



Invasive Species Management for Katmai National Park & Preserve, Alagnak Wild River, and Aniakchak National Monument & Preserve

2018 Annual Report

Natural Resource Report NPS/KATM/NRR—2020/2094



**ON THIS PAGE**

Sow with cubs walking along Spit Road
(NPS-SCA/THOMAS HATTON)

ON THE COVER

EPMT SCA crew member, Thomas Hatton, mapping Dumpling Mountain trail
(NPS-SCA/KAYLA SHERMAN)

Invasive Species Management for Katmai National Park & Preserve, Alagnak Wild River, and Aniakchak National Monument & Preserve

2018 Summary Report

Natural Resource Report NPS/KATM/NRR—2020/2094

Kayla Sherman and Thomas Hatton

National Park Service
Katmai National Park & Preserve
P.O. Box 7
King Salmon, AK 99613

March 2019

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.

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

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:

Sherman, K. and T. Hatton. 2020. Invasive species management for Katmai National Park & Preserve, Alagnak Wild River, and Aniakchak National Monument & Preserve: 2018 Summary Report. Natural Resource Report NPS/KATM/NRR—2020/2094. National Park Service, Fort Collins, Colorado.

Contents

	Page
Figures.....	v
Tables.....	vi
Abstract.....	vii
Acknowledgments.....	viii
List of Acronyms	ix
Introduction.....	1
Katmai EPMT Survey and Management History.....	2
Methods.....	3
Overview	3
Data Management.....	3
Chemical Control.....	3
Manual Control.....	3
Elodea Surveys	3
Results.....	5
Overview	5
Site Narratives – Terrestrial Surveys	10
Katmai National Park	10
Brooks Camp Developed Area (BCDA)	10
Naknek Lake.....	16
Lake Grosvenor	18
Battle Lake and River.....	18
Outer Coast.....	19
Katmai National Preserve.....	20
Nonvianuk Ranger Cabin	20
Crosswinds Lake Area.....	21
Big Ku Lodge	21

Contents (continued)

	Page
Alagnak-Nonvianuk Confluence	22
Aniakchak National Monument & Preserve.....	22
Aniakchak Bay Beach and Cabin Area	22
Bristol Bay Borough.....	22
NPS Administered Properties.....	22
Prevention	24
Education and Outreach.....	24
Phenology	25
Recommendations for the NPS and 2019 Field Season.....	28
Literature Cited	29
Appendix.....	30
Maps Showing General Locations of 2018 Invasive Plant Survey and Treatment Sites	30

Figures

	Page
Figure 1. Map of Katmai National Park and Preserve.	1
Figure 2. A view of Brooks Camp from Dumpling Mountain Trail. (NPS-SCA/KAYLA SHERMAN).....	10
Figure 3. Shepherd’s purse found around and under lodge kitchen. (NPS-SCA/THOMAS HATTON).....	11
Figure 4. Mouth of the Brooks River. (NPS-SCA/KAYLA SHERMAN)	12
Figure 5. Manual removal of common plantain along Beaver Pond Trail. (NPS-SCA/THOMAS HATTON).....	13
Figure 6. Kayla Sherman manually removes shepherd’s purse in the maintenance yard. (NPS-SCA/THOMAS HATTON)	15
Figure 7. Kayla Sherman holding a shepherd’s purse plant found in 5-mile gravel pit. (NPS-SCA/THOMAS HATTON)	16
Figure 8. <i>R. acetosella</i> patches at Lake Camp. (NPS-SCA/THOMAS HATTON).....	17
Figure 9. Blue dye indicator can be seen on recently treated common dandelions at Grosvenor Lodge. (NPS-SCA/THOMAS HATTON)	18
Figure 10. Common dandelions in seed on Mink Island. (NPS-SCA/KAYLA SHERMAN).....	20
Figure 11. A walking trail at Big Ku Lodge surrounded by tundra. (NPS-SCA/THOMAS HATTON).....	21
Figure 12. <i>T.officinale</i> patch sprayed with Milestone herbicide. (NPS-SCA/THOMAS HATTON).....	22
Figure 13. Common dandelion infestation at the dormitory lawn. (NPS-SCA/THOMAS HATTON).....	23
Figure 14. Thomas Hatton and Kayla Sherman tabling at the Fishtival Bazaar. (NPS).....	24

Tables

	Page
Table 1. A summary of exotic plant management efforts since 2014 (includes KATM, ALAG, and ANIA data).....	5
Table 2. Amount of the herbicide mix (Milestone/2, 4-D) used in 2018 by site and month including equivalent amount of herbicide concentrate applied in parentheses.....	5
Table 2. Amount of the herbicide mix (Milestone/2, 4-D) used in 2018 by site and month including equivalent amount of herbicide concentrate applied in parentheses.....	6
Table 3. Summary of 2018 terrestrial invasive plant survey and treatment efforts by Katmai National Park staff and interns.	7
Table 4. Summary of 2018 aquatic invasive plant survey efforts by Katmai National Park staff and interns.....	8
Table 5. Observed KATM phenology log by location for the 2018 field season.	26

Abstract

2018 marked the ninth consecutive season that the Alaska Exotic Plant Management Team (EPMT) protocol was implemented to survey and control invasive plants in Katmai National Park & Preserve (KATM), Alagnak Wild River (ALAG), and Aniakchak National Monument & Preserve (ANIA). KATM's EPMT consisted of two Student Conservation Association (SCA) interns accompanied by an experienced NPS biological technician. Field work focused on surveying sites for invasive plants and treating known infestations. The goal is to detect and treat early to prevent the establishment or spread of invasive plant infestations in the park. Most of the surveys were conducted near lodges, popular fishing locations, and park cabins. New survey locations included Mink Island, Big Ku Lodge, and Aniakchak Bay. Manual and chemical methods were used to treat infestations at Brooks Camp, Lake Camp, Fure's Cabin, the confluence of the Alagnak and Nonvianuk Rivers, Nonvianuk Ranger Cabin, Grosvenor Lodge, the Battle River Wilderness Retreat, and Mink Island. The herbicides Milestone and 2, 4-D (one location) were used for chemical treatments. The primary treatment targets were *Taraxacum officinale* ssp. *officinale* (common dandelion) and *Capsella bursa-pastoris* (shepherd's purse). Surveys were also conducted for the invasive aquatic plant *Elodea* in areas of high float plane traffic. The Alaska Region's *Elodea* Survey Protocol was followed. *Elodea* was not found and is not known to be present in any of the park units managed by Katmai National Park staff (KATM, ALAG, ANIA). The SCA interns' outreach and education efforts included presenting educational materials at a Fishtival booth.



Bob Peterson, Kayla Sherman, and Leslie Skora look out on the Bay of Islands at Fure's Cabin. (NPS–SCA/THOMAS HATTON)

Acknowledgments

There are several people to whom we owe thanks for enabling our work for the 2018 season. We would first like to thank Alyssa Reischauer for organizing our work for the season and editing and submitting this report, and Bob Peterson for supervising our backcountry trips and making sure they were safe. Many thanks to our EPMT regional staff, Chris Overbaugh, Justin Fulkerson, and Peter Frank, for ensuring we had the proper training and for always being available to answer questions. Thanks to our park pilots, Adam Grenda and Troy Hamon for safely flying us to and from many of our backcountry sites. Thanks to Law Enforcement, for providing boat transportation while our boat was out of service. Thank you to bear management and monitoring staff for helping to pull shepherd's purse at Brooks Camp. We would also like to recognize Big Ku Lodge, Grosvenor Lodge, Battle River Wilderness Retreat, and allotment owner Katherine Brown for allowing us to survey and/or treat on their land. We certainly want to also give thanks to the SCA and AmeriCorps for providing us with the opportunity to work in such a unique place where we had so many wonderful and rewarding experiences while doing our part to keep Alaska parks pristine.

List of Acronyms

AKEPIC: Alaska Exotic Plants Information Clearinghouse

AKEPMT: Alaska Exotic Plant Management Team

AKNHP: Alaska Natural Heritage Program

ALAG: Alagnak Wild River

ANIA: Aniakchak National Monument & Preserve

APCAM: Alien Plant Control and Monitoring

BCDA: Brooks Camp Developed Area

DNR: Department of Natural Resources

EPMT: Exotic Plant Management Team

FAA: Federal Aviation Administration

FWS: Fish and Wildlife Service

GPS: Global Positioning System

KATM: Katmai National Park & Preserve

KSVC: King Salmon Visitor's Center

LACL: Lake Clark National Park & Preserve

NPS: National Park Service

SAGA: Southeast Alaska Guidance Association

SCA: Student Conservation Association

USGS: US Geological Survey

VRAA: Valley Road Administrative Area

VTTSR: Valley of Ten Thousand Smokes Road

VTTS: Valley of Ten Thousand Smokes.

Introduction

Katmai National Park & Preserve, established in 1918, spans over four million acres of wilderness at the base of the Alaska Peninsula (Figure 1). Since its establishment, the park has expanded and it now draws in visitors from around the globe with the large salmon run, fishing, and its dense populations of brown bears. The Alagnak Wild River (ALAG) and Aniakchak National Monument & Preserve (ANIA) are nearby national park units that are also managed by KATM. Visitors arrive by plane or boat to visit sites such as Brooks Camp, VTTS, Crosswinds, Amalik Bay, Hallo Bay, and various lodges around the park.

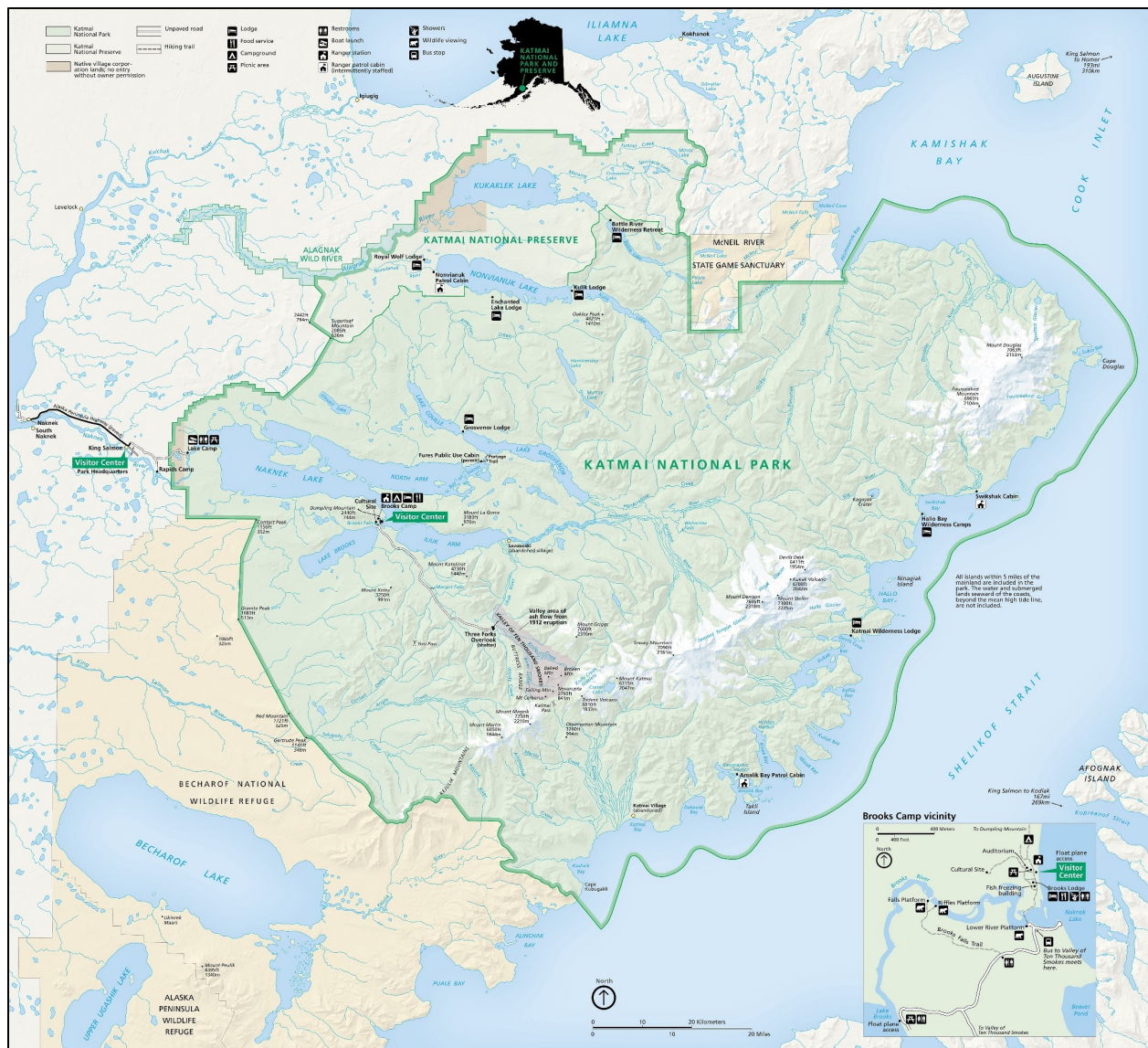


Figure 1. Map of Katmai National Park and Preserve.

Katmai EPMT Survey and Management History

Invasive plants are defined as a non-native, often introduced species that have the ability to proliferate in their new environment (Richardson et al. 2000). Human activity is the most common vector for the introduction of invasive plants, with seeds and plant fragments being transported on clothing, gear, or vehicles of travelers. Although, the short growing season and remoteness of Katmai slows the progress of exotic plants compared to the contiguous United States, certain invasive plants such as *Taraxacum officinale* ssp. *officinale*, *Capsella bursa-pastoris*, and *Rumex acetosella* are able to thrive in disturbed locations.

Invasive plant monitoring in Katmai began in 2000, when members of the United States Geological Survey (USGS) took Global Positioning System (GPS) data showing the known extent of invasive infestations. Between 2005 and 2009, surveying and treatment were conducted by volunteers, NPS staff, Tribal Civilian Corps (TCC), and Southeast Alaska Guidance Association (SAGA) crews. Since 2010, the majority of EPMT work has been conducted by two Student Conservation Association (SCA) interns. In addition to field work, the Katmai EPMT participates in education/outreach events including boot brush installations, vehicle inspections, and information booths at Fishtival.

The goal of the 2018 EPMT was to continue surveys for exotic plants and treatment of infestations to prevent establishment and spread in the park. Survey and treatment data was systematically collected to evaluate current and inform future management efforts.



SCA EPMT crew member, Kayla Sherman, chemically treats *R. acetosella* (sheep sorrel) at Lake Camp. (NPS-SCA/THOMAS HATTON)

Methods

Overview

In 2018, EPMT work was conducted from late May-September in accordance with the Alaska Exotic Plant Management Team 2018 Field and Office Protocols (Overbaugh and Frank 2018a, b) and the Alaska Region *Elodea* Survey Protocol (Frank and Overbaugh, 2017). Fieldwork was carried out by SCA interns Kayla Sherman and Thomas Hatton with assistance from NPS biological technician Bob Peterson. The KATM EPMT was supervised by GIS specialist/biologist Alyssa Reischauer, with additional guidance provided by AKEPMT program manager Chris Overbaugh and data manager Peter Frank. Bear monitoring/management technicians also contributed in the removal of *C. bursa-pastoris* and *T. officinale*, at Brooks Camp. Fieldwork involved surveying for and treating terrestrial invasive plant infestations and surveying for *Elodea*, an aquatic invasive plant discovered in other parts of Alaska in 2010. Priority locations for treatment included Lake Camp, Brooks Camp, Fure's Cabin, and the Battle River Wilderness Retreat.

Data Management

Almost all areas surveyed or treated were mapped using a Trimble GeoExplorer GeoXT (2008 Series) GPS unit using the standard AKEPMT data dictionary with TerraSync 5.86 software. Occasionally surveyed or treated areas were mapped using Garmin GPS data. Site information and chemical and manual control data were recorded. Standardized polygons were used for frequently visited infestations to streamline data collection and evaluate the effectiveness of control efforts. Data collected in the field was uploaded, edited, and differentially corrected using Pathfinder Office (Version 5.85) before being submitted to AKEPMT Data Manager Peter Frank.

Chemical Control

Chemical treatment was carried out on *T. officinale*, *Plantago major*, and *R. acetosella*. The herbicide used is called Milestone, which is broad-leaf specific with the active ingredient aminopyralid. A mix of Milestone and 2, 4-D was used to manage *R. acetosella*. All treatments were performed using backpack or handheld sprayers. Sprayers were calibrated for each applicator. Our average application rate was 30 gallons per acre (GPA). Herbicide was diluted with water and mixed with blue dye to ensure accurate application. Milestone was applied at a rate of 6 oz. /acre and 2, 4-D was applied at a rate of 2 pints /acre. Herbicide usage was documented on herbicide data sheets.

Manual Control

Manual control methods (hand pulling, shovels, and trowels) were used to treat all other infestations. Invasive plants removed were disposed of in labeled trash bags and incinerated.

Elodea Surveys

The National Park Service's Alaska Region *Elodea* Survey Protocol was followed to survey for *Elodea* in selected areas of waterbodies deemed by park staff to be at higher risk of infestation due to float plane traffic (Frank and Overbaugh, 2017).



Seed pods and flowers of *Taraxacum officinale* ssp. *officinale* on Mink Island, Amalik Bay. (NPS-SCA/KAYLA SHERMAN)

Results

Overview

In regards to terrestrial work in 2018, KATM's EPMT crew surveyed 103.6 acres, of which 2.31 were infested with invasive plants and 1.78 were treated (Table 1). New survey locations were Big Ku Lodge, Mink Island, and a native allotment at the confluence of the Alagnak and Nonvianuk rivers. A total of 37.43 gallons of herbicide mixture was applied in 2018 (Table 2). Fourteen sites were visited to survey and treat for terrestrial invasive plants and ten sites were surveyed for aquatic invasive plants targeting *Elodea* (Tables 3 and 4). *Taraxacum officinale* ssp. *officinale* was the most common terrestrial invasive plant found and treated. Neither *Elodea* nor other aquatic invasive plants were found. An attempt was made to identify native aquatic plant species found while surveying for *Elodea*. This information will be reported separately.

Table 1. A summary of exotic plant management efforts since 2014 (includes KATM, ALAG, and ANIA data).

Year	# EPMT Personnel	Field Season Length ^A	Invasive Plant GPS Data Acres (NPS Lands/Non-NPS Lands)		
			Surveyed	Infested ^B	Treated ^C
2014	2	5/1-10/20	46.87 / 0.95	1.17 / 0.07	0.56 / 0.04
2015	2	5/3-10/9	58.64 / 26.76	0.37 / 2.30	0.15 / 0.30
2016	3	4/25-10/9	43.17 / 5.18	0.30 / 1.02	0.26 / 0.18
2017	3	4/24-9/24	76.04 / 15.34	4.74 / 0.12	3.29 / 0.05
2018	2-3	4/30-9/14	103.63 ^D / 0.88	2.31 / 0.06	1.78 / 0.06

^A Field season length refers to the amount of time that seasonal EPMT personnel were on staff

^B Acres infested is determined by multiplying the area mapped by the percent cover of all invasive species present. Percent cover is calculated based on the amount of herbicide used for areas that were chemically treated. Percent cover is visually estimated for manual control and survey sites.

^C Acres treated is determined by multiplying the area mapped by its percent cover of invasive plants and by the percent of that infestation which was treated.

^D Includes an estimated 3.76 acres surveyed in ANIA.

Table 2. Amount of the herbicide mix (Milestone/2, 4-D) used in 2018 by site and month including equivalent amount of herbicide concentrate applied in parentheses.

Site ^A	Gallons of Herbicide Mix Used (equivalent ounces of Milestone/2,4-D concentrate)				
	June	July	August	September	Total
Fure's	0.88	1.24	1.25	1.75	5.12 (0.98/-)
Brooks Camp	1.49	0.09	0.08	—	1.66 (0.34/-)
Battle River	2.25	6.25	—	—	8.5 (1.59/-)
Nonvianuk	0.53	0.38	—	—	0.91 (0.16/-)
A-N confluence	—	3.00	—	—	3.00 (0.55/-)

^A Table only includes sites where chemical treatment methods were used.

Table 2. Amount of the herbicide mix (Milestone/2, 4-D) used in 2018 by site and month including equivalent amount of herbicide concentrate applied in parentheses.

Site^A	Gallons of Herbicide Mix Used (equivalent ounces of Milestone/2,4-D concentrate)				
	June	July	August	September	Total
Lake Camp	–	6.50	0.13	–	6.63 (1.11/0.37)
NPS Dorm	0.23	-	10.6	–	10.83 (2.17/-)
Grosvenor	0.07	0.08	–	–	0.15 (0.02/-)
Mink Island	–	0.63	–	–	0.63 (0.10/-)
Grand Total					37.43 (7.02/0.37)

^A Table only includes sites where chemical treatment methods were used.

Table 3. Summary of 2018 terrestrial invasive plant survey and treatment efforts by Katmai National Park staff and interns.

Unit	Site	General Location	2018 Site Visit Information			
			Survey or Treatment	Visit #	Visit Date	Invasive Plants Found ^A
KATM	King Salmon NPS Property	NPS Administered Area ^B	Treatment	1	6/7	CD
	King Salmon NPS Property	NPS Administered Area ^B	Treatment	2	8/29	CD,NH,WC,PW,FD
	Brooks Camp Developed Area	Within Park/Preserve Boundary	Treatment	1	6/9-6/15	CD,SP,PW,CP
	Brooks Camp Developed Area	Within Park/Preserve Boundary	Treatment	2	6/20-6/23	SP,PW
	Brooks Camp Developed Area	Within Park/Preserve Boundary	Treatment	3	7/3-7/5	CD,SP,PW
	Brooks Camp Developed Area	Within Park/Preserve Boundary	Treatment	4	7/24-7/27	CD,SP,CP,PW
	Brooks Camp Developed Area	Within Park/Preserve Boundary	Treatment	5	8/21-8/26	CD,SP,CP,NH,PW
	Lake Camp	Within Park/Preserve Boundary	Treatment	1	7/27	SS
	Lake Camp	Within Park/Preserve Boundary	Treatment	2	8/29	SS,FD
	Fure's Cabin & Portage Trail	Within Park/Preserve Boundary	Treatment	1	6/6	CD
	Fure's Cabin & Portage Trail	Within Park/Preserve Boundary	Treatment	2	7/19	CD
	Fure's Cabin & Portage Trail	Within Park/Preserve Boundary	Treatment	3	8/16	CD
	Fure's Cabin & Portage Trail	Within Park/Preserve Boundary	Treatment	4	9/1	CD
	Grosvenor Lodge	Within Park/Preserve Boundary	Treatment	1	6/6	CD,CP
	Grosvenor Lodge	Within Park/Preserve Boundary	Treatment	2	7/19	CD,PW
	Grosvenor Lodge	Within Park/Preserve Boundary	Treatment	3	8/16	CD,CP,PW
	Battle River Wilderness Retreat	Within Park/Preserve Boundary	Treatment	1	6/5	CD
	Battle River Wilderness Retreat	Within Park/Preserve Boundary	Treatment	2	7/10	CD
	Nonvianuk Cabin	Within Park/Preserve Boundary	Treatment	1	7/6	CD
	Nonvianuk Cabin	Within Park/Preserve Boundary	Treatment	2	7/12	CD
	Alagnak-Nonvianuk Confluence	Within Park/Preserve Boundary	Treatment	1	7/12	CD
	Big Ku Lodge	Within Park/Preserve Boundary	Survey	1	7/11	–

^A Species codes used: CD= common dandelion (*Taraxacum officinale* ssp. *officinale*), CP= common plantain (*Plantago major*), NH= narrowleaf hawksbeard (*Crepis tectorum*), SP= shepherd's purse (*Capsella bursa-pastoris*), SS= sheep sorrel (*Rumex acetosella*), WC= white clover (*Trifolium repens*), PW= pineapple weed (*Matricaria discoidea*), FD= fall dandelion (*Leontodon autumnalis* var. *pratensis*).

^B NPS Administered area outside the park boundary.

Table 3 (continued). Summary of 2018 terrestrial invasive plant survey and treatment efforts by Katmai National Park staff and interns.

Unit	Site	General Location	2018 Site Visit Information			
			Survey or Treatment	Visit #	Visit Date	Invasive Plants Found ^A
KATM (cont.)	Mink Island	Within Park/Preserve Boundary	Treatment	1	7/1	CD
	Amalik Bay Cabin	Within Park/Preserve Boundary	Survey	1	6/28	–
	Swikshak	Within Park/Preserve Boundary	Other Observation	1	6/30	CD
	Geographic Harbor	Within Park/Preserve Boundary	Survey	1	7/2	–
	Moraine-Funnel Confluence	Within Park/Preserve Boundary	Survey	1	8/4	–
ANIA	Aniakchak Cabin & Beach	Within Monument/Preserve Boundary	Survey	1	7/13-7/16	–

^A Species codes used: CD= common dandelion (*Taraxacum officinale* ssp. *officinale*), CP= common plantain (*Plantago major*), NH= narrowleaf hawksbeard (*Crepis tectorum*), SP= shepherd's purse (*Capsella bursa-pastoris*), SS= sheep sorrel (*Rumex acetosella*), WC= white clover (*Trifolium repens*), PW= pineapple weed (*Matricaria discoidea*), FD= fall dandelion (*Leontodon autumnalis* var. *pratensis*).

^B NPS Administered area outside the park boundary.

Table 4. Summary of 2018 aquatic invasive plant survey efforts by Katmai National Park staff and interns.

Site	General Location	Date	Survey Type	Acres Surveyed ^A	Surveyed From	Sampling Tools	# Sample Points	Water Clarity	Substrate Type	Elodea found?
Contact Pond (pond near Contact Creek Airstrip) – SE end	Within Park/ Preserve Boundary	8/1	meander	160.8	packraft, wading	DH rake/L ^B , hand	>20	muddy	sand, silt	NO
Twin Lakes (Moraine-Funnel Confluence Area)	Within Park/ Preserve Boundary	8/4	meander	19.0	packraft	DH rake/L ^B	34	slightly muddy	gravel, sand	NO
Crosswinds Lake (Moraine-Funnel Confluence Area)	Within Park/ Preserve Boundary	8/5	meander	56.1	packraft	DH rake/L ^B	61	slightly muddy	sand, muck	NO
Spectacle Lake (Moraine-Funnel Confluence Area)	Within Park/ Preserve Boundary	8/5	meander	99.3	packraft, wading	DH rake/L ^B	54	slightly muddy	cobble	NO
Pothole Lake (Moraine-Funnel Confluence Area)	Within Park/ Preserve Boundary	8/6	meander	2.0	packraft	DH rake/L ^B	13	muddy	cobble	NO
American Creek – near mouth	Within Park/ Preserve Boundary	8/15	meander	31.8	motor boat	DH rake/L ^B	42	muddy	muck	NO
Lake Grosvenor – outlet area	Within Park/ Preserve Boundary	8/16	meander	6.8	motor boat	DH rake/L ^B	27	muddy	muck	NO

^A Acres calculated in ArcGIS by digitizing an area around the survey track lines and sample points to best represent the area searched and sampled. This is an approximation.

^B Double headed rake on line.

Table 4 (continued). Summary of 2018 aquatic invasive plant survey efforts by Katmai National Park staff and interns.

Site	General Location	Date	Survey Type	Acres Surveyed ^A	Surveyed From	Sampling Tools	# Sample Points	Water Clarity	Substrate Type	Elodea found?
Naknek Lake – Mortuary Cove	Within Park/ Preserve Boundary	8/16	meander	6.1	motor boat	DH rake/L ^B	7	clear	sand, muck	NO
Naknek River – Float Plane Row	Bristol Bay Borough	9/5	meander	31.7	motor boat	DH rake/L ^B	9	clear	silt, sand, muck	NO
Pike Lake – along western shore where houses are	Within Park/ Preserve Boundary	9/10	meander	34.7	canoe	DH rake/L ^B	7	muddy	muck	NO
Lake Coville	Within Park/ Preserve Boundary	8/15	opportunistic	< 0.1	motor boat	DH rake/L ^B	2	NA	NA	NO
Olga Lake – west shore float plane landing area	Within Park/ Preserve Boundary	8/24	opportunistic	< 0.1	wading	hand	NA	clear	silt, muck	NO

^A Acres calculated in ArcGIS by digitizing an area around the survey track lines and sample points to best represent the area searched and sampled. This is an approximation.

^B Double headed rake on line.

Site Narratives – Terrestrial Surveys

Detailed descriptions of the survey and treatment work done by the EPMT crew follows, organized by location. See appendix A for a map of site locations.

Katmai National Park

Brooks Camp Developed Area (BCDA)

BCDA includes all developed areas in the Brooks Camp, Lake Brooks, and Valley Road area. This area has seasonal housing facilities for NPS and lodge staff as well as park visitors and is the most highly visited area of the park. High visitation means that there are substantially more invasive plants than any other area within KATM. As a result, this site has been a focal point of EPMT efforts each season (Figure 2). The most common invasive plants found include: *T. officinale* (common dandelion), *C. bursa-pastoris* (shepherd's purse), and *P. major* (common plantain). Other common, but non-priority exotics include *Matricaria discoidea* (pineapple weed) and *Poa annua* (annual bluegrass).



Figure 2. A view of Brooks Camp from Dumpling Mountain Trail. (NPS-SCA/KAYLA SHERMAN)

Campground and Dumpling Mountain Trail

The campground occupies 2.6 acres at the northeast end of Brooks Camp. In previous years, the campground was found to have a considerable amount of common dandelion and common plantain. Our first visit to the campground was June 13. Patches of common dandelion were typically found near tent sites or fire pits. Both rosette and flower forms were found and subsequently treated with Milestone mix. No other species were observed through the tall grass. During a second treatment on August 22nd fewer common dandelions were observed and treated and we manually removed a few common plantain rosettes.

The lower 2.5 miles of the 4 mile Dumlupınar Mountain trail was surveyed by EPMT on July 26th. No invasive plants were observed this season but annual surveys should be conducted because past crews have found both common dandelion and common plantain near the beginning of the trail.

Brooks Camp

The majority of visitors arrive by float plane to Naknek Lake and stay in the Brooks Lodge area. A standardized polygon was created for this part of the camp because it requires repeated treatment to control invasive plants. This polygon encompasses employee and visitor housing and facilities for the both the park and lodge. Common dandelions, common plantain, and shepherd's purse were all found in this location. Annual bluegrass and pineapple weed, non-priority species, are widespread in this area. We treated this site two times, June 9-10 and July 24-25, with milestone for common dandelions and common plantain. We manually removed shepherd's purse, which was observed around the lodge kitchen/bar and visitor cabins (Figure 3). Common dandelion and shepherd's purse were also found around the lodge employee housing area, Tuckerville. A native knotweed, Fowler's knotweed, was found in the leach field and along the Naknek shoreline. The EPMT mistook this for the invasive, *Polygonum aviculare* (prostrate knotweed) and pulled over 2,000 stems. The species look very similar but can be distinguished by seed shape.



Figure 3. Shepherd's purse found around and under lodge kitchen. (NPS-SCA/THOMAS HATTON)

Oxbow Overlook Trail and Cultural Site

Park interpreters and tourists visit the cultural site frequently via the oxbow overlook trail, which runs parallel to the Brooks River. We surveyed the trail twice finding no invasive plants, although park rangers removed a few common dandelion rosettes at a popular interpretation stop. Even though few invasive plants are found along the trail, we used a ¼ gallon of herbicide mix to treat common

dandelions at the cultural site during our first visit on June 10th. We observed far fewer common dandelions on our second visit using only a hand sprayer to chemically treat the infestation.

Mouth of Brooks River

The bridge at the mouth of the Brooks River that separates the viewing platforms from the lodge is heavily travelled making this a highly susceptible area for infestations (Figure 4). The closed trail, adjacent to the bridge on the north side, has large infestations of shepherd's purse and is blanketed with pineapple weed and annual bluegrass. Between two visits, June 9th and 21st, we manually removed over 1,000 shepherd's purse stems. Near the southern end of the bridge is an area known as the lower platform where visitors can view bears and fish in the river. We chemically treated a few common dandelions on June 6th and August 23rd as well as manually removed shepherd's purse and common plantain. The invasive plants are found in small numbers at the lower platform and occur along the trail. The gravel bar near the mouth known as the "spit" is home to the densest infestation of shepherd's purse at Brooks Camp. We were able to manually remove over 5,700 stems between two visits, June 12th and 22nd. Manual removal should be done with care because a native look alike, *Arabidopsis lyrata* (lyrate rockcress), also grows on the spit and closed trail. The spit and closed trail are priority areas in the beginning of the season because once July hits the bear activity makes it impossible to work in these sites.



Figure 4. Mouth of the Brooks River. (NPS-SCA/KAYLA SHERMAN)

Beaver Pond Trail

Beaver Pond trail is moderately used for hiking or bird watching and extends to a pond and a large vehicle lot used by maintenance. Similar to spit road, shepherd's purse is found in large patches along this walkway and common plantain is occasionally found as well. We manually removed shepherd's purse three times, June 13th, July 4th, and August 26th. During our last visit we also found and removed a few common plantain rosettes (Figure 5).



Figure 5. Manual removal of common plantain along Beaver Pond Trail. (NPS-SCA/THOMAS HATTON)

Brooks Falls

The Brooks Falls Trail originates on the VTTS Road, stretching just over a half mile to the bear viewing platforms. Despite the presence of shepherd's purse underneath the falls platform, the trail is found to be free of invasive plants. We were able to get under the falls platform before June 15th with bear tech, Tammy Carmack, and manually remove the shepherd's purse. We only treated this area once because bears were still using the falls frequently after August 15th. Pineapple weed is very abundant at this site due to highly disturbed soil and bear grazing.



Brooks Falls from viewing platform. (NPS-SCA/KAYLA SHERMAN)

Lake Brooks Area

The Lake Brooks area can be accessed by the VTTS Road, and contains NPS employee housing, a boat launch, and picnic area. This area sees consistent visitor and employee use, and also serves as a backup landing area for float planes when wind prevents landing on Naknek Lake. As is the case with the rest of the Brooks Camp Developed Area, common dandelion, shepherd's purse, and common plantain have been found in past years. This year, several individuals of each species were found around employee housing and along the road leading to the area. We chemically treated common dandelions during our first visit, June 14th but manually removed all invasive plants on the second visit, July 24th due to rain. We surveyed the closed road near the old fisheries research building (BL-3). Here we removed common plantain and shepherd's purse during our first visit and only common plantain on the second visit.

Valley Loop Road

The Valley Loop Road provides access to the NPS maintenance facility and newly constructed employee housing near the north end of the Valley of Ten Thousand Smokes Road. The maintenance yard was treated twice this season June 14th and August 22nd. We manually removed shepherd's purse and sprayed one common dandelion during our first visit. On the follow up visit we manually removed additional shepherd's purse and one common plantain rosette (Figure 6). This season a new bunkhouse and common area was built next to the existing housing area. We surveyed this site on August 22nd. Pineapple weed was the only invasive plant found.



Figure 6. Kayla Sherman manually removes shepherd's purse in the maintenance yard. (NPS-SCA/THOMAS HATTON)

5-Mile Gravel Pit

Gravel is taken from 5-Mile Gravel Pit for BCDA construction projects. This site is frequently disturbed and is now a hotspot for invasive plants. This year, the EPMT surveyed and treated the entirety of the pit at the beginning and end of the season. Shepherd's purse, common plantain, and *Crepis tectorum* (narrowleaf hawksbeard) were found and removed. The majority of narrowleaf hawksbeard and shepherd's purse were observed in the seed stage during our last visit (Figure 7). Future EPMT's should visit this area frequently, especially from early to mid-August.



Figure 7. Kayla Sherman holding a shepherd's purse plant found in 5-mile gravel pit. (NPS-SCA/THOMAS HATTON)

Naknek Lake

Naknek Lake provides boat access to Brooks Camp, as well as various other popular destinations including Fure's Cabin, Margot Creek, and the Savonoski River. The west end of Naknek Lake can be accessed by a road from King Salmon.

Lake Camp

Lake Camp lies at the outlet of Naknek River. It is the only part of KATM accessible by road from King Salmon and serves as the main access point for boats entering the park. In 2018, we found many patches of *R. acetosella* (sheep sorrel) along the road and parking lot (Figure 8). We sprayed 6.5 gallons of herbicide mix (Milestone/ 2.4-D) because Milestone alone doesn't kill the plants. During a second visit we only sprayed 1/8th of a gallon of the herbicide mix on sheep sorrel and inventoried a few patches of *Leontodon autumnalis* (fall dandelion). Milestone, in conjunction with 2.4-D, is highly effective in controlling sheep sorrel. Within a week or two, most of rosettes were standing dead.



Figure 8. *R. acetosella* patches at Lake Camp. (NPS-SCA/THOMAS HATTON)

Fure's Cabin

Fure's Cabin is a historic cabin located in the Bay of Islands at the east end of Naknek Lake's North Arm. This season we chemically treated common dandelions four times at this location. Common dandelions were observed all summer but became denser as the season progressed. During our first visit we used 7/8th of a gallon of herbicide mix followed by 1.24 gallons, 1.25 gallons, and 1.75 gallons in subsequent visits.



Kayla Sherman prepares to perform chemical treatment at Fure's Cabin. (NPS-SCA/THOMAS HATTON)

Lake Grosvenor

Grosvenor Lodge

Grosvenor Lodge is located on the western shore of Lake Grosvenor. This year we chemically treated common dandelion and common plantain during our first two visits (Figure 9). On the third visit we manually removed these species due to rain and recent floods.



Figure 9. Blue dye indicator can be seen on recently treated common dandelions at Grosvenor Lodge. (NPS-SCA/THOMAS HATTON)

Battle Lake and River

Battle River Wilderness Retreat

The Battle River Wilderness Retreat, located near the outlet of Battle River, is a small private lodge. Common dandelion infestations have decreased remarkably from previous years but still present with potential to spread if not treated early in the season. Flowering was observed during our first visit June 5th, indicating early blooming and seeding compared to other areas of the park. We used 2.25 gallons of herbicide mix our first visit and 6.25 gallons during a second treatment on July 10th. The grass was overgrown during the second visit making it hard to spot rosettes and stems.



Thomas Hatton, Alyssa Reischauer, and Bob Peterson survey Battle River Wilderness Retreat for common dandelions. (NPS-SCA/KAYLA SHERMAN)

Outer Coast

Amalik Bay

Amalik Bay is located along the scenic southern region of Katmai's outer coast, and sees significant visitation from tourist in August. Amalik is home to a NPS ranger cabin, which is staffed periodically during times of expected high visitation. This season, Kayla surveyed the land surrounding the ranger cabin, including the beach and the trail leading to the cabin. She also surveyed the bear viewing area in Geographic Harbor. No invasive plants were found during these surveys. The patch of dandelions spotted last year on Mink Island, were confirmed to be common dandelion. When treated on July 1st, the majority of the dandelions were in the seed stage (Figure 10).



Figure 10. Common dandelions in seed on Mink Island. (NPS-SCA/KAYLA SHERMAN)

Swikshak Bay

A common dandelion was noted, photographed, and location recorded near the ranger cabin on Swikshak Bay by a park employee who was working in the area.

Katmai National Preserve

Nonvianuk Ranger Cabin

A NPS ranger cabin is located on the Nonvianuk River, just downstream from the outlet of Nonvianuk Lake. We treated a small infestation of common dandelion near the floatplane drop off. A larger infestation was found along the river leading to the cabin. These locations were treated twice this summer; on June 5th and again on July 12th.



Kayla Sherman conducts chemical treatment for common dandelion along the Nonvianuk River. (NPS-SCA/THOMAS HATTON)

Crosswinds Lake Area

Morraine-Funnel Confluence

Last year's EPMT manually removed what they identified as prostrate knotweed. This year we returned and could not find any knotweed. Future crews should survey this site and be cautious of misidentifying the native, Fowler's knotweed as invasive.

Big Ku Lodge

Big Ku lodge, located on the west side of Kukaklek Lake near its outlet, was surveyed for the first time this season. The land is mostly tundra and no invasive species were found (Figure 11).



Figure 11. A walking trail at Big Ku Lodge surrounded by tundra. (NPS-SCA/THOMAS HATTON)

Alagnak-Nonvianuk Confluence

The private inholding located at the confluence of Nonvianuk and the Alagnak was chemically treated for a common dandelion infestation (Figure 12). This site was one of the densest infestations we observed and should be a top priority for future crews.



Figure 12. *T.officinale* patch sprayed with Milestone herbicide. (NPS-SCA/THOMAS HATTON)

Aniakchak National Monument & Preserve

Aniakchak Bay Beach and Cabin Area

Katmai's GIS specialist, Alyssa Reischauer, surveyed a few locations along the coast near the Aniakchak packers' cabin and around the cabin while she was there in July for another project. She did not find invasive plants with the possible exception of *Poa trivialis*. She did not bring a specimen back for identification.

Bristol Bay Borough

The Bristol Bay Borough includes the towns of Naknek, South Naknek, and King Salmon. KATM's headquarters, employee housing, and maintenance yard are in King Salmon. Invasive species such as common dandelion, sheep sorrel, and white clover are common here. The area is a potential source of seeds transported inadvertently into the park on contaminated equipment and clothing.

NPS Administered Properties

Survey and control work on NPS administered properties outside the park boundary took place in the area surrounding the NPS housing and warehouse. The dormitory lawn has a significant infestation of common dandelion (Figure 13). Other invasive plants such as white clover, narrowleaf hawksbeard, sheep sorrel, and pineapple weed are present in small amounts. We weren't able to treat

this area until the end of the season so many of the early season dandelions had already seeded and died. On August 29th we used 10.6 gallons of milestone mix to treat the late emerging rosettes. Future EPMTs should treat this area as early as possible and coordinate with maintenance about mowing activities.



Figure 13. Common dandelion infestation at the dormitory lawn. (NPS-SCA/THOMAS HATTON)

Prevention

Transport of materials and equipment to build the new bridge at Brooks Camp started in August. The building contract specifies that everything must be clean before entry into the park. EPMT personnel and other KATM staff have been inspecting all truckloads either in King Salmon or at Lake Camp to clear them for loading on the barge for transport to Brooks Camp. Most loads were suitably clean. A few had to be rewashed by the contractor.

Education and Outreach

Education and community outreach are an integral part of invasive plant management. Invasive plants are often spread and introduced to new areas due to human negligence, so raising awareness about how invasive plants are spread can be an important part of prevention.

The 2018 EPMT members, Kayla and Thomas, presented a map of treatment sites, information booklets, activity booklets, and games at a booth during the Fishtival Bazaar (Figure 14). This is an annual event celebrating the end of commercial salmon fishing season. We also created an outline for a program at the visitor's center. Unfortunately the program had to be cancelled due to poor weather and the start of school.



Figure 14. Thomas Hatton and Kayla Sherman tabling at the Fishtival Bazaar. (NPS)

Phenology

Knowledge of plant lifecycles and timing can be helpful for scheduling control efforts. Phenology is likely to vary from year to year depending on environmental conditions. Many of the invasive plants within KATM, including common dandelion and shepherd's purse, start flowering as early as May or June. Others such as common plantain, sheep sorrel, white clover, and narrowleaf hawksbeard start flowering later. Phenology stages and dates of observation for 2018 are noted in Table 5.

Table 5. Observed KATM phenology log by location for the 2018 field season.

Location	Taxon	First Observation		Second Observation		Third Observation	
		Date	Phenology	Date	Phenology	Date	Phenology
King Salmon Dormitory	<i>T. officinale</i>	5/14	rosette	5/18	flower	6/4	seed
	<i>T. repens</i>	6/16	rosette	7/10	flower	—	—
	<i>L. autumnalis</i>	8/29	rosette	—	—	—	—
	<i>C. tectorum</i>	8/17	flower	—	—	—	—
Lake Camp	<i>R. acetosella</i>	7/27	rosette, flower	8/29	seed	—	—
	<i>L. autumnalis</i>	8/29	flower, seed	—	—	—	—
Brooks Camp	<i>T. officinale</i>	6/9	rosette, flower	6/22	seed	—	—
	<i>C. bursa-pastoris</i>	6/9	rosette, flower, seed	—	—	—	—
	<i>P. major</i>	6/11	rosette	7/24	flower, seed	—	—
5-Mile Gravel Pit	<i>C. bursa-pastoris</i>	6/15	rosette, flower, seed	—	—	—	—
	<i>C. tectorum</i>	8/23	rosette, flower, seed	—	—	—	—
	<i>P. major</i>	6/15	rosette	8/23	flower, seed	—	—
Fure's Cabin	<i>T. officinale</i>	6/6	rosette, flower	7/19	seed	—	—
Battle River Wilderness Retreat	<i>T. officinale</i>	6/5	rosette, flower	7/10	seed	—	—

Table 5 (continued). Observed KATM phenology log by location for the 2018 field season.

Location	Taxon	First Observation		Second Observation		Third Observation	
		Date	Phenology	Date	Phenology	Date	Phenology
Mink Island	<i>T. officinale</i>	7/1	flower, seed	—	—	—	—
Grosvenor Lodge	<i>T. officinale</i>	6/6	rosette	—	—	—	—
	<i>P. major</i>	6/6	rosette	—	—	—	—
Alagnak-Nonvianuk Confluence	<i>T. officinale</i>	7/12	rosette	—	—	—	—
Nonvianuk River Outlet	<i>T. officinale</i>	6/5	rosette, flower	—	—	—	—

Recommendations for the NPS and 2019 Field Season

Early in the season when things are slow study for and take the test to become a certified herbicide applicator for the State of Alaska. It is good information to know and it would be advantageous to have more licensed applicators available.

Try to treat the dandelion infestation on the dorm lawn in early May. By mid-May they were all blooming and by late May several had already gone to seed.

Getting to Brooks Camp in early June should be a priority. The later in the season you wait the taller the grass gets and it makes finding the dandelions in the campground very difficult. Plan on revisiting Brooks as often as possible to monitor infestations throughout the season.

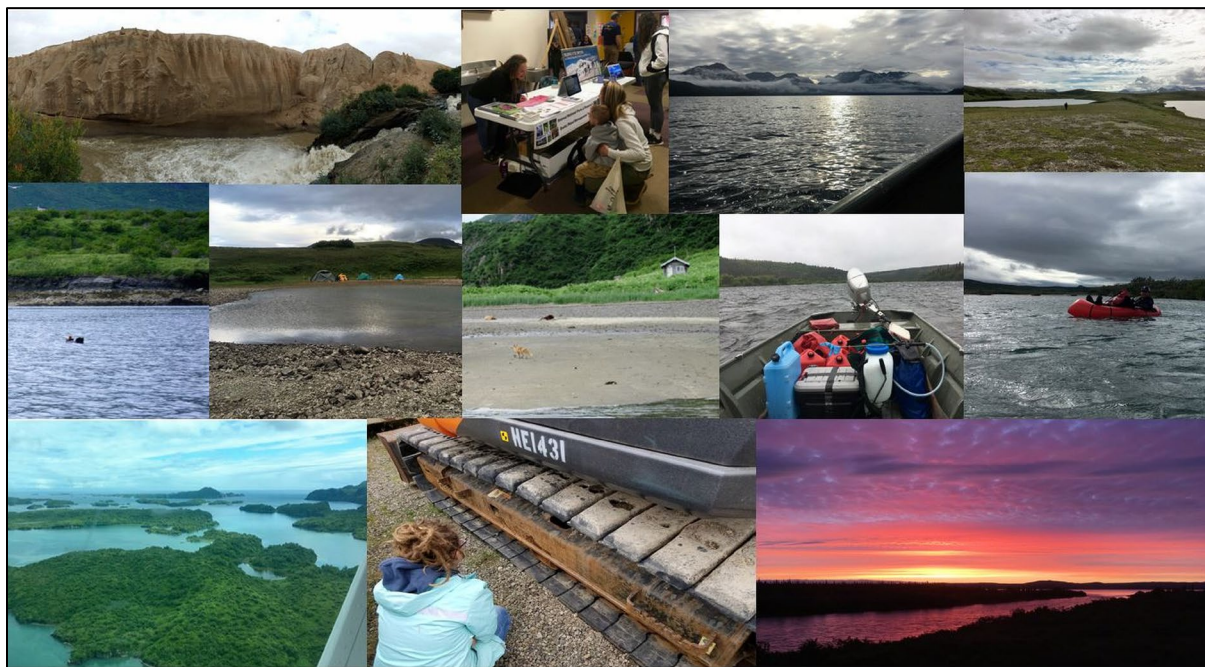
Try and do a program early in the season with the visitor center so bad weather and school won't get in the way.

Organize one or two weed pulls at Brooks Camp mainly targeted at off duty NPS and lodge staff. Consider similar 'community' seed collection events.

Talk with Wendy, from Denali, at training and get some advice on doing revegetation around all of the Valley Road housing to prevent invasive plants from moving in and taking over.

Continue attempting to establish relationships with private fishing lodges that have not been contacted to obtain permission to survey for invasive plants on their land.

Coordinate with other projects to survey for invasive plants in high visitation areas on the coast.

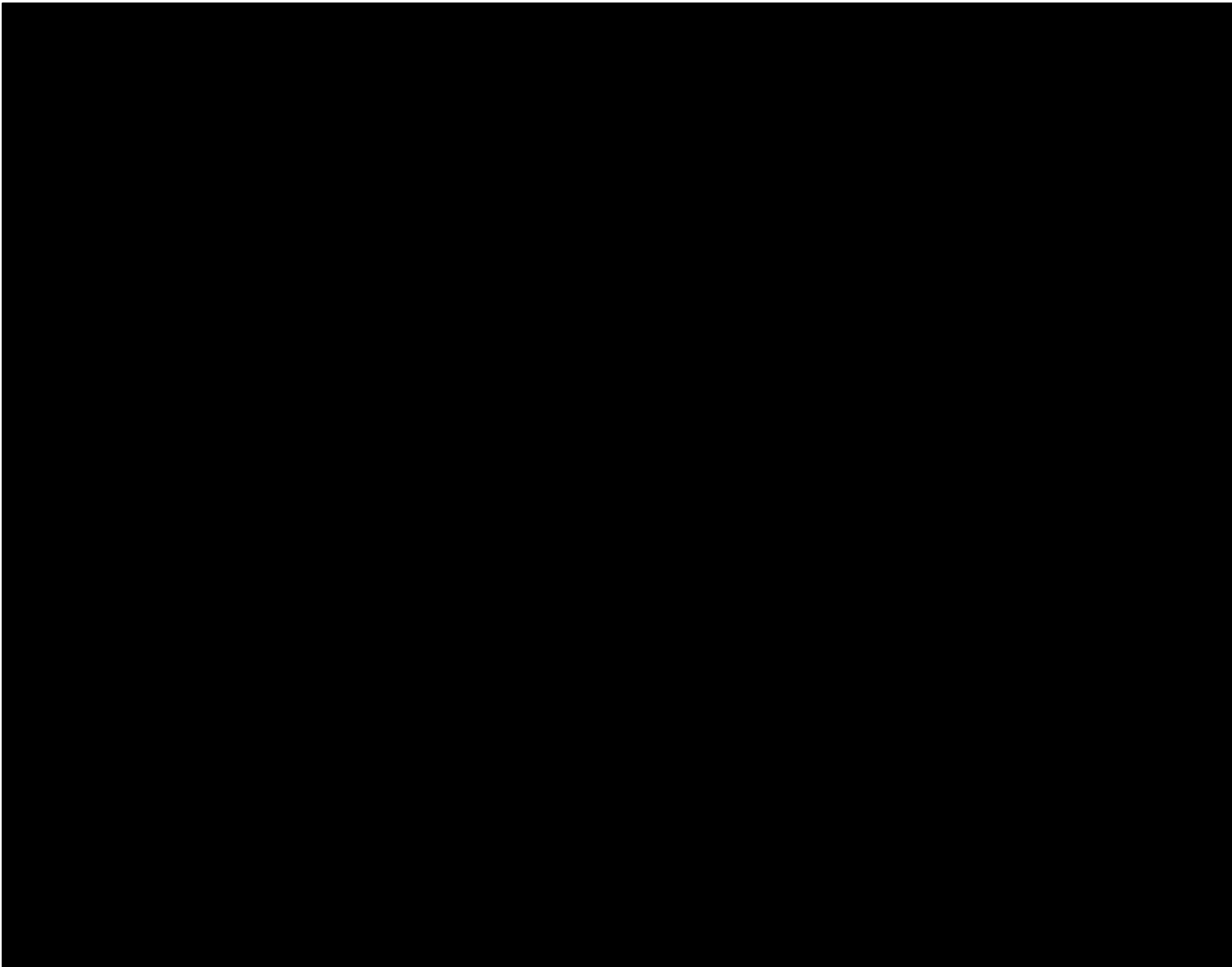


Literature Cited

- Frank, P. and C. Overbaugh. 2017. Elodea Survey Protocol: Alaska Region. National Park Service, Anchorage, Alaska.
- Overbaugh, C. and P. Frank. 2018. Alaska Exotic Plant Management Team: 2018 Field Protocol. National Park Service, Anchorage, Alaska.
- Overbaugh, C. and P. Frank. 2018. Alaska Exotic Plant Management Team: 2018 Office Protocol. National Park Service, Anchorage, Alaska.
- Richardson, D. M., P. Pysek, M. Rejmanek, M. G. Barbour, F. D. Panetta, C. J. West. 2000. Naturalization and invasion of alien plants: concepts and definitions. *Diversity and distributions* 6(2): 93-107

Appendix

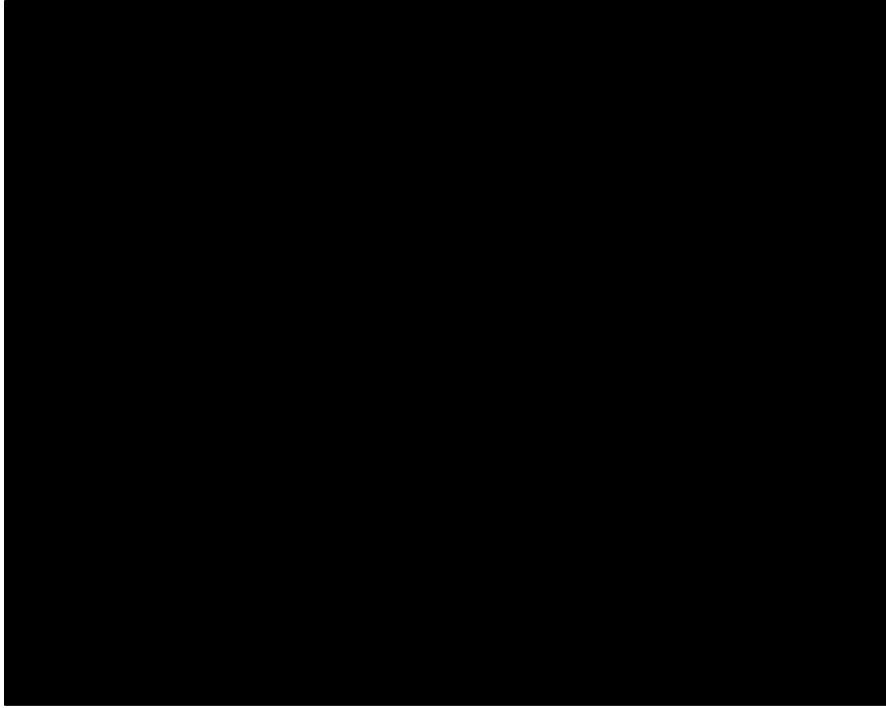
Maps Showing General Locations of 2018 Invasive Plant Survey and Treatment Sites



Katmai National Park & Preserve and Alagnak Wild River sites visited for terrestrial invasive plant surveys or control work in 2018.



Katmai National Park & Preserve and Alagnak Wild River sites visited for aquatic invasive plant surveys in 2018.



Aniakchak National Monument & Preserve sites visited for terrestrial invasive plant surveys in 2018.

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 127/167220, 193/167220, 181/167220, March 2020

National Park Service
U.S. Department of the Interior



[Natural Resource Stewardship and Science](#)

1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525