



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

2017 Annual Report

Natural Resource Report NPS/KATM/NRR—2018/1624





ON THIS PAGE

The NPS float plane in Amalik Bay.
(NPS-SCA/JESSICA WESTBROOK)

ON THE COVER

Stephen Caron pulling shepherd's purse (*Capsella bursa-pastoris*) at the mouth of the Brooks River.
(NPS-SCA/JESSICA WESTBROOK)

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2017 Summary Report

Natural Resource Report NPS/KATM/NRR—2018/1624

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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.

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Abstract

2017 marked the eighth 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). KATM's EPMT consisted of two Student Conservation Association (SCA) interns accompanied, while in the backcountry or when using herbicide, by an experienced National Park Service technician. Field work focused on surveying high use areas 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 on private inholdings and at popular fishing destinations. Several remote, less visited, areas were surveyed as well. New survey locations included the east end of Kulik Lake, Kulik Lodge, Royal Wolf Lodge, Kamishak River, and the Contact Creek airstrip. Manual and chemical methods were used to treat infestations at Brooks Camp, Lake Camp, Fure's Cabin, Nonvianuk Ranger Cabin, Grosvenor Lodge, the Battle River Wilderness Retreat, and Funnel Creek. The aminopyralid herbicide, Milestone, was used for chemical treatments, the primary target being *Taraxacum officinale* ssp. *officinale* (common dandelion). The EPMT assisted with surveys for the aquatic invasive plant *Elodea* on some of the more frequently visited waterbodies within the park boundary (reported separately). The SCA interns' outreach and education efforts included presenting educational materials at a Fishtival booth and leading a SCA crew at Brooks Camp for one week in August. Katmai National Park encompasses some of the most pristine areas in the National Park system, with healthy, intact ecosystems and very few invasive plant species. Continued monitoring, control work, education, and outreach are essential to the preservation of this extraordinary landscape.



View from the eastern shore of Kulik Lake. (NPS–SCA/Jessica Westbrook)

Acknowledgments

There are several people to whom we owe thanks for enabling our work for the 2017 season. We would first like to thank Alyssa Reischauer for organizing our work for the season, and Bob Peterson for supervising our backcountry trips and making sure they were safe. Many thanks to our EPMT regional staff, Chris Overbaugh and Peter Frank, for ensuring we had the proper training and for always being available to answer questions. Thank you to Justin Fulkerson of University of Alaska for assisting in plant identification. Thanks to our park pilot, Adam Grenda, for safely flying us to and from many of our backcountry sites. Thanks to Chad Billock and the maintenance team, for providing boat transportation while ours was out of service. With our time at Brooks Camp being limited and bear activity being unpredictable we were very thankful to have Bear Management act as our allies when it came to pulling shepherd's purse. Thank you to our Dispatch team, Katie Hagaman and Landis Ehler for all they do, and for helping us keep an eye on the flight board for potential survey opportunities. We would also like to recognize Royal Wolf Lodge, Kulik Lodge, Grosvenor Lodge, and Battle River Wilderness Retreat for allowing us to survey 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.

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 spans over four million acres of scenic, wild land at the base of the Alaska Peninsula (Figure 1). First established as a National Monument in 1918, the park was created to protect the natural volcanic wonder known as the Valley of Ten Thousand Smokes (VTTTS). Since its establishment, the park has expanded and it now draws in visitors from around the globe with its dense populations of brown bears and world class fishing. KATM boasts an extremely wide variety of habitat types, ranging from coastal meadows to alpine tundra to rich freshwater river systems. The Alagnak Wild River (ALAG) and Aniakchak National Monument & Preserve (ANIA) are nearby national park units that are also managed by KATM.

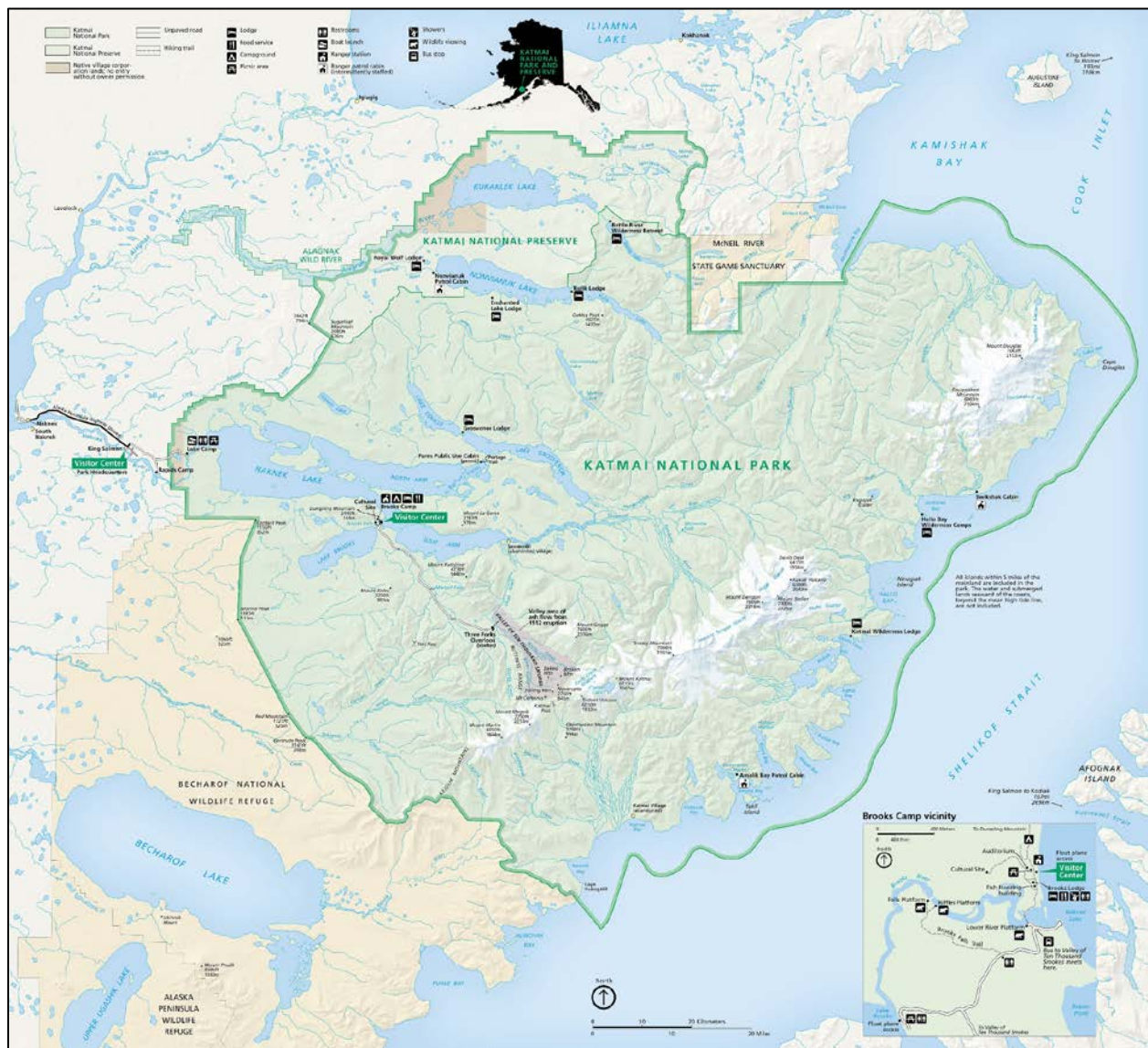


Figure 1. Map of Katmai National Park and Preserve

Katmai is one of the larger national park units in the United States, but its remote location makes it one of the least visited. Visitors from around the world arrive by plane or boat, as the road system does not extend to the Alaska Peninsula. The most highly visited area in the park is Brooks Camp, which draws in visitors with excellent opportunities for bear viewing and some of the best fishing in the world. The 23 mile long road to access the Valley of Ten Thousand Smokes also originates here. Other highly visited areas of the park include Hallo Bay and Amalik Bay on the coast, Crosswinds Lake and Moraine Creek in the preserve, and various fishing lodges located on private inholdings.

Invasive Plant Ecology and Management

In recent years, ecologists and natural resource managers have begun to recognize and respond to the significant threat posed by invasive plants. 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). Once established, successful invaders have shown the ability to colonize and eventually dominate a wide variety of habitats (Thompson 1991). Without the typical competitors from their native range, invasive plants often easily outcompete natives, in turn homogenizing the areas in which they are introduced (Mack *et al.* 2000). In addition to reducing biodiversity, exotic plants may also alter the chemical composition of soil, resulting in dramatic ecosystem changes that have the potential to stress native flora (Ehrenfeld 2003). While the ecological costs associated with invasive species are readily apparent, it should also be noted that their presence results in an estimated \$120 billion in annual damages in the United States alone (Pimentel *et al.* 2005).

Human activity presents the most common vector for the introduction of invasive plants, with seeds and plant fragments being transported on clothing, gear, or vehicles of travelers. Once introduced, wind and flowing water provide ample opportunities for exotic plants to spread into novel environments (Richardson *et al.* 2000). In Alaska, a short growing season and remoteness has slowed the progress of exotic plants compared to many areas of the contiguous United States. Despite the challenges, several high ranking invasive plants such as *Vicia cracca*, *Trifolium repens*, and *Elodea* have taken hold in more heavily trafficked areas of the state (UAA 2017). As visitation to Alaska's wild lands increases, ecologists and land managers are faced with the challenge of preventing further proliferation of invasive species.

Katmai EPMT Survey and Management History

In 2000, the National Park Service (NPS) established the Exotic Plant Management Team (EPMT) Program to address the growing issues posed by the spread of invasive plants on public lands across the United States. The EPMT is split into seventeen regionally organized units throughout the country, each with the goal of early detection and swift removal of invasive plants on NPS managed lands in their respective areas. The Katmai EPMT is a part of Alaska EPMT (AKEMPT), which monitors and treats exotic plants throughout the Alaska Region of the NPS.

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. In 2005, the EPMT collected further GPS data for submission to three invasive plant

databases: Alaska EPMT geodatabase; Alien Plant Control and Monitoring (APCAM), a national database managed by the NPS; and the Alaska Exotic Plants Information Clearinghouse (AKEPIC), a collaborative database and mapping tool managed by the Alaska Natural Heritage Program (Rapp 2009). Between 2005 and 2009, surveys and control work were carried out in high visitation areas by volunteers, NPS staff, Tribal Civilian Corps (TCC), and Southeast Alaska Guidance Association (SAGA) crews (Bauder and Heys, 2005; Rapp 2009). Beginning in 2010, the majority of EPMT work has been conducted by two Student Conservation Association (SCA) interns. Areas surveyed and treated have also expanded to the far reaches of Katmai, including popular visitor destinations on the coast and private fishing lodges throughout the northern area of the Park and Preserve.

In addition to extensive field work, the Katmai EPMT has used education and outreach in the local community in the effort to prevent further introduction of invasive species. In 2011, boot brushes and informational signs were installed at common points of entry to the park and a protocol was established for vehicle inspection before entry to the park. In recent years, the EPMT has hosted invasive plant programs for local children at the King Salmon Visitor Center, participated in the U.S. Fish and Wildlife Service (USFWS) high school science camp, and manned a table at Fishtival, the annual celebration in the nearby community of Naknek marking the end of the Sockeye salmon season.

The goal of the 2017 EPMT was to continue to provide the NPS with up-to-date infestation data throughout Katmai and use various control methods to prevent the establishment and spread of exotic plants in the park. As with 2016, the 2017 EPMT sought to make connections with the lodges on private inholdings within the park, and were thus able to conduct survey and control work on some of these inholdings in the effort to help prevent the spread of invasive plants to more remote areas (Figure 2). In addition to surveys conducted at several previously unsurveyed backcountry locations, the 2017 EPMT carried out extensive manual and chemical control of known exotic infestations. In August, KATM's EPMT assisted with surveys for the aquatic invasive plant *Elodea* at several heavily trafficked sites on various lakes. The EPMT also had a table at the Fishtival bazaar in Naknek, where fishermen and members of the local community had the opportunity to learn about invasive plants and how to prevent their spread.



Figure 2. J. Westbrook and S. Caron preparing to survey at Kulik Lodge (NPS).

Methods

Overview

In 2017, EPMT work was conducted from June through September in accordance with the Alaska Exotic Plant Management Team 2017 Field and Office Protocols (Overbaugh and Frank 2017a, b). Fieldwork was carried out by SCA interns Stephen Caron and Jessica Westbrook, alongside NPS Biological Technician Bob Peterson. The KATM EPMT was supervised by GIS Specialist/Biologist Alyssa Reischauer, with additional supervision and guidance provided by AKEPMT Program Manager Chris Overbaugh and AKEPMT Data Manager Peter Frank. In August, a six person SCA crew assisted with manual control in the Brooks Camp Developed Area (BCDA). Additionally, Bear Technicians Tammy Carmack, Michael Saxton, and VIP Allegra Sandstrom assisted in the removal of *Capsella bursa-pastoris* at Brooks Camp between EPMT trips.

Fieldwork involved invasive plant surveys and control work in areas of high visitor use. Priority locations for control work included Lake Camp, BCDA, VTTS Road, Fure's Cabin, Nonvianuk Ranger Cabin and boat landing, the Battle River Wilderness Retreat inholding, and the NPS administered property in King Salmon. Surveys were conducted at several locations including the Kulik Lodge and airstrip, Royal Wolf Lodge, the east end of Kulik Lake, Kamishak River, and Contact Creek airstrip.

Data Management

All areas surveyed or treated were mapped using a Trimble GeoExplorer GeoXT (2008 Series) GPS unit utilizing TerraSync and the standard AKEPMT data dictionary. Survey information and chemical and manual control data were recorded. Standardized polygons were used for frequently visited infestations to streamline data collection and facilitate evaluating 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 at Lake Camp, Brooks Camp, Fure's Cabin, Nonvianuk Ranger Cabin, Battle River Wilderness Retreat, and NPS administered property in King Salmon, targeting common dandelions and sheep's sorrel (Lake Camp only). The herbicide used is called Milestone, which is a broad-leaf specific herbicide with the active ingredient aminopyralid. All treatments were performed by or under the direct supervision of a state licensed herbicide applicator using backpack or handheld sprayers. Sprayers were calibrated for each applicator and found to have an average application rate of 40 gallons per acre (GPA). Herbicide was diluted with water and mixed with blue dye to ensure accurate application, and applied at a rate of 6 ounces per acre.

Manual Control

Manual control methods were used on all other infestations treated and involved using hand tools to remove invasive plants from the site. Invasive plants removed were disposed of in labeled trash bags and incinerated.

Elodea Surveys

In August the KATM EPMT assisted with surveys for the aquatic invasive Elodea at popular float plane destinations within the park (Figure 3). Surveys involved collecting aquatic vegetation samples at random points and, when possible, mapping aquatic vegetation using Sound Navigation and Ranging (SONAR). The aquatic invasive species surveys will be reported separately.



Figure 3. (Left to right) T. Roberts, N. Hoffman, and S. Caron conducting an *Elodea* survey at Mirror Lake (NPS).

Results

Overview

In 2017 KATM's EPMT crew surveyed 91.4 acres, of which 4.9 were infested with invasive plants and 3.3 were treated (Table 1). New, large survey areas such as at Kulik Lodge were primarily responsible for the significant increase from previous seasons in acres surveyed. Manual treatments on the spit at Brooks Camp and near Crosswinds Lake contributed significantly to the increase in infested and treated acreage. A total of 23.06 gallons of Milestone mix was used in 2017 (Table 2). Most was used to treat the infestation at Battle River. Eleven waterbodies were sampled for aquatic invasive plants (Table 3). The target invasive species, *Elodea*, was not found (see the separate aquatic invasive species report).

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

Year	# EPMT Personnel	Field Season Length ¹	Invasive Plant GPS Data Acres Per Year (NPS Lands/Non-NPS Lands)		
			Surveyed	Infested ²	Treated ³
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

¹ Field season length refers to the amount of time that seasonal EPMT personnel were on staff

² 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.

³ 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.

Table 2. Amount of the herbicide (Milestone) mix used in 2017 by site and month including equivalent amount of Milestone concentrate applied.

Site	Gallons of Herbicide Mix Used (equivalent ounces of Milestone)				
	June	July	August	September	Total
Fure's	0.75	0.25	–	0.25	1.25 (0.19)
Brooks Camp	0.26	–	–	–	0.26 (0.04)
Battle River	–	16.00	–	–	16.00 (2.40)
Nonvianuk	–	0.75	–	–	0.75 (0.11)
Lake Camp	–	3.00	–	–	3.00 (0.45)
NPS Dorm	1.80	–	–	–	1.80 (0.27)
GRAND TOTAL					23.06 (3.46)

Table 3. Waterbodies sampled for the aquatic invasive species *Elodea* in 2017 (see separate aquatic invasive species report for details).

Waterbody	Location
Pike Lake	Village Corporation (Paug-Vik Inc.)
Naknek River ¹	Bristol Bay Borough
Brooks Lake ¹	Park
Naknek Lake ¹	Park
Lake Grosvenor ¹	Park
Lake Coville ¹	Park
American Creek ¹	Park
Crosswinds Lake	Preserve
Nonvianuk Lake ¹	Preserve
Mirror Lake ¹	Preserve
Float plane drop off for Funnel Creek	Preserve

¹ Selected high-use area(s) sampled, not entire water body.

Site Narratives

Detailed descriptions of the survey and treatment work done by the EPMT crew follows, organized by location. Twenty-five sites were surveyed and/or treated over the 2017 season (Table 4). See appendix A for site locations.

Table 4. 2017 Field Work Summary.

Site	General Location	Last Surveyed /Treated	2017 Site Visit Information			
			Survey or Treatment	Visit #	Visit Date	Invasive Plants
NPS Dormitory	NPS Administered Area ²	2016 / ~	Treatment	1	5/30	CD
KS Maintenance Yard	NPS Administered Area ²	2016 / ~	Treatment	1	7/19	CD, SS, NH
Brooks Camp	Within Park Boundary	2016 / 2016	Treatment	1	6/16-6/23	CD, SP, MC
Brooks Camp	Within Park Boundary	2016 / 2016	Treatment	2	6/30	CD
Brooks Camp	Within Park Boundary	2016 / 2016	Treatment	3	8/7-8/10	CD, SP, MC, PK,
Lake Camp	Within Park Boundary	2016 / 2016	Survey	1	6/7	SS
Lake Camp	Within Park Boundary	2016 / 2016	Treatment	2	7/21	SS
Margot Creek Outlet	Within Park Boundary	2016 / ~	Survey	1	8/15	PK
Fure's Cabin	Within Park Boundary	2016 / 2016	Treatment	1	6/30	CD
Fure's Cabin	Within Park Boundary	2016 / 2016	Treatment	2	7/31	CD
Fure's Cabin	Within Park Boundary	2016 / 2016	Treatment	3	9/6	CD
Fure's Portage Trail	Within Park Boundary	2016 / 2016	Survey	1	6/30	–
Fure's Portage Trail	Within Park Boundary	2016 / 2016	Survey	2	7/31	–
Fure's Portage Trail	Within Park Boundary	2016 / 2016	Survey	3	9/6	–
Battle River	Within Park Boundary	2016 / 2016	Treatment	1	7/7	CD
Kulik Lodge	Within Park Boundary	~ / ~	Survey	1	7/6	CD, CP
Kulik Lodge Airstrip	Within Park Boundary	2012 / ~	Survey	1	7/6	–

¹ Species codes used: CC= common chickweed (*Stellaria media*), CD= common dandelion (*Taraxacum officinale ssp. officinale*), CP= common plantain (*Plantago major*), FB= foxtail barley (*Hordeum jubatum*), NH= narrowleaf hawkbeard (*Hieracium umbellatum*), OD= oxeye daisy (*Leucanthemum vulgare*), MC= mouse-ear chickweed (*Cerastium fontanum*), PK= prostrate knotweed (*Polygonum aviculare*), SM= scentless false mayweed (*Tripleurospermum inodurum*), SP= shepherd's purse (*Capsella bursa-pastoris*), SS= sheep sorrel (*Rumex acetosella*)

² NPS Administered area outside of the park boundary

Table 4 (continued). 2017 Field Work Summary.

Site	General Location	Last Surveyed /Treated	2017 Site Visit Information			
			Survey or Treatment	Visit #	Visit Date	Invasive Plants
Kulik Lake, East Shore	Within Park Boundary	~ / ~	Survey	1	7/6	–
Kulik Lake, East Shore	Within Park Boundary	~ / ~	Survey	2	7/28	–
VRAA Housing	Within Park Boundary	2016 / 2016	Survey	1	6/16-6/23	SP
VRAA Housing	Within Park Boundary	2016 / 2016	Treatment	2	8/7-8/10	SP
Brooks Lake Side	Within Park Boundary	2016 / 2016	Treatment	1	6/16-6/23	CD, SP, MC
Brooks Lake Side	Within Park Boundary	2016 / 2016	Treatment	2	8/7-8/10	CD, SP, MC, CP
Contact Creek Airstrip	Within Park Boundary	~ / ~	Survey	1	7/27	–
Kamishak River	Within Park Boundary	~ / ~	Survey	1	7/28	–
Amalik Bay	Within Park Boundary	2016 / ~	Survey	1	7/29	–
American Creek	Within Park Boundary	2016 / ~	Survey	1	8/1	–
Grosvenor Lodge	Within Park Boundary	2016 / 2016	Treatment	1	8/1	CD, CP, SP
Grosvenor Lodge	Within Park Boundary	2016 / 2016	Treatment	2	9/6	CD
Hammersly Lake	Within Park Boundary	2016 / ~	Survey	1	8/2	
BC Maintenance Yard	Within Park Boundary	2016 / 2016	Treatment	1	6/20	SP
BC Maintenance Yard	Within Park Boundary	2016 / 2016	Treatment	2	8/9	SP, PK
5-Mile Gravel Pit	Within Park Boundary	2016 / 2016	Treatment	1	8/8	SP, NH, FB, CP
Nonvianuk Ranger Cabin	Within Preserve Boundary	2016 / 2016	Treatment	1	7/5	CD
Nonvianuk Ranger Cabin	Within Park Boundary	2016 / 2016	Treatment	2	8/31	CD
Royal Wolf Lodge	Within Preserve Boundary	~ / ~	Survey	1	7/5	
Crosswinds Lake	Within Preserve Boundary	2016 / ~	Survey	1	7/28	
Funnel Creek	Within Preserve Boundary	2015 / ~	Treatment	1	8/27	PK

¹ Species codes used: CC= common chickweed (*Stellaria media*), CD= common dandelion (*Taraxacum officinale ssp. officinale*), CP= common plantain (*Plantago major*), FB= foxtail barley (*Hordeum jubatum*), NH= narrowleaf hawkbeard (*Hieracium umbellatum*), OD= oxeye daisy (*Leucanthemum vulgare*), MC= mouse-ear chickweed (*Cerastium fontanum*), PK= prostrate knotweed (*Polygonum aviculare*), SM= scentless false mayweed (*Tripleurospermum inodorum*), SP= shepherd's purse (*Capsella bursa-pastoris*), SS= sheep sorrel (*Rumex acetosella*)

² NPS Administered area outside of the park boundary

Katmai National Park

Brooks Camp

The Brooks Camp Developed Area (BCDA), spanning the length of the Brooks River between Lake Brooks and Naknek Lake, is the most frequently visited area of Katmai. Visitors from across the world come to Brooks Camp for its world famous bear viewing and fishing opportunities, as well its proximity to the Valley of Ten Thousand Smokes (VTTS). Brooks Camp's high visitation also means that it has substantially more invasive plants than any other area within KATM. As a result, the BCDA has been a focal point of EPMT efforts each season (Figure 4). The most common invasive plants found at Brooks Camp include: *Taraxacum officinale* ssp. *officinale* (Common dandelion), *Capsella bursa-pastoris* (Shepherd's purse), *Plantago major* (Common plantain), *Polygonum aviculare* (Prostrate knotweed), and *Cerastium fontanum* (Mouse-ear chickweed). Other common, but low priority exotics include *Matricaria discoidea* (Pineapple weed) and *Poa annua* (Annual bluegrass).



Figure 4. Members of an SCA trail crew removing common plantain from Park Avenue at Brooks Camp (NPS).

Brooks Camp Campground and Dumpling Mountain Trail

The Brooks Camp campground provides the only developed camping in KATM, occupying approximately 2.5 acres at the northeast end of Brooks Camp. The campground also marks the starting point of the Dumpling Mountain trail. In previous years, the campground was found to have a considerable amount of common dandelion and common plantain. Unexpected delays meant that the campground was not visited until late June, when the grass was already five to six feet tall. All dandelions found were chemically treated with Milestone herbicide, but no other species were visible through the tall grass.

The extent of the Dumpling Mountain trail, which is approximately four miles one way, was surveyed by the EPMT in late June and early August. Common dandelions were found and manually removed near the start of the trail, but the common plantain that had been noted in previous years was not discovered. While it is possible the absence of plantain means they were all successfully

removed, it is more likely that the overgrown trail obscured any that remained. The trail was brushed by the maintenance crew at the end of the season, and should be revisited next year.

Employee Facilities

The northern end of Brooks Camp contains various employee facilities, including housing cabins, a recreation room, and maintenance facilities. This area has been repeatedly surveyed and treated for invasive plants over the years, with the most common found being common dandelion, common plantain, and shepherd's purse. This year, the area was surveyed and treated in late June by the EPMT, and again in early August with the help of a six person SCA trail crew (Figure 4). As in previous seasons, common dandelion, common plantain, and shepherd's purse were found sporadically throughout the area. A new, albeit small, infestation of common dandelion was found on the south side of the incinerator building, which was mapped and chemically treated. Another small, but dense patch of common dandelion near the gravel pile behind the recreation cache was manually removed by the SCA crew.

Visitor Areas

Areas of Brooks Camp open to visitor use include the Visitor Center and picnic area, auditorium, Brooks Lodge, and the Cultural Site. Common dandelion, shepherd's purse, and common plantain were found scattered throughout the area, as with the rest of the BCDA. Limited time at Brooks Camp this season hindered the ability of the EPMT to consistently monitor old problem sites, but most infestations were found to have substantially decreased from past years. The cultural site, previously home to a dense dandelion infestation, turned up less than ten dandelions on each visit. Additionally, individual dandelions and shepherd's purse were found along camp trail and lawn areas surrounding Lodge cabins. Conducting at least one multi-day trip to Brooks per month would allow for more consistent monitoring and treatment in the future.

Mouth of Brooks River

The mouth of the Brooks River is a highly trafficked area that is used by visitors to access bear viewing platforms, as well as by NPS staff to access park boats and the VTTS Road. The area known as the "spit" is home to the densest infestation of shepherd's purse at Brooks Camp, and flooding in 2016 prevented significant treatment (Devries and Zampieri, 2016). Limited time spent in the BCDA this year meant that this area was a priority, as its location gives invasive plants easy opportunities to travel to other areas of the park. The Spit and Spit Road were mapped and manually treated in June, and revisited with the SCA trail crew in August. All visible shepherd's purse was removed from the Spit with the SCA crew's help, taking eight people approximately 10 hours to complete. In addition to shepherd's purse, *Polygonum aviculare* and small amounts of *Cerastium fontanum* were found on the Spit Road in August. The *P. aviculare* infestation appears to have grown substantially from previous years, and should be a priority for late season treatment next year.

On the north bank of the river (camp side), there is a significant infestation of shepherd's purse immediately to the right of the bridge on what is informally referred to as the "closed trail" (Figure 5). This location is a hub for bear activity throughout the season, making complete treatment at one time difficult. This year, NPS Bear Technician Tammy Carmack and volunteer Allegra Sandstrom

spent a significant amount of time pulling Shepherd's purse in this area, making a complete manual treatment possible when the EPMT visited in June and August.



Figure 5. (Front to back) J. Westbrook, S. Caron, and A. Sandstrom pulling shepherd's purse on the closed trail (NPS).

On the beach nearby, at an area referred to by rangers as the “lagoon”, another small infestation of *P. aviculare* was discovered by the EPMT. Again, bear activity made treatment impossible while at Brooks Camp. This area should be a priority to be opportunistically treated as bear activity allows.

Brooks Falls Trail

The Brooks Falls Trail originates on the VTTS Road, stretching just over a half mile to the bear viewing platforms at Brooks Falls. This is the most popular site at Brooks Camp, and sees heavy visitor use throughout the season. Despite a large infestation of shepherd's purse underneath the Falls platform, the trail has remained largely free of invasive plants. This year, we found fewer than ten individual shepherd's purse plants on each of our visits. Unfortunately, we were not at Brooks Camp at a time when the infestation below the platform could be treated, as the area is closed from June 15th to August 15th.

Lake Brooks Side

The Lake Brooks side of Brooks Camp 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 Brooks Camp, 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. They were mapped and manually removed.

Valley of Ten Thousand Smokes

The Valley of Ten Thousand Smokes is an ashen, mountainous landscape left behind by the 1912 eruption of the Novarupta volcano. The VTTS is accessible by a 23-mile road from Brooks Camp known as the Valley of Ten Thousand Smokes Road (VTTSR). During the summer, Brooks Lodge

runs daily bus trips to the VTTS to give visitors the opportunity to see the Three Forks Visitor Center and hike the Ukak Falls trail.

Valley of Ten Thousand Smokes Road

The VTTSR stretches 23 miles from the Brooks River to the Three Forks Visitor Center. The road is frequently used by NPS and Brooks Lodge staff to access the VTTS, as well as various stops along the way. The entire road has been surveyed by past EPMTs, with isolated patches of exotic plants found throughout. Invasive plants have most commonly been found growing along the side of the road between the mouth of the Brooks River and the Valley Road Administrative Area (VRAA), approximately one mile up the road. This year, the EPMT documented and manually treated scattered shepherd's purse, common plantain, common dandelion, and mouse-ear chickweed in this area. The road was further surveyed as far as the Margot Falls trail, with stops at the Research Bay overlook and a maintenance pullout approximately two miles from the start of the road (Figure 6). The pullout yielded a single shepherd's purse and no invasive plants were found on the trails at Research Bay and Margot Falls.



Figure 6. View of Margot Creek from a popular overlook (NPS).

Other locations beyond the first river crossing were not visited this year, as timing did not allow the EPMT to be trained on driving the park vehicle through the VTTSR's three river crossings. A more complete survey of the road should be a priority next season.

Valley Road Administrative Area

The VRAA is located approximately 1.5 miles up the VTTSR from the mouth of the Brooks River, and is home a large maintenance shop and newly constructed employee housing. In the past, shepherd's purse and pineapple weed have been documented in the housing area. This year, bear technician Tammy Carmack indicated that she had pulled various individual shepherd's purse in the area, but they were not recorded with the other EPMT data. As with most disturbed areas in Brooks Camp, pineapple weed is scattered throughout and is a low priority for treatment. The nearby maintenance yard was surveyed and treated twice, in June and again in August. There were several

small infestations of shepherd's purse on either side of the fence around the yard. They were successfully pulled. The infestation of prostrate knotweed noted by the 2016 EPMT was discovered again in August and pulled with the help of the SCA trail crew.

5-Mile Gravel Pit

All gravel used as fill for construction projects in the BCDA is taken from the 5-Mile Gravel Pit along the VTTSR. This site is frequently disturbed and has naturally become a prime location for invasive plants. The pit is surveyed and treated each year, and remains a priority for the EPMT as plants found there can be easily transported to other areas of the BCDA. This year, the EPMT surveyed and treated the entirety of the pit with the help of the SCA crew and NPS Science Communicator Clint Augustson in August (Figure 7). As in previous seasons, shepherd's purse, common plantain, and *Crepis tectorum* (narrowleaf hawksbeard) were found and removed. A small and previously undocumented patch of *Hordeum jubatum* (foxtail barley) was documented and manually removed. This area will continue to change as gravel is taken in and out, which will necessitate regular visits by future EPMTs.



Figure 7. SCA trail crew members and NPS Science Communicator Clint Augustson (right) display invasive plants removed from the 5-Mile gravel pit (NPS).

Naknek Lake

Naknek Lake is accessible by road from King Salmon and provides 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 Lake. Being that it is the only part of KATM accessible by road from King Salmon, Lake Camp serves as the main access point for boats entering the park. The area is used extensively by NPS personnel and visitors throughout the season. In 2016, the EPMT noted dense patches of *Leontodon autumnalis* (fall dandelion) and *Rumex acetosella* (sheep sorrel) growing throughout the property. The fall dandelion was treated in the past and was not noted this

year. However, sheep sorrel has proven difficult to eradicate as it does not respond well to manual or chemical control. This season, the sheep sorrel was found to cover a large portion of both upper and lower parking areas. Figuring out a more effective treatment for the sheep sorrel here should be a priority.

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. The cabin can be reserved and is frequently used by visitors seeking to complete the Savinoski Loop, which involves portaging across a 1.5 mile trail from the Bay of Islands to Lake Grosvenor. Past invasive plant surveys of the area surrounding the cabin have turned up shepherd's purse, mouse-ear chickweed, pineapple weed, and annual bluegrass. In 2016, common dandelion remained the only invasive plant noted, which was true again this year. The EPMT visited Fure's three times to spray common dandelion, and found that the infestation had been substantially reduced (Figure 8). On all three occasions, less than one gallon of herbicide mix was needed to complete treatment. The area should continue to be a priority however, as visitors frequent the cabin and the potential for the spread of invasive plants will remain high.



Figure 8. S. Caron prepares to perform chemical treatment at Fure's Cabin (NPS).

Margot Creek

The outlet of Margot Creek, in the Iliuk Arm of Naknek Lake, is a popular fishing destination and is frequently visited by Brooks Lodge guests. In the past, shepherd's purse has been found growing along the river bank, but it was not found in 2017. This year, a sizeable infestation of prostrate knotweed was found growing on a gravel bar at the outlet of the creek. The patch of knotweed was discovered while completing an *Elodea* survey in the area. It was mapped but not treated.

Lake Brooks

Lake Brooks lies to the southwest of Brooks Camp, and is another popular destination for visitors and employees. Although a formal survey was not conducted, the EPMT did not notice any exotic

plants during a short recreational visit to the popular campsite at Missy's Island, a small island about a mile from the eastern shore of the lake. *Elodea* was not found during the late August survey.

Lake Grosvenor

2016 marked the first year that the EPMT was given permission to survey and manually remove any invasive plants found at the Grosvenor Lodge, located on the western end of Lake Grosvenor. This year, permission was again granted to map and remove invasive plants, including common dandelion, shepherd's purse, and common plantain. Pineapple weed and annual bluegrass were also present, as noted last season. As these species have been deemed low priority they were not mapped or removed. Boat troubles and scheduling conflicts prevented the EPMT from visiting Grosvenor until early August this season. A second visit in early September turned up a moderate amount of common dandelion, which were manually removed with the help of Southwest Alaska Network Hydro Techs Katie Junghans and Michelle Harrison (Figure 9). Ideally this site should be treated earlier in the season.



Figure 9. SWAN Hydro Techs K. Junghans and M. Harrison pulling common dandelions at Grosvenor Lodge (NPS).

Lake Grosvenor was also surveyed for the aquatic invasive plant *Elodea* with none found.

Lake Coville

The northwest end of Lake Coville by the outlet of American Creek, a popular destination for anglers, was surveyed for *Elodea*. None was found.

Kulik Lake

Kulik Lake is located in the northern region of the park. The Kulik Lodge is located on a private inholding along the Kulik River, which connects Nonvianuk and Kulik Lakes. The EPMT was given permission to survey the Kulik Lodge and airstrip for the first time. There was a dense infestation of common dandelion throughout the lodge property, as well as a significant amount of common plantain along various footpaths. Permission was not given to treat this season, so the area was only mapped. The EPMT also surveyed and mapped the large airstrip maintained by the lodge, where no invasive plants were detected (Figure 10). In the future, it should be a priority to obtain permission to

spray for common dandelion and common plantain on lodge property, ideally before guests begin arriving for the season.

The EPMT was able to conduct a short survey of the shore area on the remote eastern end of Kulik Lake. No invasive plants were detected, and as this area is seldom visited it does not need to be a high priority in future seasons.



Figure 10. View from the Kulik Lodge airstrip (NPS).

Battle River

Battle River is located in the northernmost tip of the park, flowing from Battle Lake to Kukaklek Lake in the preserve. The Battle River Wilderness Retreat, located near the outlet of Battle Lake, is a small private lodge that sees limited visitation. As noted by last years' EPMT, the lodge is home to the densest infestation of common dandelion in the park. The EPMT was given permission to spray for common dandelion again this year, but did not get there until early July. The infestation remained very thick. Two applicators applied 16 gallons of herbicide mix to treat the property. Unfortunately, by the time the EPMT arrived to treat the infestation, most of the common dandelion present had already dropped seed (Figure 11). Additionally, several individual dandelions were observed further downriver towards park property. Early season treatment should be a priority. A mid-season retreatment before guests arrive in August would also be beneficial.



Figure 11. S. Caron recording data for the common dandelion infestation at Battle River Wilderness Retreat (NPS).

Contact Creek

Contact Creek, located in the southwest region of the park, is a fishing destination and contains a small, seldom used airstrip for wheeled plane access. In late July, one member of the EPMT was able to survey the extent of the airstrip. No invasive plants were detected, but this area should be monitored every few seasons as time allows as airstrips are a common vector for invasive plant introduction.

Kamishak River

The Kamishak River flows from the northeast region of the park, through the McNeil River State Game Sanctuary and eventually into Kamishak Bay. In late July, the EPMT was able to conduct a short survey along the riverbank near the park's border with the McNeil River sanctuary. The river is a very popular fishing destination, evidenced by the numerous boats and float planes present during the visit (Figure 12). Time on the ground was limited, but the EPMT detected no invasive plants in the area surveyed. Due to high traffic of sport fishermen, this area should be revisited and surveyed more extensively in the future.



Figure 12. J. Westbrook recording survey data amid tall grass at the Kamishak River (NPS).

American Creek

American Creek is located in the northern region of the park, flowing southwest from Hammersly Lake to Lake Coville. In 2016, the EPMT floated the length of the river, surveying campsites frequently used by rafters and fishermen. This season, only a short survey was conducted at the outlet of the river near Lake Coville, with focus placed on locations along the riverbank used by fishing lodges to store their boats, as these areas were flooded during last year's survey. While the ground was significantly disturbed in the boat launch areas, no invasive plants were detected. This area should continue to be monitored due to the high visitation levels, as well its relative ease of access.

Hammersly Lake

Hammersly Lake is a remote lake in the northern region of the park, immediately to the west of the Walatka Mountains. As American Creek originates at the northern end of Hammersly, it is visited by fishermen and rafters as they begin their journeys down the popular creek. This site was briefly visited again by this year's EPMT, and the shoreline and mouth of American Creek were found to be free of invasive plants.

Outer Coast

Amalik Bay

Amalik Bay is located along the scenic southern region of Katmai's outer coast, and sees significant visitation from boaters throughout the season. Amalik is also home to a NPS ranger cabin, which is staffed periodically during times of expected high visitation. As with past years, the EPMT was able to conduct a short survey in the area immediately surrounding the ranger cabin. No invasive plants were found during the survey, however the KATM coastal biologist noted the presence of what she believed were common dandelions on Little Mink Island. Finding and removing this small infestation should be a priority for the EPMT in coming years, as the island is easily accessible by boat from the ranger cabin. This survey area was not mapped with a GPS device because the battery died.

Katmai National Preserve

Nonvianuk Ranger Cabin

The Nonvianuk ranger cabin is located near the Nonvianuk River just downstream from the outlet of Nonvianuk Lake. The cabin is primarily used by NPS law enforcement rangers as a base from which to patrol the surrounding area. There are a number of small trails in the area immediately surrounding the cabin, which have been surveyed and found to be free of invasive plants in the past. The floatplane drop off location just upriver from the cabin, however, has a well-documented infestation of common dandelion (Figure13). This location was treated with three quarters of a gallon of herbicide mix in early July, and manually treated again in late August as inclement weather prevented spraying. No other invasive plants were detected in the area.



Figure 13. S. Caron conducts chemical treatment for common dandelion along the Nonvianuk River (NPS).

Nonvianuk Lake

Nonvianuk Lake is located along the southern border of the Katmai Preserve, and is a popular destination for anglers. There are numerous private lodges in the area as well as a constant flow of float plane traffic during the summer. In late August, both the east and west ends of the lake were surveyed for the presence of *Elodea*, with none found at either location.

Crosswinds Lake Area

Crosswinds Lake is one of the most visited destinations in KATM due to the world class fishing and bear viewing. This year, the EPMT visited Crosswinds twice. At the end of July the EPMT surveyed the angler trail from Crosswinds Lake to the confluence of Moraine and Funnel Creeks and found no invasive plants. In late August they focused on surveying Crosswinds Lake and Mirror Lake for *Elodea*. *Elodea* was not found. However, two dense infestations of *P. aviculare* were discovered on the bank of Funnel Creek: one at the confluence and the other just upstream. The extent of the infestation was mapped before being manually treated, which took approximately 5 hours for two people to complete. This infestation had not been found in previous years, perhaps owing to the fact that *P. aviculare* tends to flower late in the season. Future EPMTs should plan to revisit the area at least once late in the field season in order to contain the infestation.

Royal Wolf Lodge

The Royal Wolf Lodge is a fishing lodge located on a private inholding along the Nonvianuk River, approximately one mile downstream from the Nonvianuk Ranger Cabin. The EPMT was granted permission to survey the property for invasive plants for the first time. In early July, the EPMT spent approximately three hours surveying, with only pineapple weed found. The area was revisited in late August to survey three small lakes for *Elodea* with none found.

Alagnak Wild River

The Alagnak Wild River refers to a separate NPS unit which comprises 69 miles of the Alagnak River and falls under the administrative responsibilities of KATM. The Alagnak originates at the west end of Kukaklek Lake in the preserve, and flows west into Bristol Bay. As in previous years, the EPMT briefly visited the area to assess an infestation of common dandelion from the boat. The

infestation lies on a private inholding at the confluence of the Alagnak and Nonvianuk Rivers, and permission has not been obtained to enter the property. Common dandelion appears to cover approximately 80% of the ground (Figure 14).



Figure 14. A view of the thick dandelion infestation at the confluence of the Nonvianuk and Alagnak rivers (NPS).

Bristol Bay Borough

The Bristol Bay Borough includes the towns of Naknek, South Naknek, and King Salmon. The Borough's only commercial airport is located in King Salmon. Most visitors to Katmai arrive there before continuing into the park via floatplane. King Salmon also houses KATM's headquarters and serves as the launch point for field operations throughout the park. The area is a significant potential seed source for spread of invasive plants into the park.

NPS Administered Properties

Survey and control work on NPS administered properties outside the park boundary took place in the area surrounding the NPS dormitory and housing, maintenance shop, and warehouse. The dormitory lawn has a significant infestation of common dandelion. The maintenance shop was found to have common dandelion, shepherd's purse, sheep sorrel, and narrowleaf hawksbeard scattered throughout the yard. All invasive plants found in the maintenance yard were manually controlled. Milestone herbicide was used in late May to treat the dandelion infestation around the dormitory buildings. Consistent high use of the area made further treatments difficult. Future EPMTs should consult with staff living in the area to determine the best time to treat the dormitory lawn.

Non-NPS Administered Properties

This year, the only survey on non-NPS property in the King Salmon area was conducted along the Alaska Peninsula Highway, where a small infestation of *Vicia cracca* had been noted by previous EPMTs. The infestation was still present and was mapped but not treated as the NPS does not have jurisdiction here. Monitoring should be continued.

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. This applies to the community in King Salmon, visitors from all over the world, and all NPS employees that enter the park.

The 2017 EPMT manned a table at the Fishtival Bazaar, an annual event celebrating the end of commercial salmon fishing season. Here, the EPMT was able to educate members of the community about invasive plants, including the dangers they pose and how to prevent their spread (Figure 15). Invasive plant guides were also printed and distributed to interpretive rangers at Brooks Camp to aid in their ability to report new infestations.



Figure 15. S. Caron and J. Westbrook tabling at the Fishtival Bazaar.

Prevention and Restoration

The most effective form of invasive plant control is prevention. Identifying sources and vectors of invasive plant seeds can save an enormous amount of time and money if they can be mitigated before the plants enter the park. Previous EPMTs have installed boot brushes and inspected heavy machinery before park entry to prevent the transport of seeds. Restoration of disturbed areas is another way to prevent establishment of invasive plants. At Brooks Camp, ongoing construction requires ongoing revegetation and restoration. Although restoration projects have not been routinely carried out at KATM after construction, some revegetation was attempted in 2013 by distributing seeds in disturbed areas (Connealy and Parker, 2013). No projects have been carried out since. A seed bank has been established at KATM, with contributions from 2013 through 2016, and consists of seeds from *Calamagrostis canadensis* (blue-joint grass), *Achillea millefolium* (yarrow), *Epilobium angustifolium* (fireweed), and *Geum macrophyllum* (large-leaf avens) collected in KATM. Construction associated with new housing in the VRAA and the upcoming Brooks River bridge project will necessitate revegetation and restoration efforts on the part of the EPMT.

Phenology

Plant phenology is important to consider for effective management of invasive plants. Knowledge of plant lifecycles and timing can be helpful for scheduling control efforts. Ideally infestations should be treated before the plants go to seed. Phenology is likely to vary from year to year as it is

dependent on environmental conditions, which are highly variable. Many of the invasive plants within KATM tend to flower as early in the season as May or June, including common dandelion, sheep sorrel, and shepherd's purse. This should be considered when planning and scheduling control work in the more highly infested areas like Brooks Camp. At KATM, limited visits to backcountry locations makes determining exact dates of first flower or seed very difficult. Phenology stages and dates of observation for 2017 were consistent with the general phenology trends noted in Table 5.

Table 5. Observed phenology by location for the 2017 field season

Location	Taxon	1st Visit		2nd Visit		3rd Visit	
		Date Observed	Phenology	Date Observed	Phenology	Date Observed	Phenology
King Salmon Dormitory	<i>Taraxacum officinale</i> ssp. <i>officinale</i>	5/30/2017	In seed	–	–	–	–
King Salmon Maintenance Yard	<i>Taraxacum officinale</i> ssp. <i>officinale</i>	7/19/2017	Rosette	–	–	–	–
	<i>Rumex acetosella</i>	7/19/2017	Full flower	–	–	–	–
	<i>Crepis tectorum</i>	7/19/2017	Full flower	–	–	–	–
Lake Camp	<i>Rumex acetosella</i>	6/7/2017	Full flower	7/21/2017	In seed	–	–
Brooks Camp	<i>Taraxacum officinale</i> ssp. <i>officinale</i>	6/16/2017	In seed	8/7/2017	Rosette	–	–
	<i>Capsella bursa-pastoris</i>	6/16/2017	In seed	8/7/2017	Standing dead	–	–
	<i>Plantago major</i>	8/7/2017	In seed	–	–	–	–
	<i>Cerastium fontanum</i>	8/7/2017	Full flower	–	–	–	–
	<i>Polygonum aviculare</i>	8/9/2017	Full flower	–	–	–	–
Lake Brooks Housing	<i>Taraxacum officinale</i> ssp. <i>officinale</i>	6/20/2017	Full flower	–	–	–	–
	<i>Capsella bursa-pastoris</i>	6/20/2017	In seed	8/9/2017	In seed	–	–
	<i>Plantago major</i>	8/9/2017	In seed	–	–	–	–
Valley of Ten Thousand Smokes Road	<i>Capsella bursa-pastoris</i>	6/20/2017	In seed	8/9/2017	Standing dead	–	–
	<i>Plantago major</i>	8/6/2017	In seed	–	–	–	–
	<i>Cerastium fontanum</i>	6/22/2017	Full flower	–	–	–	–
Valley Road Administrative Area	<i>Capsella bursa-pastoris</i>	6/20/2017	In seed	8/9/2017	Standing dead	–	–
	<i>Polygonum aviculare</i>	8/9/2017	Full flower	–	–	–	–
5-Mile Gravel Pit	<i>Capsella bursa-pastoris</i>	8/8/2017	In seed	–	–	–	–
	<i>Crepis tectorum</i>	8/8/2017	In seed	–	–	–	–
	<i>Plantago major</i>	8/8/2017	In seed	–	–	–	–
	<i>Hordeum jubatum</i>	8/8/2017	In seed	–	–	–	–
Fure's Cabin	<i>Taraxacum officinale</i> ssp. <i>officinale</i>	6/30/2017	In seed	7/31/2017	Rosette	9/6/2017	Rosette
Margot Creek	<i>Polygonum aviculare</i>	8/15/2017	Full flower	–	–	–	–
Battle River Wilderness Retreat	<i>Taraxacum officinale</i> ssp. <i>officinale</i>	7/7/2017	In seed	–	–	–	–

Table 5 (continued). Observed phenology by location for the 2017 field season

Location	Taxon	1st Visit		2nd Visit		3rd Visit	
		Date Observed	Phenology	Date Observed	Phenology	Date Observed	Phenology
Kulik Lodge	<i>Taraxacum officinale</i> ssp. <i>officinale</i>	7/6/2017	In seed	–	–	–	–
	<i>Plantago major</i>	7/6/2017	Full flower	–	–	–	–
Grosvenor Lodge	<i>Taraxacum officinale</i> ssp. <i>officinale</i>	8/1/2017	Rosette	9/6/2017	Rosette	–	–
	<i>Capsella bursa-pastoris</i>	8/1/2017	In seed	–	–	–	–
	<i>Plantago major</i>	8/1/2017	In seed	–	–	–	–
Funnel Creek	<i>Polygonum aviculare</i>	8/27/2017	Full flower	–	–	–	–
Nonvianuk River Outlet	<i>Taraxacum officinale</i> ssp. <i>officinale</i>	7/5/2017	In seed	8/31/2017	Rosette	–	–

Recommendations for the NPS and 2018 Field Season

Early in the season when things are slow use your time to study for and take the test to become a certified herbicide applicator for the State of Alaska. Although you can spray under the direct supervision of someone who is licensed, it would be advantageous to have more licensed applicators available.

If possible, treat the dandelion infestation on the dorm lawn in early May. By mid-May they were all blooming and by the time we returned from training in Anchorage in late May several had already gone to seed. Be sure to post proper signage and let park employees know well before the treatment.

Talk to the USFWS about their plans to treat the orange hawkweed infestation at the Ugashik Narrows and see what kind of NPS assistance they would like. The Orange hawkweed infestation went untreated this year and was very dense in 2016.

Prioritize a trip to the Crosswinds Lake area later in the season to monitor the prostrate knotweed infestation found there. Plan at least two full days there to allow for a thorough survey of the confluence area.

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.

While at Brooks Camp later in the season, plan to spend a day at the Margot Creek outlet pulling the prostrate knotweed infestation and carefully surveying the surrounding area to ensure it does not spread. Boat transportation will need to be arranged to get from Brooks Camp to Margot.

See about doing a brief presentation on the most common invasive plants in Katmai during the training period for the Interpretive Rangers.

Begin creating/gathering educational materials for any outreach opportunities. The King Salmon VC does weekly educational programs for kids and will work with you to schedule a day for an activity. If your field season allows for it, plan on attending Fishtival. The Bazaar takes place at the school in Naknek and is a great way to connect with the locals.

Think about most effective ways to educate visitors to the park regarding invasive plants and their spread. Consider talking to lodges and float plane offices about posting signs where visitors might see them.

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

Make sure the appropriate people at the Department of Transportation know about the *Vicia cracca* along the Alaska Peninsula Highway.

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.

Maintain a relationship with Royal Wolf Lodge and Kulik Lodge. Although all we found at Royal Wolf was pineapple weed it should continue to be surveyed. See about getting Kulik Lodge to let you conduct chemical treatments as their lawns were heavily infested with dandelions and some of the paths had a fair amount of common plantain.

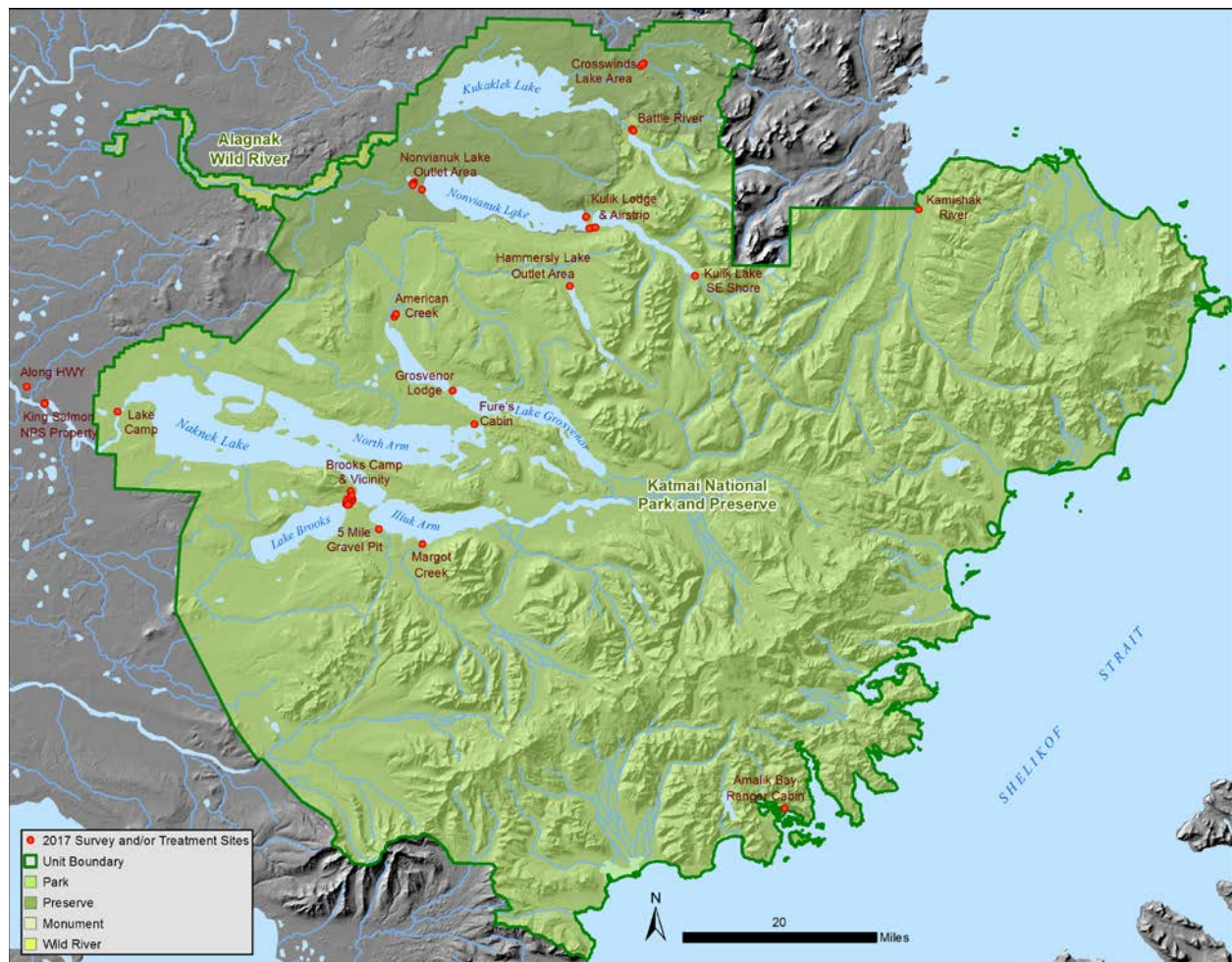
Continue attempting to establish relationships with private fishing lodges that have not been contacted to obtain permission to survey for invasive plants on their land.

Try and coordinate with NPS maintenance staff so that you can inspect and clean off any equipment before it is taken into the Park.

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Appendix A: Map of 2017 Survey and Treatment Sites



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

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