized polygons. During the second treatment on June 12, we applied 0.133 gallons of Milestone herbicide solution to common dandelion in polygons 1, 2, and 5.

During the final application of Milestone on July 29 and July 30, we applied 0.305 gallons of herbicide solution in all nine standardized polygons. We treated common dandelion, pineapple weed (*Matricaria discoides*), one white clover (*Trifolium repens*) stem, one prostrate knotweed stem, four sheep sorrel stems and a small population of fall dandelion during this final treatment.

Fall dandelion was discovered on the south side of the RV parking lot and is a new species to the park. Prostrate knotweed had never been documented in the Exit Glacier Area before this summer. Common sheep sorrel had not been documented in the parking area since 2016 (Geier and Kriedeman 2018) but was identified again in 2020.

We used Roundup Custom to treat common plantain (*Plantago major*) and annual bluegrass in polygons 1, 2, and 5. We applied 0.366 gallons of herbicide solution to these species on July 30.



KEFJ biological science technician collects data in the Exit Glacier parking area.

The IPMT found one oxeye daisy in the parking lot but could not find it when we returned to treat it. It was located on the south side of the parking area near the RV parking sites. Efforts should be made to relocate it next summer.

We found 32 narrowleaf hawksbeard stems on June 19 and one stem on July 29 in the parking lot and hand pulled them. This population was not documented in 2019 and should be a priority for retreatment in 2021.

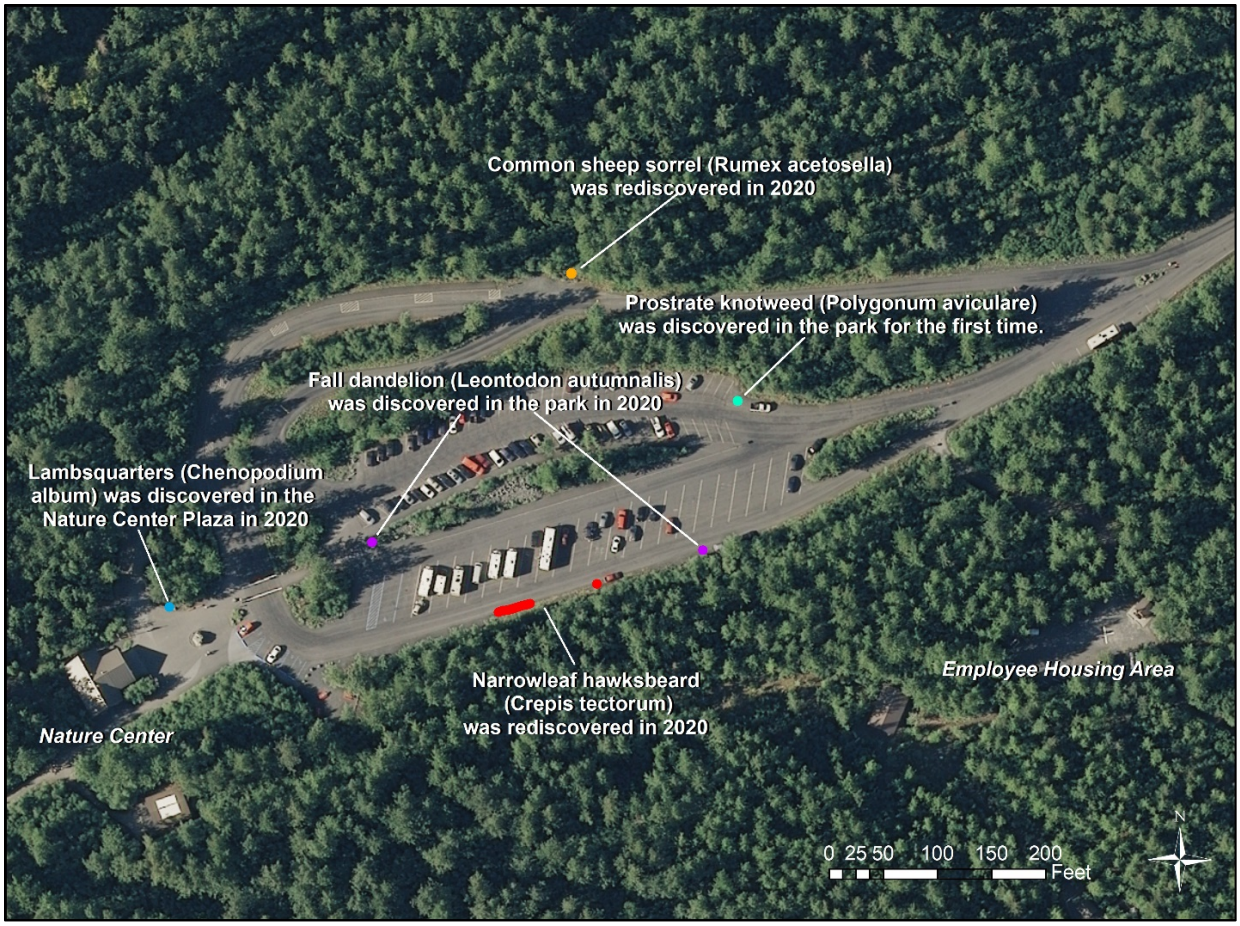


Figure 2. New and historic invasive plant species found in the Exit Glacier Area in 2020.

Campground

The IPMT surveyed and treated the Exit Glacier campground twice during the summer. During the first application on June 29, we used 0.167 gallons of Roundup Custom herbicide solution on annual bluegrass and common dandelion in the parking lot and in the campground. During the second treatment on August 14, we used 0.429 gallons of herbicide solution on annual bluegrass, common dandelion, and common plantain in the parking area, and annual bluegrass, common dandelion, and pineapple weed in the campground. We treated two white clover plants between the parking lot and the campground picnic shelter during the second treatment. This was the first time white clover was found in the campground. We applied a total of 0.596 gallons of Roundup Custom herbicide solution in the campground.

SNOTEL Site

Common dandelion has been found at the Snow Telemetry (SNOTEL) automated weather and climate data collection station since 2012 (Fulton 2013). During the 2020 season, we surveyed the SNOTEL site on June 11 and treated two common dandelions with Milestone. We revisited the SNOTEL site on August 28 and found no common dandelion.

Employee Housing

Employee Housing includes the parking lot, Trail Builder's Camp, Willow Cabin, Spruce Cabin, and Alder Cabin. We surveyed and treated invasive plants in the area four times during the summer. On June 11, we treated 16 common dandelions around Alder Cabin and Spruce Cabin and nine common dandelions at the Trail Builder's Camp with Milestone. We resurveyed the Trail Builder's Camp on July 1 when one common dandelion was found and treated. We used a total of 0.026 gallons of Milestone herbicide solution.

On June 29 we treated 12 common dandelions on the trail to Willow Cabin and scattered populations of annual bluegrass on the trail with 0.26 gallons of Roundup Custom herbicide solution. We surveyed the Employee Housing area again on July 7 and treated annual bluegrass in the parking lot with 0.032 gallons. On July 15 we retreated annual bluegrass in the parking lot and used 0.176 gallons of herbicide solution. We applied a total of 0.468 gallons of Roundup Custom herbicide solution.

Nature Center Plaza

The Nature Center Plaza includes the area around the Nature Center, the picnic area behind the building, the pump house, and the Pavilion. We first surveyed the Nature Center Plaza on June 22 and applied Milestone to common dandelion around the building. We resurveyed on July 29 and June 30 and finished treating populations of common dandelion around the building and pineapple weed in front of the Nature Center. We applied a total of 0.061 gallons of Milestone solution around the Nature Center.

On June 25, we surveyed the picnic area behind the Nature Center for annual bluegrass. We treated annual bluegrass and big chickweed (*Cerastium fontanum*) in the picnic area with Roundup Custom and used 0.171 gallons of herbicide solution. We retreated annual bluegrass at the picnic area on July 15 and used 0.139 gallons of herbicide solution.

We applied Roundup Custom herbicide solution to annual bluegrass in front of the Nature Center building and near the restrooms on July 7. We resurveyed the area and applied herbicide to annual bluegrass and common plantain in front of the plaza on July 30. We retreated the annual bluegrass in the area on August 5. We applied a total of 1.95 gallons of Roundup Custom herbicide solution.

The pump house and Pavilion have populations of annual bluegrass that we treated twice over the summer. We first applied Roundup Custom to annual bluegrass in front of the pump house on June 25 and June 26. We retreated the population on July 30. We used a total of 1.544 gallons of herbicide solution. We treated a population of annual bluegrass in front of the Pavilion on July and retreated the population on July 30. We used a total of 0.346 gallons of Roundup Custom solution in front of the Pavilion.

Picnic Area

The picnic area is located on the south side of the RV parking lot. On August 5, we used one gallon of Roundup Custom herbicide solution to treat annual bluegrass around the picnic area. We treated the area early in the morning to avoid conflicts with visitor use.

Glacier View Loop Trail

We treated invasive plant populations found along the Glacier View Loop Trail twice in the season with both Milestone and Roundup Custom herbicide. On June 8, we applied 0.09 gallons of Milestone herbicide solution to common dandelion and one big chickweed stem along the paved trail. We finished treating the paved trail with Milestone on June 22 and used 0.14 gallons of herbicide solution on scattered populations of big chickweed and common dandelion. We used a total of 0.23 gallons of Milestone herbicide solution.



KEFJ biological science technician applies herbicide to annual bluegrass on the Glacier View Loop Trail.

We used three gallons of Roundup Custom herbicide solution to treat annual bluegrass along the paved trail on June 30. We returned on July 16 to finish surveying and treating the paved section of trail and the rest of the loop. We used 2.57 gallons of herbicide solution on annual bluegrass, big chickweed, and one patch of white clover. The big chickweed and white clover were found along the paved section of the trail. Annual bluegrass was found in scattered populations around the loop. We used a total of 5.57 gallons of Roundup Custom herbicide solution along the trail.

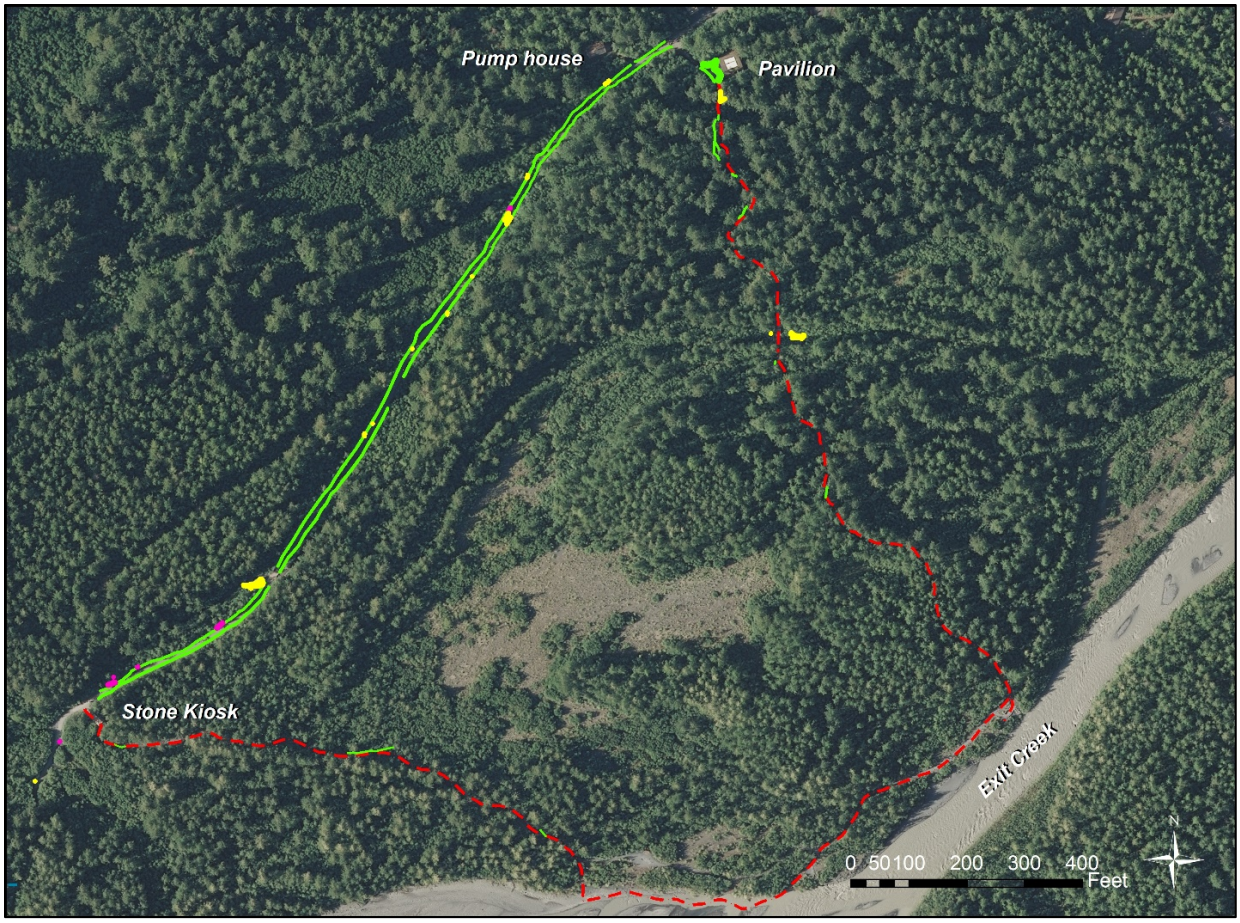


Figure 3. Common dandelion (yellow), annual bluegrass (green), and big chickweed (pink) treatments along the Glacier View Loop Trail in 2020.

We surveyed the open area in the middle of the Glacier View Loop Trail on June 22. We applied 0.015 gallons of Milestone herbicide solution on 17 common dandelions. We revisited the area on August 28 and found and hand pulled four dandelions.

We treated common dandelion found in the wash east of the bridge on the Glacier View Loop Trail with 0.034 gallons of Milestone herbicide solution on June 22. There were 33 common dandelions on the east side of the bridge and one on the west side. We resurveyed the area on August 28 and hand pulled 31 dandelions.

We found five new populations of common dandelion in the woods north of the paved section of trail that we hand pulled on June 25 and July 10. We found more than 40 dandelions in the five scattered populations in the woods.

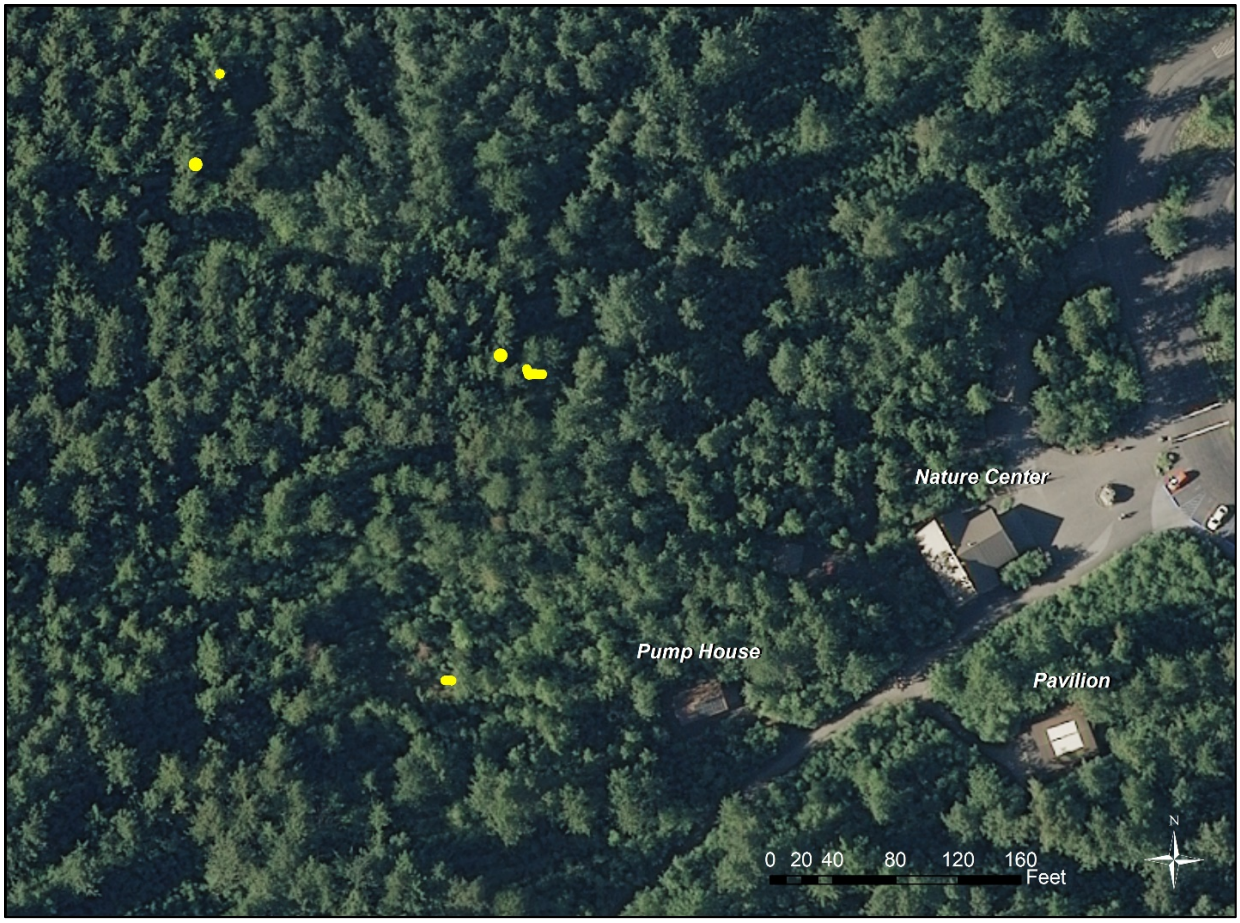


Figure 4. New common dandelion populations found north of the Glacier View Loop Trail in 2020.

Glacier Overlook Loop Trail

We treated invasive plants located on the Glacier Overlook Loop Trail during the season with both Milestone and Roundup Custom. We applied Milestone on June 8 and used 0.037 gallons of herbicide solution on common dandelion on the north side of the trail. We treated common dandelion in the same area again on August 5 and used 0.055 gallons of herbicide solution. We found and treated one population of big chickweed across from the intersection of the spur trail on August 5. We used a total of 0.092 gallons of Milestone herbicide solution.

We applied Roundup Custom to annual bluegrass between the end of the paved portion of the Glacier View Loop Trail and the bridge on July 16 and used 0.797 gallons of herbicide solution. On August 5, we used 1.355 gallons of herbicide solution to treat annual bluegrass and common plantain on scattered populations around the trail. We used a total of 2.152 gallons of Roundup Custom herbicide solution.

Harding Icefield Trail

The Harding Icefield Trail has several documented populations of common dandelion at an old section of trail at mile 0.25. On June 22 we found and treated seven dandelions with Milestone. We

resurveyed the area on August 13 and treated six dandelions. We used a total of 0.02 gallons of Milestone herbicide solution.

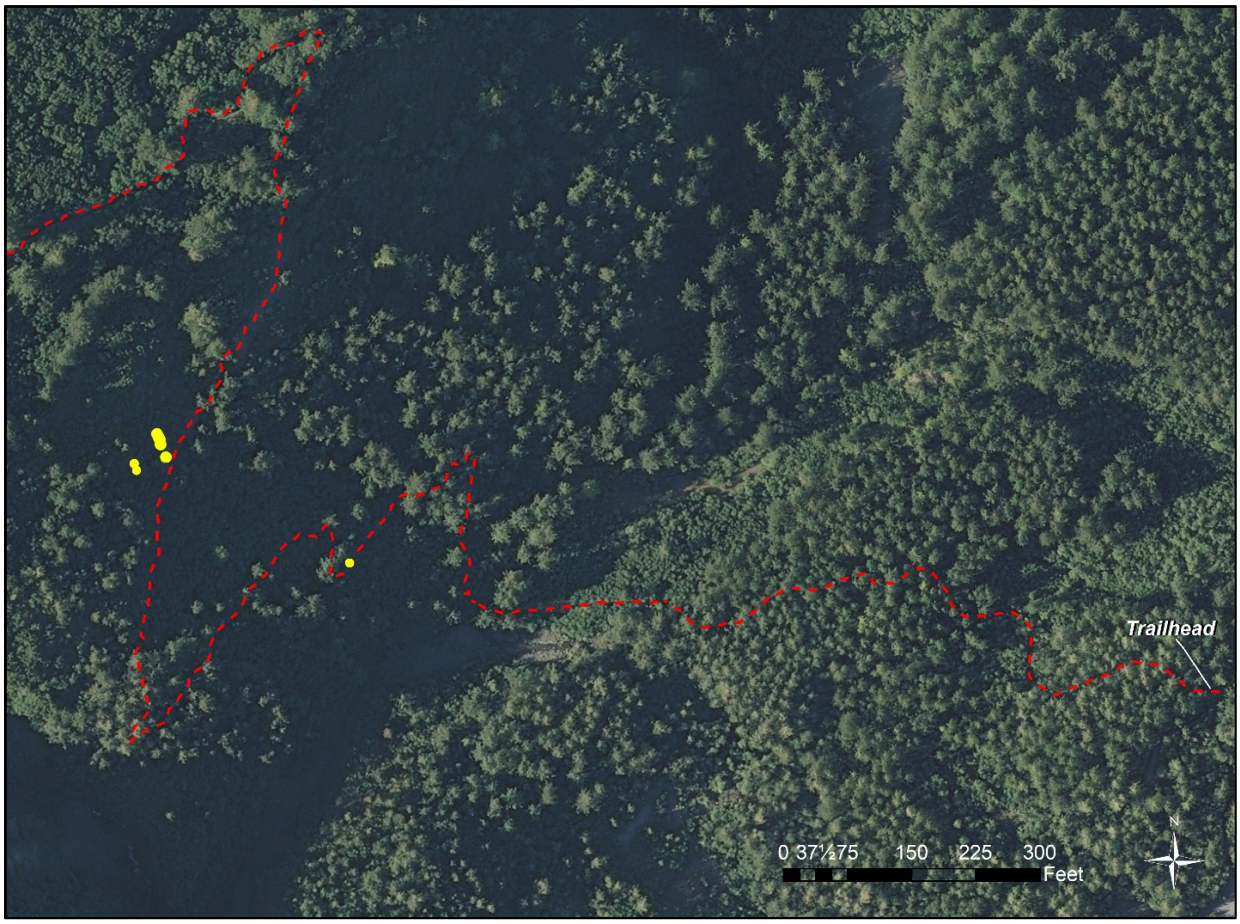


Figure 5. Common dandelion populations along the Harding Icefield Trail at mile 0.25.

Previous data showed only a few common dandelions at a location along the trail at mile 1.1 between the Bridge and Marmot Meadows. This year however, we found a much larger population in this area. On July 9, we used 0.139 gallons of Milestone herbicide solution on the population. We revisited this population and treated it with Roundup Custom on July 14 and used 0.155 gallons of herbicide solution. We applied a final treatment of the area on August 13 and used 0.097 gallons of Milestone herbicide solution. We used a total of 0.236 gallons of Milestone solution and a total amount of 0.155 gallons of Roundup Custom herbicide solution on this population.

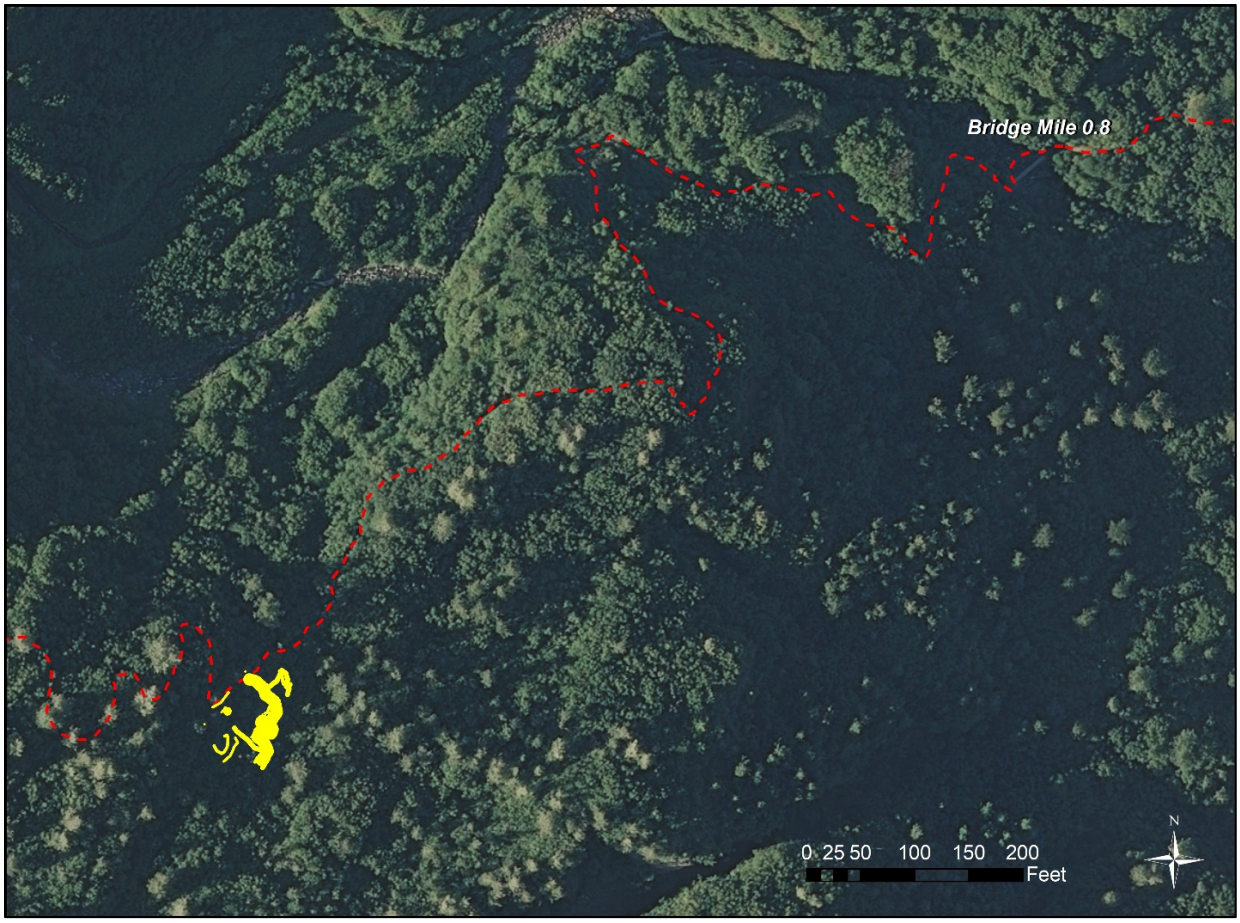


Figure 6. Common dandelion population along Harding Icefield Trail at mile 1.1.

We surveyed and treated a population of common dandelion at Marmot Meadows with 0.029 gallons of Milestone herbicide solution on July 9. We revisited the population on August 7 and manually pulled 50 common dandelion and 3 common plantain stems.

On July 14 and 15, we used 5.1 gallons of Roundup Custom herbicide solution to treat annual bluegrass from the trailhead to mile 1.1 on the Harding Icefield Trail. Annual bluegrass has been hand pulled on the trail since 2010 (Kurtz 2010), with little effect on the density and extent of the population. We were able to test the logistics of applying herbicide for the first time along this narrow and typically busy trail since visitation was lower than normal this summer.



KEFJ biological science technician applies herbicide to annual bluegrass on the Harding Icefield Trail.

Nike Stripe

The area locally known as the "Nike Stripe" is located about 0.4 miles north of the entrance sign on the park road. In 2019 the area was surveyed once during the season and one dandelion was treated in this area (Sampson and Kriedeman 2020). We surveyed the Nike Stripe on July 2 and treated two common dandelions with 0.002 gallons of Milestone herbicide solution. We found a single common dandelion on the way to the Nike Stripe just north of the park road and treated it with Milestone.

Outwash Plain

We did not treat common dandelion populations in Outwash Plain standardized polygons with herbicide in 2020 because the area is too large for two people to survey and treat efficiently. We surveyed and treated common dandelion populations south of the park road near the Resurrection River Bridge with Milestone on June 16th and used 0.064 gallons of solution.

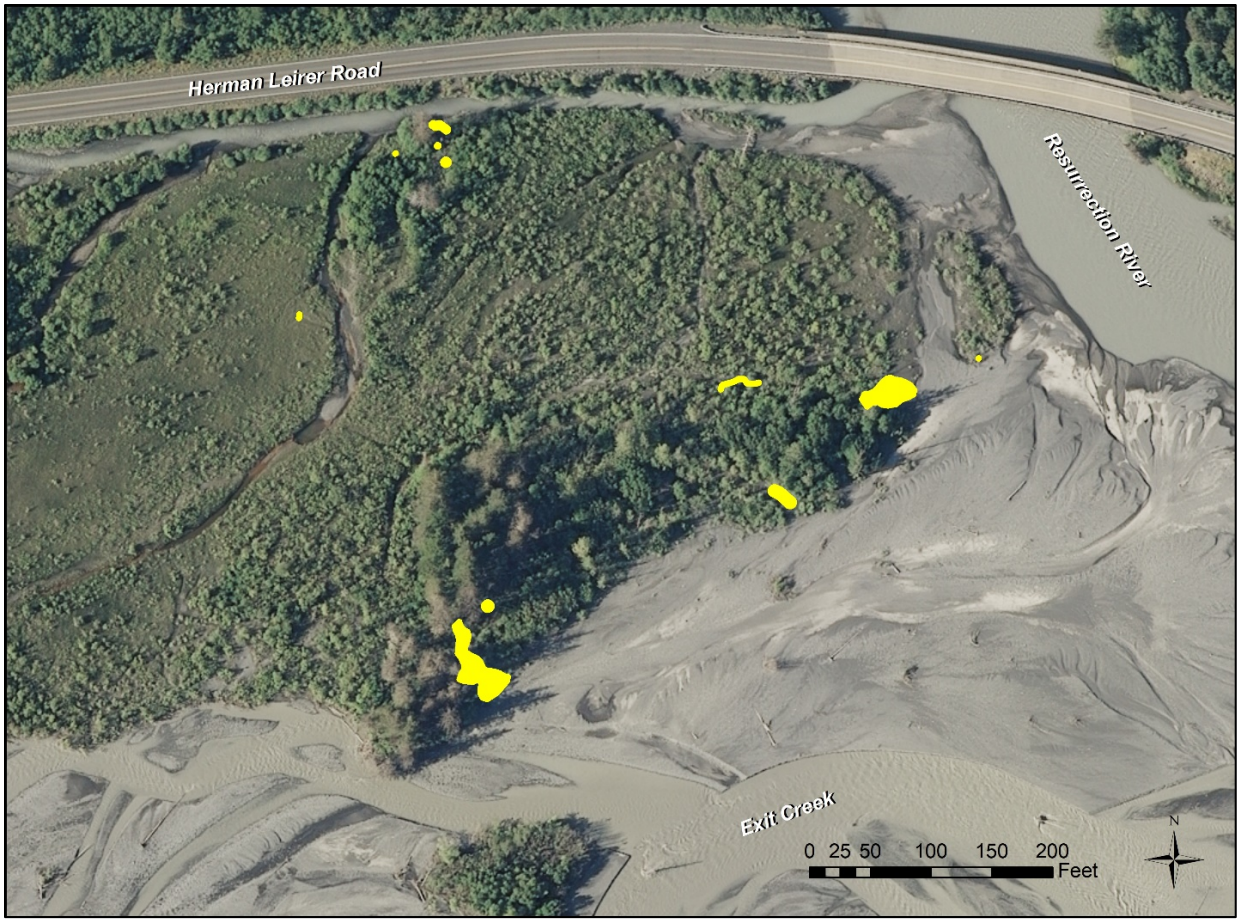


Figure 7. Common dandelion populations near Resurrection River Bridge.

We surveyed the area again on July 1 and treated a population of common dandelion with 0.053 gallons of herbicide solution. We treated a population of common dandelion southwest of the Trail Builder's Camp near Exit Creek on July 1 and used 0.033 gallons of herbicide solution.



KEFJ biologist navigates to known populations of common dandelion near Exit Creek.



Figure 8. Common dandelion populations near the Trail Builder's Camp and Exit Creek.

Coastal Areas

Aialik Bay

We made two day trips to Aialik Bay on the park's landing craft, the M/V Couloir. Typically, the IPMT spends three days surveying and treating invasive plants in Aialik Bay and working out of the Aialik Bay Ranger Station (ABRS.) Because of restrictions due to COVID-19, day trips on small boats with limited staff on board were deemed a safe method of travel.

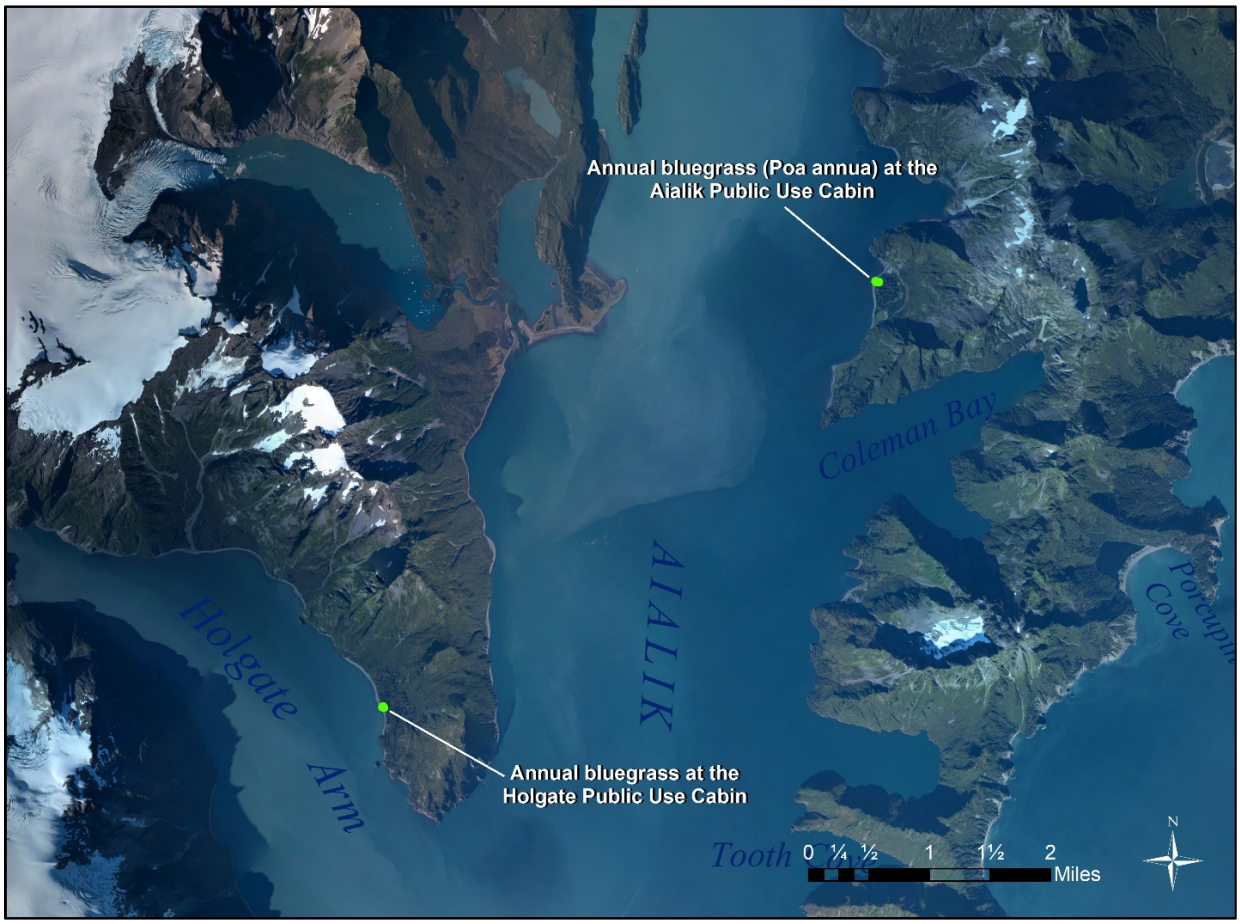


Figure 9. Annual bluegrass chemical treatments in Aialik Bay in 2020.

The two Public Use Cabins (PUC) in Aialik Bay were not available in 2020 for the public to reserve. This was a safety precaution enacted due to COVID-19. This provided an opportunity to treat annual bluegrass populations around the PUCs with herbicide without impacting visitors' access to cabins. Annual bluegrass around the cabins has been hand pulled since 2009 (Kurtz 2009) and this method has not been successful at reducing the size and density of these populations. The first day trip to Aialik Bay was on July 23, when we treated annual bluegrass at Holgate PUC with 0.75 gallons of Roundup Custom herbicide solution. We treated the population of annual bluegrass around Aialik PUC with one gallon of Roundup Custom herbicide solution. A small population of annual bluegrass was hand pulled in previous years at Abra Cove, but no plants were detected this year.



Annual bluegrass infestation at Aialik PUC.



KEFJ biologist collects data at Abra Cove.

The second day trip to Aialik Bay was on August 19. The aim of this trip was to survey park lands at the upper Pedersen Lagoon. This area is a destination for park visitors and lodge guests from the Kenai Fjords Glacier Lodge and has not been surveyed since 2016. The land around the lower Pedersen Lagoon is privately owned by Port Graham Corporation and is leased by Kenai Fjords Glacier Lodge. We were granted permission from the lodge to access their trail from the lower lagoon to the upper lagoon, which provides access to park land. We surveyed the lodge trail for invasive plants and found none. We surveyed park land at the upper Pedersen Lagoon for invasive plants and found none.



KEFJ biological science technician inflates a pack raft used to access Upper Pedersen Lagoon.

Northwestern Fjord

The IPMT did not complete invasive plant surveys at campsites or treat a population of annual bluegrass at the campsite north of the moraine in Northwestern Fjord.

McCarty Fjord

The IPMT did not treat the population of common dandelion south of Dinglestadt Glacier.

Nuka Bay

The IPMT did not treat the population of common dandelion at the head of Beauty Bay.

Seward

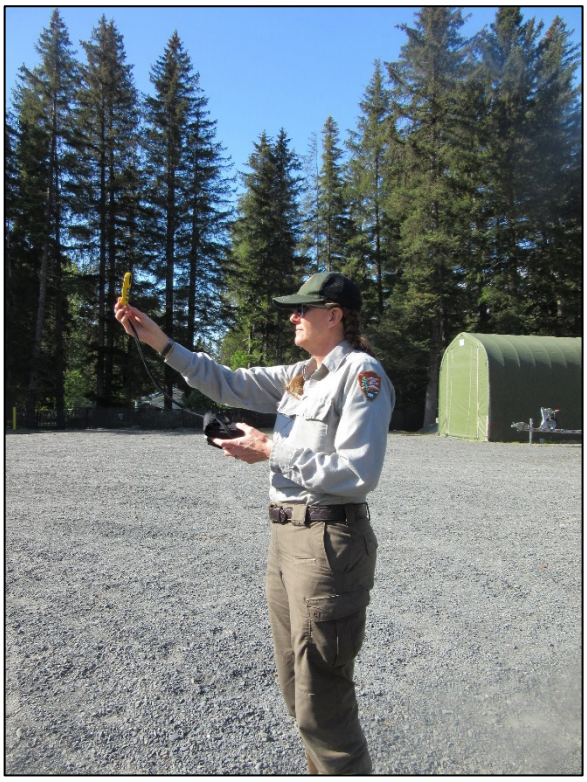
The IPMT did not treat the Visitor Center and Shea Parking Lot located in the City of Seward.

Maintenance Facility

We completed six treatments of the entire Maintenance Facility grounds between June and August. We used Milestone for three treatments, focusing on broadleaf invasive plants, and we used Roundup Custom for three treatments, treating primarily annual bluegrass. Other invasive plants were treated opportunistically during Roundup Custom applications.

The first treatment with Milestone occurred on June 15 and we used 4.35 gallons of solution to treat common dandelion, common chickweed (*Stellaria media*), and white clover. We applied Milestone a second time on July 21 and treated common dandelion, pineapple weed, prostrate knotweed, common chickweed, and big chickweed with 2.92 gallons of solution. We completed a third and final treatment with Milestone over two days on August 14 and August 21. We treated common dandelion, pineapple weed, common chickweed, big chickweed, prostrate knotweed, and white clover with 3.25 gallons of solution. We used a total of 10.52 gallons of Milestone herbicide solution in the Maintenance Facility.

The first treatment with Roundup Custom occurred over two days on June 16 and June 26, and we used 2.25 gallons of solution to treat annual bluegrass, common plantain, common dandelion, common chickweed, and big chickweed. We treated the Maintenance Facility for a second time with Roundup Custom on July 21 and July 27. We applied 4.5 gallons of solution to annual bluegrass and common plantain. We completed a final application on August 14 and August 20 and used 4.54 gallons of solution to treat annual bluegrass and common plantain. We used a total of 11.29 gallons of Roundup Custom solution at the Maintenance Facility.



KEFJ biologist takes weather measurements before herbicide applications at the Maintenance Facility.

Elodea Monitoring

The IPMT did not monitor for the aquatic invasive plant Elodea in 2020.

Prevention

Using boot brushes and encouraging other park staff to use them continued to be a priority for the IPMT, especially when hiking off trail and in undeveloped areas of the park. Doing so helps prevent the spread of invasive plant seeds that get stuck on shoes when walking through infested areas. This helps ensure that park staff are not vectors for the spread of invasive plants. This was the first year that we distributed handheld boot brushes to Resource Management and Visitor and Resource Protection (VRP) staff. We encouraged using these brushes to clean shoes and clothes, especially if staff were going to be completing field work off trail.

Restoration

Native seed collection began on July 28 and continued through August. We collected meadow barley (*Hordeum brachyantherum*), alpine timothy (*Phleum alpinum*), and spike trisetum (*Trisetum spicatum*). We collected seed from the Exit Glacier Parking Area and the Glacier View Loop Trail.

We did not complete any revegetation project monitoring this year.

Outreach and Education

During the 2020 summer season, normal outreach and education activities did not occur due to COVID-19 restrictions. We did not complete presentations and informal talks about the invasive plant program for park staff and partners this year.

The IPMT did not coordinate the Seward community weed pull which occurs annually with Kenai Peninsula Cooperative Weed Management Area (KP-CWMA) partners.

Partnerships

The IPMT did have the opportunity to assist KP-CWMA partners with a project to remove seed heads from reed canary grass (*Phalaris arundinacea*) on a powerline corridor near the Chugach National Forest Russian River Campground in Cooper Landing on August 11. During this day, we removed over 20 pounds of seed heads to prevent reseeding before herbicide could be applied to the population in the fall.



KEFJ IPMT with KP-CWMA partners and volunteers mechanically treating reed canary grass.

We assisted KP-CWMA partners with identifying priority invasive plant species for herbicide treatment adjacent to the park boundary. We also assisted with the treatment of yellow sweet clover with Milestone on a population growing on an island in the Resurrection River on June 18.

Gypsy Moth Monitoring

During the summer, we deployed five invasive gypsy moth pheromone traps in the Exit Glacier Developed Area for the 10th year (Fulton 2011). We received these traps from the Alaska Division of Agriculture, as part of their invasive gypsy moth monitoring program for the State of Alaska. We deployed traps near the Nature Center, by the picnic area, in the Exit Glacier parking lot, by employee housing, and at the campground parking lot. We installed traps in June, checked them twice during the season, and removed them in September. We found no gypsy moths in the traps. The Alaska Division of Agriculture provided data sheets that we filled out and sent back to our DNR contact.



Gypsy moth trap hangs in the Exit Glacier Parking Area.

Discussion and Recommendations

Annual Bluegrass

The treatment of annual bluegrass at KEFJ has been a conundrum over the years. Invasive plant populations have been relatively small in the park until recent years and annual bluegrass was thought to be an invasive plant species that we could contain even if it was not considered highly invasive. After years of hand pulling this invasive grass on trails in the Exit Glacier Area and around the coastal PUCs with little reduction in size and density of these populations, we are reconsidering the efforts expended to treat this species. The time and resources that are needed to treat this invasive plant species may not be worth the effort when there are more highly invasive plant species spreading into the park. Reconsideration should be given to the treatment plan for this species. Control efforts may need to be considered on a site-specific bases in the future.

Standardized Polygons

The use of standardized polygons has been an efficient way to track herbicide use and determine efficacy of treatments. The amount of time necessary to collect data is greatly reduced for large invasive plant populations where standardized polygons make sense. The KEFJ IPMT should continue to use current standardized polygons and explore other populations where this method could be utilized.

The IPMT used the standardized polygon for the Harding Icefield Trail for the first time during the 2020 season to document herbicide use along a short section of the trail. Because the standardized polygon includes the entire length of the trail, it did not reflect the small extent of the population we treated spatially. Should we continue chemical treatments on the Harding Icefield Trail, the standardized polygon should be divided into smaller, more manageable sections.

Retreatment

Retreating invasive plant populations with herbicide multiple times throughout the summer has proven to be a useful strategy to reduce the density of a population during a single summer. Applying herbicide to a population for a second time provides the opportunity to treat plants that were missed during the first treatment or that sprouted after the initial application. There is not always enough time or resources to treat all populations two or more times during the summer, but this strategy should be considered for populations that are a high priority for treatment.

Roadside Brushing

There can be conflicts with the timing of brushing on Herman Leirer Road and herbicide treatment of invasive grasses found along the roadside. It is important to coordinate with the trail crew early in July to identify areas that we plan to treat later and want them to avoid cutting. Invasive grass populations need to be identified and flagged by early July so conflicts can be avoided and both projects can be accomplished.

Coastal Monitoring

Coastal areas of the park are remote and can be difficult to access. Areas with known invasive plant populations are a priority, but areas that are likely to be used by visitors are an important priority as

well. They should be surveyed on a regular basis to detect infestations early while they are small. Only a subset of coastal sites can be surveyed each summer because of limited access and time constraints. A spreadsheet developed in 2018 provides the year and location of each coastal site that has been surveyed. This spreadsheet should be used to create a more systematic approach to surveying coastal areas based on location and survey year in the future.

Shea Parking Lot

The Shea Parking Lot is in downtown Seward and is infested with over 15 species of invasive plants, including many that are not currently found in the park. Invasive plants are growing on the parking surface where both park vehicles and employees are exposed to seeds. Invasive plant seeds can easily be carried from the parking lot on vehicle tires and shoes into the park. The best way to stop the growth of invasive plants in the parking lot would be to pave the parking surface, but this option will include long-term maintenance costs. A potential plan to address this problem in the short term would be to apply herbicide to invasive plants growing in the lower parking lot used for park vehicles. Additionally, a weed-free path could be created from the ally into the parking lot for employees walking to and from the parking lot to the park headquarters building. We have never applied herbicide at any of the park's properties located in the City of Seward before. This will require a commitment to applying herbicide on a yearly or every other year basis to keep the parking surface free of invasive plants. There is an endless seed source for invasive plants all around the parking lot and the parking lot will continue to be re-infested. A more sustainable long-term plan should be considered to address the invasive plant infestations in the parking lot.

Prevention

Boot brushes installed at trailheads are a great way to educate the public and to reduce the spread of invasive plants on trails in the Exit Glacier Area. The KEFJ IPMT should continue to maintain the boot brushes at the Nature Center Plaza and at the Harding Icefield Trail register and encourage more educational outreach on interpretive signs and in interpretive programs.

Handheld boot brushes were shared with other resource management staff and the backcountry rangers to encourage them to brush their boots before hiking off trail. We should continue to provide hand-held boot brushes to field staff and educate them about the potential roll all park staff can play in the spread of invasive plants in the park.

Mitigation measures to reduce the introduction of invasive plants during construction projects are currently incorporated into contracts. Contractors are required to clean equipment before work is completed in the park. The KEFJ IPMT completes inspections, looking for soil and plant parts that have not been cleaned off the equipment. We should continue to incorporate these types of measures into all construction projects to reduce the introduction of new invasive plant populations into the park.

Partnerships

Partnerships are an important component of outreach and community engagement and should continue to be a priority. Attending monthly conference calls with the state-wide Alaska Invasive Species Partnership (AK-AISP) provides opportunities to network and learn about invasive species

issues outside the National Park Service. As a member of the Kenai Peninsula Cooperative Weed Management Area (KP-CWMA) we are a partner in hosting the Seward community weed pull, participate in invasive plant control efforts on partner agency lands, and are currently working with partners to facilitate installation of boot brushes in the Seward boat harbor. These types of relationships provide opportunities to broaden our scope and participate in borough and state-wide efforts.

Personnel

Working through a field season with only two people on the KEFJ IPMT provided an opportunity to reflect on the number of employees necessary to accomplish invasive plant survey and control work. In a typical field season, the KEFJ IPMT has a field crew which includes a biological science technician, a SCA intern and two high school age YCC employees. This summer we only had two people working on the team. This summer we surveyed and treated many of the smaller existing populations of invasive plants around the Exit Glacier Area and in the Maintenance Facility. We could not complete the large-scale herbicide project at the Outwash Plain on the east side of Exit Creek that includes 10 standardized polygons that cover over 18 acres. Although the population of common dandelion we treat in the Outwash Plain includes only 1.18 acres, we still must survey the entire area looking for individual plants. To complete large herbicide projects like this one, we need additional assistance in the field with hand pulling flowerheads before applying herbicide, locating individual plants to treat and delineating the boundaries of standardized polygons for herbicide applicators. With only one or two people collecting seeds at a time, we were limited in the number of seeds we could collect and did not have the resources to complete any restoration projects. After this summer's experience with a small crew it became clear that a crew of at least four people is required to complete all the current invasive plant control projects in the park. A reduced IPMT size did have an impact on our ability to treat all priority invasive plant populations in the park.



KEFJ 2020 IPMT following Covid-19 safety protocols by staying six feet apart and wearing face masks.

Literature Cited

Carlson, M. L., I. V. Lapina, M. Shephard, J. S. Conn, R. Densmore, P. Spencer, J. Heys, J. Riley, and J. Nielsen. 2008. *Invasiveness ranking system for non-native plants of Alaska*. USDA Forest Service, R10, R10-TP-143.

Fulton, T. 2011. Invasive plant management in Kenai Fjords National Park: 2011 Summary report. Natural Resource Data Series NPS/KEFJ/NRDS—2011/223. National Park Service, Fort Collins, Colorado.

Fulton, T. 2013. Invasive plant management for Kenai Fjords National Park: 2012 summary report. Natural Resource Data Series NPS/KEFJ/NRDS—2013/430. National Park Service, Fort Collins, Colorado.

Geier, G. S., and C. L. Kriedeman. 2018. Invasive plant management in Kenai Fjords National Park: 2017 summary report. Natural Resource Report NPS/KEFJ/NRR—2018/1609. National Park Service, Fort Collins, Colorado.

Kurtz, D. 2009 Invasive Plant Management in Kenai Fjords National Park; Summer 2009 Field Report. Kenai Fjords National Park. National Park Service Unpublished Report, Seward, Alaska.

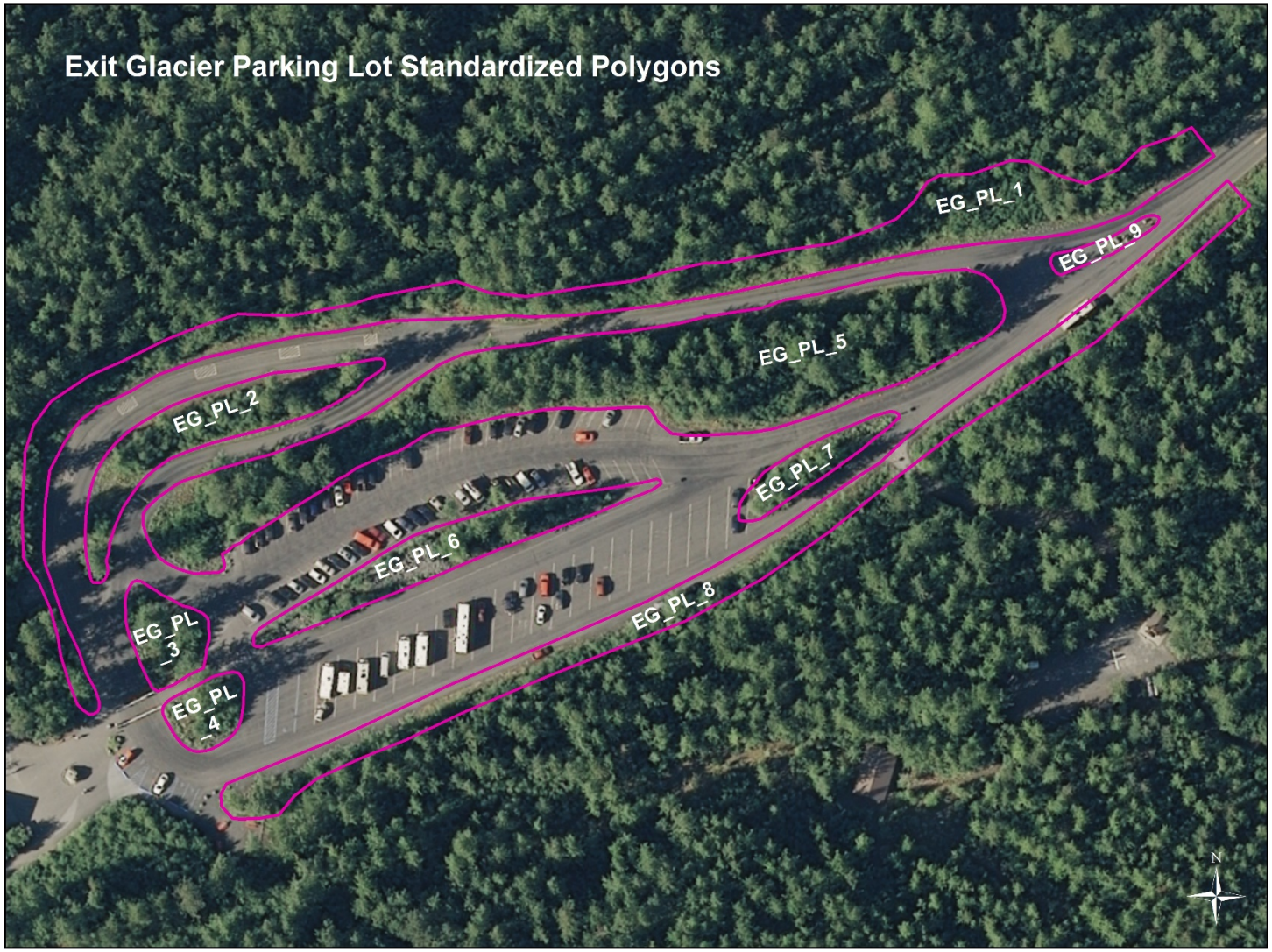
Kurtz, D. 2010. Invasive plant management for Kenai Fjords National Park: 2010 Summary report. Natural Resource Data Series NPS/KEFJ/NRDS—2010/109. National Park Service, Fort Collins, Colorado.

Overbaugh, C. and P. Frank. 2020 a. Alaska Exotic Plant Management Team 2020 Field Protocol. 2020. U.S. Department of the Interior, National Park Service, Anchorage, Alaska.

Overbaugh, C. and P. Frank. 2020 b. Alaska Exotic Plant Management Team 2020 Office Protocol. 2020. U.S. Department of the Interior, National Park Service, Anchorage, Alaska.

Sampson, S. N., and C. L. Kriedeman. 2020. Invasive plant management in Kenai Fjords National Park: 2019 summary report. Kenai Fjords National Park. National Park Service Unpublished Report, Seward, Alaska.

Appendix A: Exit Glacier Parking Lot Standardized Polygons



Appendix B: Herman Leirer Standardized Polygons



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 186/175072, February 2021



Natural Resource Stewardship and Science
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525