



Invasive and Exotic Species Management for Katmai National Park & Preserve

2010 Summary Report

Natural Resource Data Series NPS/KATM/NRDS—2010/107



ON THE COVER

Left: Fall dandelion (*Leontodon autumnalis*). Upper Right: SAGA crew member pulling sheep sorrel (*Rumex acetosella*).

Lower Right: Common dandelion (*Taraxacum officinale* ssp. *officinale*) at Fure's Cabin.

Photographs by: Crystal Shepherd and Devin Bartley

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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.

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Contents

	Page
Figures.....	v
Tables.....	v
Abbreviations.....	vi
Abstract.....	vii
Introduction.....	1
Invasive Species History at Katmai National Park & Preserve.....	1
Significance and Status of Invasive Species in the Park.....	2
Methods.....	3
Results.....	5
Highlights and Observations, 2010.....	5
Brooks Camp.....	7
<i>Brooks Lodge</i>	7
<i>Cultural Center</i>	8
<i>Brooks Camp Campground</i>	8
<i>Brooks Camp – South Side</i>	9
<i>Brooks Falls Trail and Platforms</i>	9
Valley of 10,000 Smokes Road.....	10
<i>Gravel Pit</i>	10
Lake Camp.....	11
Rest of Katmai.....	11
<i>Fure’s Cabin</i>	11
<i>Nonvianuk Ranger Cabin</i>	12
<i>Jojo Lake</i>	13

<i>Outer Coast</i>	13
<i>Kulik, Katmai, and Grosvenor Lodges</i>	13
King Salmon	13
Aniakchak National Monument & Preserve.....	14
Education and Outreach.....	15
<i>Fishtival</i>	15
<i>Invasive Species Posters</i>	15
Recommendations for the 2011 Field Season.....	17
Staffing	17
Volunteers.....	17
Phenology	17
Suggested Schedule	18
Disposal Methods	18
Literature Cited.....	19
Appendix A – Maps	21
Appendix B – Bristol Bay’s Most Wanted Posters.....	37

Figures

	Page
Figure 1. A map of the Katmai National Park & Preserve.	1
Figure 2. The Brooks Camp Developed Area.	2
Figure 3. SAGA crew treating common dandelion at the fish-freezing building.	7
Figure 4. SAGA crew removing common dandelion at the Brooks Camp Cultural Center.	8
Figure 5. EPMT crew member, Devin Bartley, prepares to retreat bird vetch.	10
Figure 6. EPMT crew member, Crystal Shepherd, points out a single narrowleaf hawksbeard at the Gravel Pit.	10
Figure 7. Common sheep sorrel at Lake Camp.	11
Figure 8. Common dandelion in the lawn at Fure’s Cabin.	11
Figure 9. Common dandelion growing along the Nonvianuk River.	12
Figure 10. Native dandelion (<i>Taraxacum officinale ssp. cerataphorum</i>) at Grosvenor Lake.	13
Figure 11. Common dandelion along the Aniakchak River. Photo by Tina Boucher.	14
Figure 12. SAGA crew volunteers, happy after removing shepherd’s purse from the closed bridge trail.	17

Tables

	Page
Table 1. Annual summary of Katmai National Park & Preserve Exotic Plant Management.	5
Table 2. Invasive plant species observed during the 2010 EPMT field season.	6

Abbreviations

AKNHP	Alaska Natural Heritage Program
ANIA	Aniakchak National Monument & Preserve
BCDA	Brooks Camp Developed Area
EPMT	Exotic Plant Management Team
GPS	Global Positioning System
KATM	Katmai National Park & Preserve
NPS	National Park Service
PUC	Public Use Cabin
SAGA	Southeast Alaska Guidance Association
SCA	Student Conservation Association
VTTS	Valley of Ten Thousand Smokes

Abstract

Though prior invasive plant control and survey work has occurred in Katmai National Park & Preserve, 2010 is the first year that monitoring and control work was executed according to the standardized Alaska Exotic Plant Management Team protocols. Invasive plant survey and management projects were focused in the Brooks Camp Developed Area, Lake Camp, the Valley of 10,000 Smokes Road and Fure's Cabin. Sites that were newly surveyed this year include: Nonvianuk Lake, Jojo Lake, Dumpling Mountain, Margot Falls and Katmai Bay. A total of more than 1,400 pounds of invasive plants were removed from the park throughout the summer. Because of its remote location in Southwest Alaska, visitation to Katmai is relatively low and isolated to only a few locations. Because of the small extent of invasive species at Katmai, continued monitoring and control efforts in coming years will likely prevent invasive plants from spreading outside of the most highly disturbed areas in the park. Proposed construction activities around Brooks Camp serve as significant near term threats to the integrity of the native plant community, particularly if preventative and restorative actions are not taken.

Introduction

Invasive Species History at Katmai National Park & Preserve

Monitoring and control of invasive plant species has been performed with varying intensity in Katmai National Park & Preserve (KATM) since 2004 (Fig. 1). Beyond initial baseline surveys for invasive species performed in 2004 and 2005 (Bauder and Heys 2005), limited volunteer control work was performed by the park in 2006 and 2007 and by a Tribal Civilian Community Corps group in 2007 (Rapp 2008). Southeast Alaska Guidance Association (SAGA) AmeriCorps crews performed control work with minimal supervision at Brooks Camp in 2008 and 2009 (KATM, Mike Fitz, personal comm.) and returned again in 2010 to assist in treating both Brooks Camp and Lake Camp. The Alaska Exotic Plant Management Team (EPMT) operated for the first season in 2010 at KATM. Their efforts have marked the first season that inventory, monitoring and control work were performed according to regional standards.

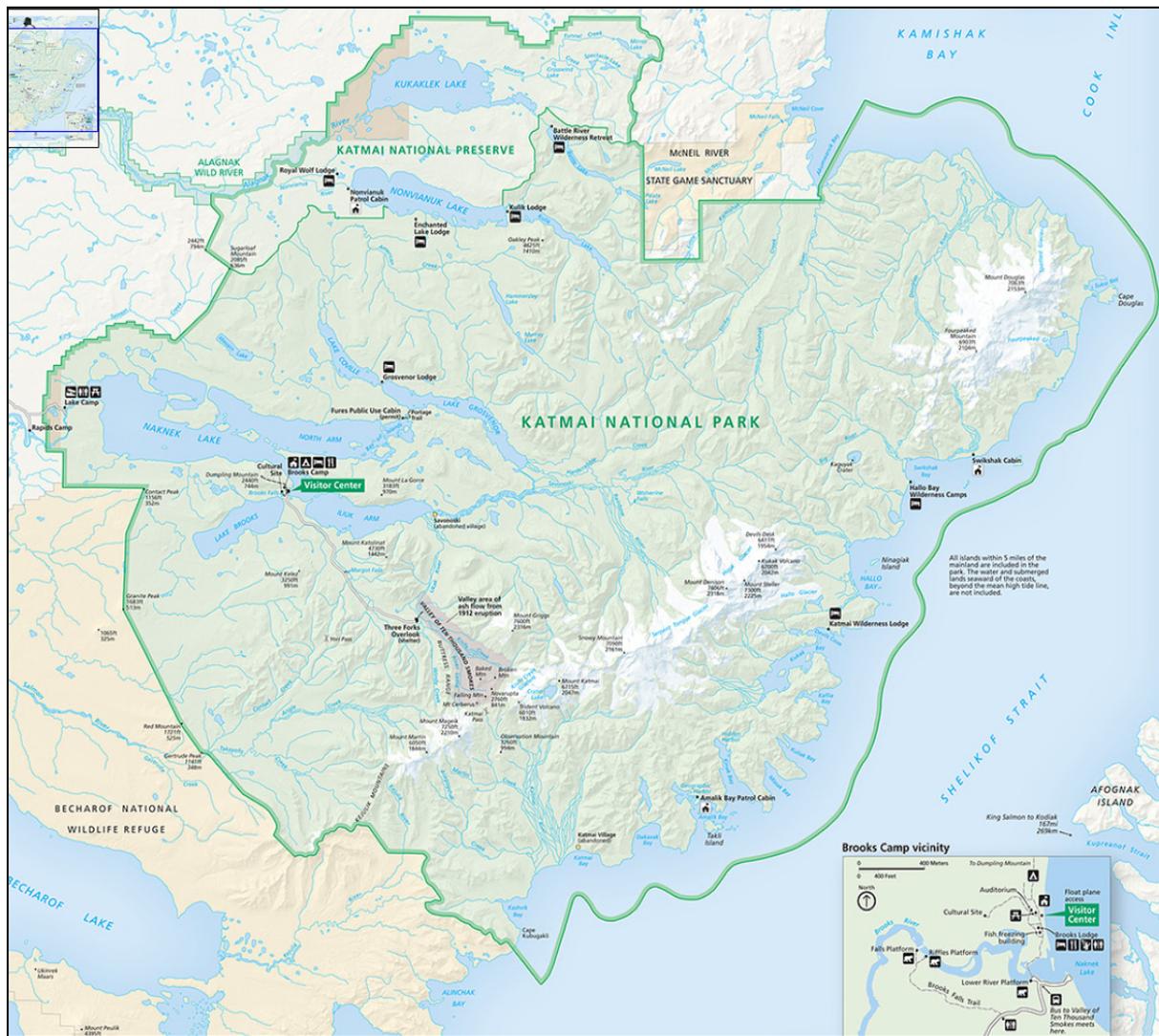


Figure 1. A map of the Katmai National Park & Preserve.

Significance and Status of Invasive Species in the Park

At KATM, invasive plants are introduced from locations outside the park by a variety of means. Seeds and plant materials attach to outdoor gear, boats, vehicles, construction materials and equipment and are then carried into the park. These invasive plants have evolved in different landscapes than KATM, and lack the competitive influences and pathogens that normally limit their growth in their native environments (Ruesnik et al. 1995). Invasive plants are of great concern to the park because they have the ability to out-compete native flora and reduce ecological diversity (Bryson and Carter 2004). Invasive plants also have the ability to hybridize with native plants, reducing their genetic integrity (D'Antonio et. al 2001). KATM's most heavily trafficked areas are especially vulnerable to the introduction of invasive plants because of the broad spectrum of seeds potentially carried in by visitors from around the world. The Valley of 10,000 Smokes is also susceptible due to massive devegetation caused by the 1912 eruption of Novarupta. This event has created an environment where the introduction of invasive species could alter natural successional processes.

Currently, no sizeable infestations of invasive plants have been detected far beyond anthropogenically disturbed locations. This provides a great opportunity to utilize the EPMT rapid response protocol to eradicate new infestations as soon as they are identified and before they spread to undisturbed areas. Typically, introductions of invasive plant species into a new environment have a varying lag time before they become invasive (Bryson and Carter 2004). However, invasive plants are also often the first colonizers of disturbed sites. The early stages of plant introduction are the most important stages for control work because of the potential for relatively easy eradication or containment of infestations. As the size of the infested area increases, the likelihood of eradication gets smaller (Rejmanek and Pitcairn 2002). Thus, the relatively small infested acreage at KATM currently justifies elevated control efforts. Because of increased construction activity in the Brooks Camp Developed Area (BCDA) in coming years (Moore 2010) this area will require intensive monitoring efforts and justify the reduction of current infestations which have potential to spread via heavy equipment and within disturbed soils (Fig. 2).



Figure 2. The Brooks Camp Developed Area.

In 2010 the EMPT identified 10 different invasive plant species growing in KATM. Since thorough surveying of KATM has not occurred since 2005, the data gathered from this year will serve as an important baseline for future monitoring. Although King Salmon, the primary entry point into KATM, lies outside of the park boundaries, the invasive species found there are of key concern. In 2010, the EMPT found 8 additional invasive plant species at National Park Service (NPS) housing and office facilities located in King Salmon that could serve as a future vector into the park.

Methods

All invasive species survey and control work performed at KATM was completed according to standard EPMT data collection protocol (Million & Rapp, 2010). Treatment and control work was completed manually. Data was collected using a Trimble GeoExplorer 2008 Series GeoXT global positioning system (GPS) unit loaded with a standardized EPMT data dictionary specific to KATM.

For the logistical purposes of this program, KATM is separated into three regions: the BCDA and Valley of Ten Thousand Smokes (VTTS) Road, Lake Camp, and the rest of the park. Controlling and monitoring was focused primarily in the most heavily visited and infested Brooks Camp area and took place during multiple visits throughout the season. Lake Camp, though easy to access, received less attention than Brooks Camp due to its peripheral location in the park, a relatively low count of invasive species variants and likelihood for little headway to be made at control or eradication. Although the EPMT was not able to survey the coastal region of the park as fully as planned, the team did expand previously mapped areas of the park to include Fure's Cabin, Dumpling Mountain, Margot Falls, Jojo Lake and Nonvianuk Lake.

Fieldwork at KATM took place from June to September 2010, following the EPMT staff training in Anchorage. Most field work was completed solely by Crystal Shepherd (Student Conservation Association (SCA) Intern/NPS) and Devin Bartley (SCA Intern/NPS), with the exception of assistance received from Whitney Rapp, EPMT Coordinator, and Ruth Rojas, a Law Enforcement Ranger intern, at Fure's Cabin in June. Also in June, an AmeriCorps SAGA crew of 10 contributed their efforts at Brooks Camp and Lake Camp for a total of 680 volunteer hours.

Results

Highlights and Observations, 2010

- Over 1,400 pounds of weeds were removed from KATM due to the efforts of the EPMT.
- More than 95% of the common dandelion (*Taraxacum officinale* ssp. *officinale*) population at Brooks Camp was not allowed to go to seed
- One new species, fall dandelion (*Leontodon autumnalis*), was discovered in the park this year
- Previously observed infestation of white clover (*Trifolium repens*) were not found this year in Brooks Camp
- Common plantain (*Plantago major*) population greatly reduced along Windy Creek Trail
- The Katmai EPMT organized and presented information and games on invasive plant species identification to community members at Fishtival, an end of salmon season celebration festival in Naknek, AK

Table 1. Annual summary of Katmai National Park & Preserve Exotic Plant Management.

Year	EPMT Personnel		Volunteers		Total Person Field Hours	Invasive GPS Data NPS Lands(non-NPS lands)			New Spp.
	# pers.	Field Hours	# pers.	Field hours		Species Acres Surveyed	Species Acres Infested*	Acres Treated	
2005	2	91	-	-	91	174.325 (37.507)	6.622 (0.012)	0.076	9
2007	1	35	6	192	227	5.198	0.526	0.495	-
2008	1	64	8	240	304	6.112	0.495	0.495	-
2009	1	27	8	56	83	3.071	0.631	0.083	1
2010	2	694	8	640	1,334	105.959 (14.527)	14.417 (0.292)	7.464 (0.276)	3

* Acres infested are calculated by acres mapped times the percent cover in areas greater than 0.5 acres. If under 0.5 acres, acreage mapped is counted as 100%.

Table 2. Invasive plant species observed during the 2010 EPMT field season.

Species		Inv rank *	KATM						King Salmon, AK							
Latin Name	Common Name		BC DA	VT TS	Lake Camp	Fure's Cabin	Nonv-anuk Cabin	Other	NPS Office	NPS Maint Yard	NPS Housing	FAA ¹ Housing	Air Force Base	US FWS ²	King Ko Inn	Other
<i>Bromus inermis</i>	smooth brome	62	-	-	-	-	-	-	-	-	-	X	-	-	-	X
<i>Capsella bursa-pastoris</i>	shepherd's purse	40	X	X	X	X	-	-	-	X	X	X	-	-	-	-
<i>Caragana arborescens</i>	Siberian peashrub	66	-	-	-	-	-	-	-	-	-	X	-	-	-	-
<i>Crepis tectorum</i>	narrowleaf hawkbeard	54	-	X	-	-	-	-	X	X	-	X	X	X	X	X ³
<i>Galeopsis bifida</i>	split-lip hempnettle	40	-	-	-	-	-	-	-	-	-	-	-	-	-	X ⁴
<i>Hordeum jubatum</i>	foxtail barley	63 ⁵	-	-	-	-	-	-	X	X	-	-	X	-	-	-
<i>Leontodon autumnalis</i>	fall dandelion	-	-	-	X	-	-	-	-	-	-	X	-	-	-	X
<i>Leucanthemum vulgare</i>	oxeye daisy	61	-	-	-	-	-	-	X	-	X	X	-	-	X	X
<i>Matricaria discoidea</i>	pineapple weed	32	X	X	X	-	-	X	X	X	X	X	-	X	X	-
<i>Plantago major</i>	common plantain	44	X	X	-	-	X	X	-	X	-	X	-	-	-	-
<i>Poa annua</i>	annual bluegrass	52	X	-	-	X	-	-	-	-	-	-	-	-	-	-
<i>Polygonum aviculare</i>	prostrate knotweed	45	X	-	-	-	-	-	-	X	-	-	-	-	-	-
<i>Rumex acetosella</i>	common sheep sorrel	51	X	-	X	-	-	-	-	-	X	X	-	X	-	-
<i>Sorbus aucuparia</i>	European mountain ash	59	-	-	-	-	-	-	-	-	-	-	X	-	-	X
<i>Taraxacum officinale ssp. officinale</i>	common dandelion	58	X	-	-	X	X	X	X	-	X	X	X	X	X	X
<i>Tanacetum vulgare</i>	common tansy	57	-	-	-	-	-	-	-	-	-	X ⁶	-	-	-	X ⁷
<i>Trifolium hybridum</i>	alsike clover	57	-	-	-	-	-	-	-	-	-	X	X	-	X	-
<i>Trifolium repens</i>	white clover	59	-	-	-	-	-	-	-	-	X	-	-	-	X	-
<i>Tripleurospermum perforatum</i>	scentless false mayweed	48	-	-	-	-	-	-	X	-	-	-	-	-	-	-
<i>Vicia cracca</i>	bird vetch	73	-	X	-	-	-	-	-	-	-	-	-	-	-	X ⁴

* Invasiveness rankings taken from Carlson et al. 2008.

1-Federal Aviation Administration

2-United States Fish & Wildlife Service

3-found along the Alaska Peninsula Highway

4-found at the King Salmon Lodge

5-Foxtail barley has, until recently, been considered a non-native. However as of 2010 it is being considered as a native to Alaska (AKEPIC 2005).

6-found at West Housing Road

7-found behind the Post Office

Brooks Camp

The most intensively used and visited area in KATM is Brooks Camp. The camp also contains relatively dense and diverse infestations of invasive species. The most common invasive species at Brooks Camp are common dandelion, shepherd's purse (*Capsella bursa-pastoris*), pineapple weed (*Matricaria discoidea*), and common plantain. Other species found at Brooks Camp were: annual bluegrass (*Poa annua*) along pathways and in the campground, common sheep sorrel (*Rumex acetosella*) on "the point" – a stretch of land at the north side of the mouth of Brooks River, and possible prostrate knotweed (*Polygonum aviculare*) around the leach field on the way to Tuckerville as well as on "the point". In 2005, a non-native wormseed mustard (*Erysimum cheiranthoides*) was identified at "the corner" - a bend in the Brooks River just north of the bridge, but the 2010 EPMT determined that it was actually native (*Erysimum cheiranthodes ssp. altum*). The Integrated Taxonomic Information System no longer recognizes a native subspecies; however, several other contemporary botanical treatments do. Common dandelion was found in most of the commonly trafficked areas in the BCDA, with particularly dense and aggressive infestations located in the lawn outside of the cultural center and the lawn on the south side of the fish freezing building (Fig. 3). Dense infestations of common plantain near the Brooks Camp generators and shepherd's purse along the spit road and the closed bridge trail were also found.



Figure 3. SAGA crew treating common dandelion at the fish-freezing building.

Brooks Lodge

Common dandelions are the most noticeable invasive in the mown areas and path edges around Brooks Lodge, the trading post and the Lodge cabins. Pineapple weed was found throughout this area, most commonly on paths and in the lodge lawn where firewood is stored. Patches of common plantain were found near the women's public bathhouse door and at the entrances to bear paths departing from the lodge toward the oxbow. Shepherd's purse, though rarely found in this area in June, was observed by July in large numbers underneath the edges of structures and in dense thickets along the human and bear trails leading to the marsh and oxbow area of Brooks River. All lawn areas around Brooks Lodge seem to have responded well to a multiple visit retreatment method except for the dense infestation between the Lodge cabins overlooking the Brooks River. A small patch of white clover identified here in 2005 was not detected this year and has probably been eradicated from Brooks Camp.

Cultural Center



Figure 4. SAGA crew removing common dandelion at the Brooks Camp Cultural Center.

The Brooks Camp Cultural Center is located at the end of a short trail to the west of the Brooks Camp Visitor Center. Despite the low to moderate foot traffic, the lawn in front of the Cultural Center is home to the densest and most aggressive infestation of common dandelions at Brooks Camp (Fig. 4). Common dandelions were also observed to be spreading into some of the grassy areas outside of the mown perimeter. Though dandelions were found along the final portion of the trail leading to the Cultural Center, the infestation was mainly concentrated around the structure itself. EPMT staff, assisted by the 2010 SAGA

crew, targeted this site in early June, with return treatments executed by EPMT staff in July, August and September. The site was observed to have an incredibly quick resurgence rate after treatment. Additional late phenology populations of shepherd's purse and pineapple weed were also discovered by the EPMT crew in September. In the future, repeated treatments should be scheduled every 2-3 weeks or as often as possible throughout the entire growing season. Because of sparse native vegetation cover, southern exposure and a well stocked seed bank, optimal conditions for common dandelion infestation exist. To combat this, the EPMT crew reseeded the devegetated site in September with seeds from nearby large-leaved avens (*Geum macrophyllum*) and yarrow (*Achillea millefolium*). Repeating treatments throughout the year to ensure that plants do not go to seed, reducing the mown area and re-vegetating with native plants are all suggested methods to ensure that this infestation does not continue to spread. Special care should also be made to remove dandelions that have escaped to the grassy areas outside of the lawn and along the bear and human trails which lead to the Cultural Center.

Brooks Camp Campground

The Brooks Camp campground has a total capacity of 60 people and is a highly utilized site with frequent visitor turnover. Common plantain and dandelion were found throughout the site, with especially dense infestations in some of the tent pads in the northwest portion of the campground. Pineapple weed and shepherd's purse were also found and were most dense around the entrance, cooking shacks and food cache buildings.

The EPMT staff and SAGA crew treated the entire campground in mid-June and controlled 76-95% of the plants growing in the area at the time. Both in June and July, efforts were made to control 95-100% of the invasive plants along the Dumpling Mountain trailhead and around the perimeter of the campground fence. Surveying and mapping of the Dumpling Mountain Trail were performed in July and August with a few individuals of common plantain discovered as far as 0.4 km up the trail. The entire campground area was retreated in July and August, with removal efforts focused mainly on late phenology plants that were in danger of going to seed before the onset of winter. Frequently, the large number of occupied campsites meant that not all of the invasives in the campground could be treated. In the future, efforts should be made to

clear particularly dense infestations of plantain and dandelion within the northern portion of the campground at times when the campground is not full of visitors. It is particularly important to monitor and control the dense infestations of plantain and dandelion along the outer mown perimeter of the electric fence to ensure that they do not escape into the forested areas around the campground. The campground is also an important target for control efforts because it is where many visitors spend time before they travel to and camp in other areas of Katmai, and is potentially a major seed vector for the park.

Brooks Camp – South Side

The south side of the Brooks River is home to the spit road which leads to recreational and maintenance boat parking and the gravel road leading to the Valley of 10,000 Smokes Road as well as to maintenance housing structures BL1, BL2 and BL3 on Lake Brooks. Starting from the graveled area below the lower platform and continuing along the shoulders of the spit road are infestations of shepherd's purse and pineapple weed, both of which were treated by the visiting SAGA crew in June. The shepherd's purse, which had returned vigorously, was retreated, though poorly because of regular bear activity, during the EPMT's July visit. The gravel road leading from the lower platform to Lake Brooks was relatively free of invasive plants, with only a few small spots of pineapple weed documented as well as a population of common plantain in front of the Brooks Falls Trail restrooms that was removed by the EPMT in September. At the end of the gravel road, the three housing structures at Lake Brooks were surrounded by pineapple weed and sparse common plantain and shepherd's purse. Of the structures, BL2 stood out due to an uncharacteristically large carpet of plantain just outside the front door. All common plantain and shepherd's purse were removed in June and then retreated with much less effort both in July and August.

Brooks Falls Trail and Platforms

Along the trail to Brooks Falls, dispersed groups of pineapple weed, shepherd's purse and annual bluegrass were found. Pineapple weed, interspersed with a few common dandelions and shepherd's purse, carpets the heavily bear trafficked river banks below the Brooks Falls and Riffles bear viewing platforms. Control efforts here were impossible during periods of heavy bear activity and only attempted in early June before their arrival. To further complicate control efforts, bears were witnessed eating pineapple weed below the platform (KATM, Whitney Rapp, pers. comm.) and then depositing the plant remains elsewhere.

Valley of 10,000 Smokes Road

As the only vehicular path leading from the BCDA, the VTTS Road has great potential to introduce new species into the backcountry. The 22.5 mile gravel road was driven slowly multiple times while scanning the shoulders for invasive plants. Pineapple weed alone was discovered in vehicle pull-outs in 2005, but this year it was found that it had been joined by shepherd's purse. In 2009, bird vetch (*Vicia cracca*) was discovered on the north side of the road at approximately mile marker 13.5. This patch was found by EPMT staff in June 2010, though in its early phenology appeared more likely to be native marsh pea (*Lathyrus palustris*). However, upon the EPMT staff's return in July, the characteristic 8-12 leaflet pairs of bird vetch had emerged and the site was mapped and the infestation removed and then retreated in early September (Fig. 5). At the Windy Creek trailhead, 7 miles further up the Valley Road, common plantain was discovered and treated in 2008 and 2009 (KATM, Mike Fitz, pers. comm.). Though the EPMT crew hiked down the trail in July and found no further infestation, in September when it was resurveyed, plantain was found and treated just a few hundred yards down the trail. The Margot Falls Trail, which begins behind the halfway restrooms, was surveyed and mapped: only native vegetation was found. The parking lot and environs for the Three Forks Visitor Center, which lies at the end of the VTTS Road, also showed no presence of invasive plants. Until recently, traffic on the VTTS Road was limited to vehicles that had already spent multiple seasons in Brooks Camp. However, this season other vehicles have been shipped in from multiple locations to assist in the maintenance facility construction effort. While efforts were made in King Salmon to clean these vehicles of soil, plants and organic matter before they were barged into the park, future surveys of the VTTS Road should be extra vigilant.



Figure 5. EPMT crew member, Devin Bartley, prepares to retreat bird vetch.

Gravel Pit



Figure 6. EPMT crew member, Crystal Shepherd, points out a single narrowleaf hawksbeard at the Gravel Pit.

Located at mile marker 5, the gravel pit is the source for fill and road building material for the length of the VTTS Road as well as for other construction projects at Brooks Camp. In 2005 numerous individuals of narrowleaf hawksbeard (*Crepis tectorum*) and shepherd's purse were found, primarily on the north side of the pit (Fig. 6). Since then, the site of the narrowleaf hawksbeard has been covered by a large pile of culverts and other building materials. Only 3 individuals were discovered and removed in July and August of 2010, but it is presumed that the seed bank still exists and the area should undergo regular surveillance for reemergence. Shepherd's

purse and common plantain were also found in August and removed from the bear fenced storage area as well as near the piles of culvert material.

Lake Camp

As the only road-accessible location in the park, Lake Camp is particularly susceptible to importation of invasive plants found in the King Salmon area. Currently, sheep sorrel is the most prevalent species, growing along the edges of all graveled areas and paths between the upper and lower parking lots. Sparse patches of pineapple weed were also found in both parking lots as well as along the connecting pathways. EPMT staff, accompanied by the SAGA crew, treated 50-75% of the upper parking lot sheep sorrel infestation in June. These treatments were followed by removal of 95-100% of the sheep sorrel found on the pathways in July and August. Numerous individuals of sheep sorrel, pineapple weed and shepherd's purse were also found growing intermixed with native plant species on the stone rip-rap along the shore as well as on the beach.



Figure 7. Common sheep sorrel at Lake Camp.

The first new species this year for KATM, hairy cat's ear, was discovered along the edge of the lower parking area, in and near the mown picnic area as well as in the grass around the permanent anchor nearest the launch ramp. A total of 111 individuals of hairy cat's ear were removed by EPMT staff in July and August. Though the EPMT inspected most heavy equipment and vehicles barged from Lake Camp to Brooks Camp for seeds and organic material, currently no similar steps are in place to inspect that equipment prior to its return to Lake Camp. Additionally, with plans in place to install a new boat ramp and anchor points at Lake Camp, future surveys will likely show an increase in number of invasive species.

Rest of Katmai



Figure 8. Common dandelion in the lawn at Fure's Cabin.

Although the EPMT was not able to survey the coastal region of the park as fully as planned, the team did expand previously mapped areas of the rest of KATM to include Fure's Cabin, Nonvianuk Ranger Cabin, Jojo Lake, and some select sites along the outer coast.

Fure's Cabin

Roy Fure's Bay of Islands cabin is a public use cabin (PUC) situated in a remote location in the park along the Savonoski Loop portage trail from Naknek Lake to Grosvenor Lake (Fig. 8). The cabin is surrounded by a large south-facing mown and treeless grassy area. The trails near the cabin are heavily infested

with common dandelions and a small population of shepherd's purse was observed around the fire pit. Annual bluegrass was also found along the trails leading to the cabin. Fortunately, the common dandelion infestation has not spread very far beyond the lawn onto the portage trail to Grosvenor Lake. Surveying along the portage trail revealed that only the first ten meters beyond the cabin clearing were moderately infested. Beyond that, only two common dandelions were found in the next 100 meters. A small cluster of native dandelions (*Taraxacum ceratophorum*) was found on the southern bank of Grosvenor Lake at the terminus of the trail. Control efforts for common dandelions at this location removed an estimated 76-95% of individuals along the trails, an estimated 76-95% of plants within the southwestern mown area, and 51-75% in front of the cabin itself. Additionally, 76-95% of the shepherd's purse infestation was removed from the fire ring area. Future control efforts should be planned well in advance as reservations for Fure's PUC often fill up early in the season. Manual removal of all of the common dandelions at this site may take up to 5 full working days or more with a crew of 3-4 people. When EPMT staff arrived at Fure's cabin in late June, many of the dandelions had already gone to seed, even after a short half day trip in early June had removed 76-95% of the flowering heads of common dandelion plants in the cabin clearing. Thus it is recommended that the site be visited in the first few weeks of June. Additionally, allowing woody vegetation to grow and reducing the area mown or brushed around Fure's cabin could help to contain the spread of invasives beyond the lawn through shading.

Nonvianuk Ranger Cabin

At Nonvianuk Lake, common dandelions and a small patch of common plantain were found within and between the two mown areas on the southern side of the head of the Nonvianuk River (Fig. 9). No invasive plants were found around the Ranger Cabin or along the trail leading from the river to the cabin. NPS backcountry law enforcement rangers worked to pull an estimated 50% of the common dandelion at this site in late June and advised EPMT staff that the private land holding on the north side of the river also contains a similar infestation. This infestation was not inventoried, but should be in the future with land owner permission. The limited common plantain infestation (less than two square meters) at this site could easily be eradicated, and the common dandelions appeared to be containable, especially if efforts are taken to reduce the mown areas. These sites are important control locations because visitors often use these beaches for camping and boating before travelling to other parts of Nonvianuk Lake or to the Alagnak and Nonvianuk Rivers.



Figure 9. Common dandelion growing along the Nonvianuk River.



Figure 10. Native dandelion (*Taraxacum officinale* ssp. *ceratophorum*) at Grosvenor Lake.

Jojo Lake

Jojo Lake lies between Lake Grosvenor and the Savonovski River. The lake is not a known destination for park visitors but has hosted a number of NPS seasonal camps for employees conducting fisheries research since 2004. The camp is located on the northern tip of the largest island in the lake. There were no invasive species found at the site or along trails surrounding the camp in 2010. Red raspberry (*Rubus ideaus*) was found in multiple locations along the edge of the island. Red raspberry is not considered to be an invasive plant; however, this is the first documented example of the plant in Katmai. Hultén (1968) describes red raspberry as ranging as far southwest in Alaska as Iliamna Lake. A population of native dandelion was also discovered on the northern side of the island (Fig. 10).

At the end of the Jojo Lake camp's 2010 field season, the soil in many of the areas of camp had minimal remaining vegetative cover as a result of concentrated foot traffic. This

environment is susceptible to invasive species infestations because of a lack of competing vegetation and the possibility that seeds may have been brought in on equipment or supplies. Continued monitoring at this location will be necessary in the future.

Outer Coast

Katmai's outer coast has numerous areas that have experienced intensive historical use. Abandoned canneries, farms, mining operations and villages are scattered throughout this region. Currently, coastal areas with human activity include: the lodges at Hallo Bay and Kukak Bay, the backcountry ranger cabins at Amalik and Swikshak Bays and two popular bear viewing destinations at Geographic Harbor and Hallo Bay. EPMT staff briefly visited Katmai Bay, a coastal location with little visitation, and found no invasive plants. Staff also visited the ranger cabin at Amalik Bay and no invasive plants were seen, though a formal GPS survey was not performed due to time constraints. The previous KATM report documented pineapple weed along some of the pathways near the Hallo Bay Lodge (Bauder and Heys, 2005). However, because of distance and weather issues, this site, as well as other coastal sites, was not surveyed nor treated during the 2010 season.

Kulik, Katmai, and Grosvenor Lodges

Three common invasive plant species were found at backcountry lodges during a survey conducted in 2000 (Densmore 2001). Kulik Lodge had infestations of common plantain, common dandelion and pineapple weed. Infestations of pineapple weed and common dandelion were also found at Grosvenor Lodge, and Katmai Lodge hosted both common dandelion and common plantain. No additional surveys have been conducted at these locations since 2000.

King Salmon

Though not within park boundaries, King Salmon is the most utilized origin for entry into the park, and is where trucks, equipment, aircraft and boats that regularly travel into the park are stored. The King Salmon NPS maintenance yard contains the largest infestation of narrowleaf

hawksbeard within KATM administered property. This infestation required frequent treatments due to staggered plant phenology times throughout the growing season. Common dandelion, pineapple weed, foxtail barley (*Hordeum jubatum*), and shepherd's purse were also found at this site, mainly near the outer edges within about six meters of the chain link fence. Since these plants are often growing under the wheels of boat trailers and heavy equipment, ensuring that seeds are not dropped at this site is important for preventing spread to the park. EPMT visited this site multiple times throughout the summer and repeatedly treated 95-100% of narrowleaf hawksbeard and shepherd's purse, but found new individuals growing upon every return trip.

The gravel area above the float plane and boat dock in King Salmon is also a frequently used departure point for NPS employees. Small infestations of common dandelion, narrowleaf hawksbeard, pineapple weed and shepherd's purse exist in this area and should be prioritized for removal so they do not spread on gear and equipment to other backcountry areas. The EPMT staff was able to treat the common dandelion and shepherd's purse at this site within a short time period.

Besides these departure points, the lawn areas around the employee housing units contain infestations of common dandelion, pineapple weed, white clover and shepherd's purse. Oxeye daisy (*Leucanthemum vulgare*) was also discovered in the yard areas around the quad-plex housing units. In the parking lot of the NPS office at the King Salmon mall, foxtail barley, pineapple weed, scentless false mayweed (*Tripleurospermum perforata*) and oxeye daisy were found.

EPMT staff collaborated with Susan Savage from the U.S. Fish and Wildlife Service to retreat an infestation of common tansy (*Tanacetum vulgare*) along West Housing Road and behind the post office in September. White clover and hairy cat's ear were found near the Bristol Bay school district building and numerous oxeye daisy plants were discovered near the employee Federal Aviation Administration housing units. A small patch of bird vetch was also found along the Alaska Peninsula Highway. All of these plants have the potential to move into KATM from King Salmon and should be monitored. Community weed pulls could be organized, with landowner permission, for management of infestations.



Figure 11. Common dandelion along the Aniakchak River. Photo by Tina Boucher.

Aniakchak National Monument & Preserve

Aniakchak National Monument & Preserve (ANIA), a separate NPS unit managed by KATM, is a remote, undeveloped national monument located on the Alaska Peninsula south of KATM. It is one of the least visited areas in the NPS (National Park Service 2010). No invasive species were detected during a 2004 floristic inventory by the Alaska Natural Heritage Program (AKNHP) or during 2009 field work conducted in the preserve. However, the AKNHP did find common dandelions along the Aniakchak River during their 2010 survey (Boucher, pers. comm. 2010) (Fig. 11). The largest infestation observed was noted to contain about 200 individuals, with smaller scattered infestations throughout the river area. ANIA is one of the least visited units in the

National Park System (National Park Service 2010) which makes this finding all the more unexpected. Photographs indicate that these individuals were growing in non-disturbed areas, a pattern uncommon to other dandelions observed in the region.

Education and Outreach

Fishtival

The KATM EPMT made an appearance at the Bristol Bay Fishtival in Naknek, AK. The event, which celebrates the end of the sockeye salmon fishing season in Bristol Bay, attracts many local and temporary residents to participate in events like fish tossing and salmon filleting competitions. The EPMT crew talked about invasive species in the Bristol Bay area with visitors and brought in potted examples of some of the most prolific invasive plants for the public to view, touch and smell. Many people also participated in playing an invasive plant species identification game created by EMPT staff. In addition to handing out “Down with Exotic Plants” temporary tattoos and informational booklets, the crew also had a positive message for those living in the area: that the spread of invasive plants can be controlled by proper cleaning of clothes and equipment before traveling to a new place. Visitors were also educated that existing infestations can be eradicated with diligent root-pulling before plants go to seed. Because of the success of this event and interest shown by the public, future EPMT staff should continue attending and participating in this event every July.

Invasive Species Posters

In preparation for Fishtival, the EPMT created two colorful posters listing ten of “Bristol Bay’s Most Wanted” invasive plants. These posters were hung in visible locations at local restaurants and grocery stores as well as at the post office and Katmai Visitor Center (Appendix B).

Recommendations for the 2011 Field Season

Staffing

KATM EPMT staff were based out of King Salmon for the majority of the 2010 field season. This was logistically practical for seizing upon opportunities to travel and survey in other areas of the park as well as to utilize the resources available in the office for data management. However, an EPMT crew based out of Brooks Camp would be better able to maintain a rigorous invasive species management regimen. Additionally, a regularly stationed EPMT member could provide interpretive plant walk programs to visitors of Brooks Camp.

Volunteers

Volunteer crews can be a great asset when organized and encouraged properly. Over two weeks in early June 2010, the EPMT received 680 hours of volunteer assistance from a SAGA crew (Fig. 12). The EPMT crew participated in the SAGA crew's morning stretch circles as well as various spoken-word games during the day to facilitate bonding and camaraderie. The 2010 KATM EPMT staff found that because of the monotonous nature of invasive plant removal work, moving to multiple sites daily was a way of keeping the work stimulating for the team. For a two-week crew, it is also suggested that the middle weekend be utilized for a team-building excursion to explore a different location of the park. In 2010, the KATM EPMT staff took the SAGA crew to the VTTS for a hiking and backpacking trip.



Figure 12. SAGA crew volunteers, happy after removing shepherd's purse from the closed bridge trail.

Phenology

Varying seasonal phenology is important to take into consideration when planning control work in the field. The 2010 KATM EPMT staff noticed that invasive plants germinated later in the season in sites where they had to compete with other established plants for sunlight and nutrients. Upon initial visits to many sites, usually in June, there often were no to very few invasive plants visible. However, in July, August and September unexpected populations of invasives were discovered that had not been previously detected. Examples of late-emerging infestations in KATM during the 2010 season were:

- Shepherd's purse found along bear trails, in the lawn at the Cultural Center and along the shaded edges of buildings in the BCDA
- Common plantain on the Windy Creek Trail and at the Gravel Pit
- Pineapple weed and shepherd's purse along the Brooks Falls Trail

Alternatively, relatively open sites with a south facing exposure might show growth of early germinating species, such as common dandelions, as early as late May. Early visitation to these sites, such as the Cultural Center lawn and the lawn around Fure's Cabin, could reduce workload and control efforts later in the season.

Suggested Schedule

May: Begin planning for trips throughout the season, sign up for accommodations at Fure's Cabin for early June, make first visit to Brooks Camp and treat the campground and Cultural Center lawn, begin treating sheep sorrel at Lake Camp, arrange to inspect equipment departing for Brooks Camp from Lake Camp once the ice breaks up

June: Monitor and control all areas at Brooks Camp, treat below bear platforms if bears are not present, survey and control at Fure's Cabin and Nonvianuk Cabin, plan for Fishtival in July, continue retreating at Lake Camp, attempt to make positive identification of grasses at Brooks Camp

July: Attempt surveying trips to the Outer Coast, treat narrowleaf hawksbeard in King Salmon maintenance yard weekly, treat King Salmon float plane dock, continue retreating at Lake Camp, continue monitoring and control at Brooks Camp, attempt to make positive identification of the possible prostrate knotweed.

August: Continue treating narrowleaf hawksbeard, make final trip to Brooks Camp, contact Susan Savage and assist in common tansy removal in King Salmon, begin saving seeds of Brooks Camp native species, particularly yarrow, for revegetation

September: Write report, upload and finalize all data, compile herbarium samples gathered throughout the season, continue monitoring for invasives in accessible locations

Disposal Methods

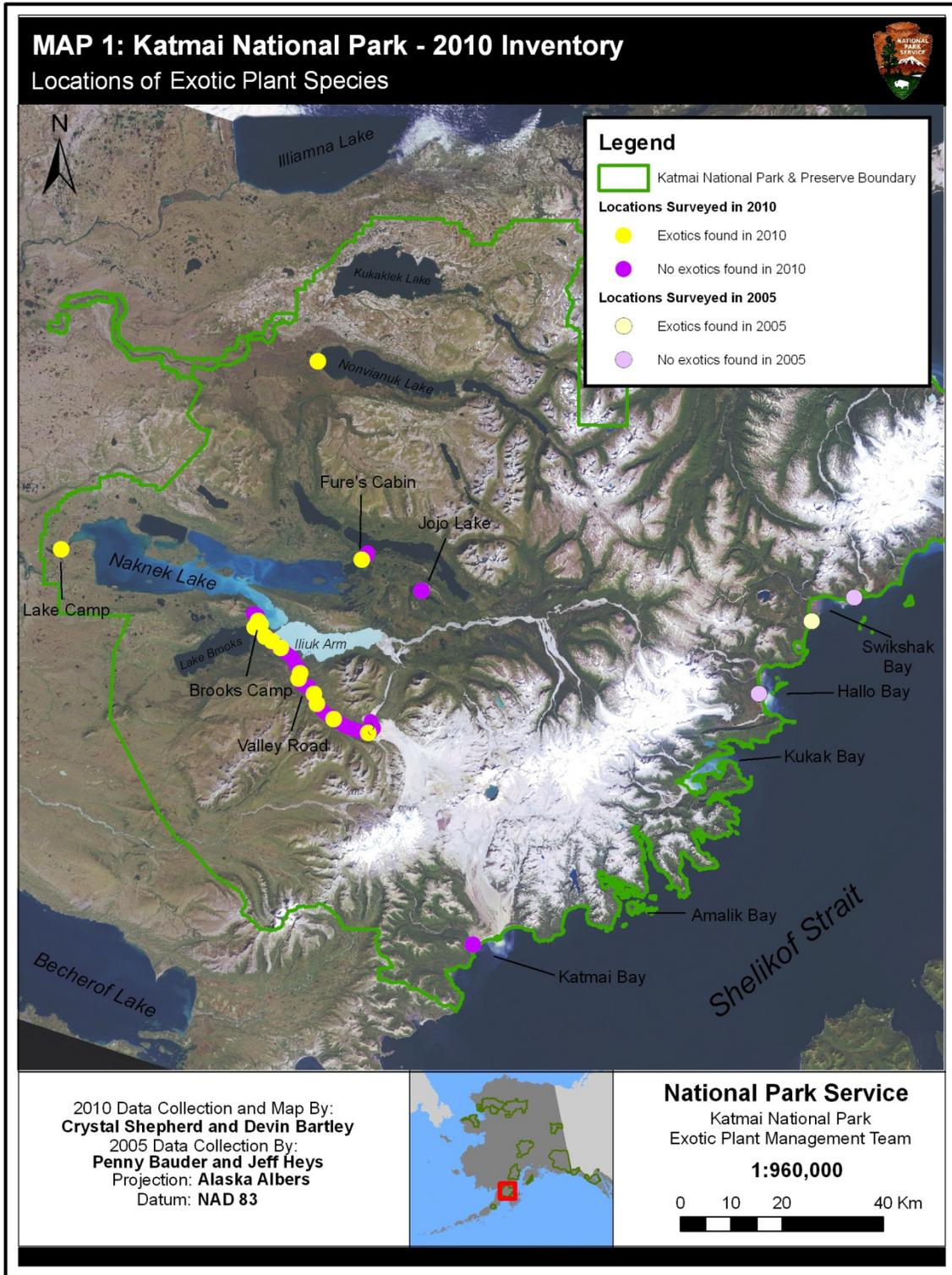
The 2010 KATM EPMT staff considered multiple options for the disposal of plants and plant materials accumulated throughout the season. However, a cool, overcast summer precluded the use of solar ovens and frequent rain had soaked the plant bags and induced the decomposition process by mid July. Thus, the team decided to experiment with a burn barrel. Based upon the designs provided by the Alaska Wildland Fire Coordinating Group (AWFCG 2008), air holes and one larger tinder-feeding hole were punched into an old oil drum using a pickax. Within the barrel, wire mesh screen was supported using fragments of concrete block. The barrel was set up off of NPS administered property and the EPMT tried burning the plants using various combinations and configurations of previously accumulated cardboard and shredded paper. Unfortunately, the large quantity of diesel fuel required to maintain the fire made this an inefficient and unhealthy choice, both for the environment and for EPMT staff. At the end of the 2010 season, EPMT staff were seeking a used kitchen oven where the plant material could be heated to around 200 degrees Fahrenheit, the temperature at which seed sterilization takes place (Agrios 2005). Remaining plant material would then be disposed of at the local dump. Recommendations to future EPMT staff include: do not store plant bags outside, if possible dispose of plants as they accumulate and, pursue the possibility of adding small quantities of plants to the incinerator at Brooks Camp during each burn event.

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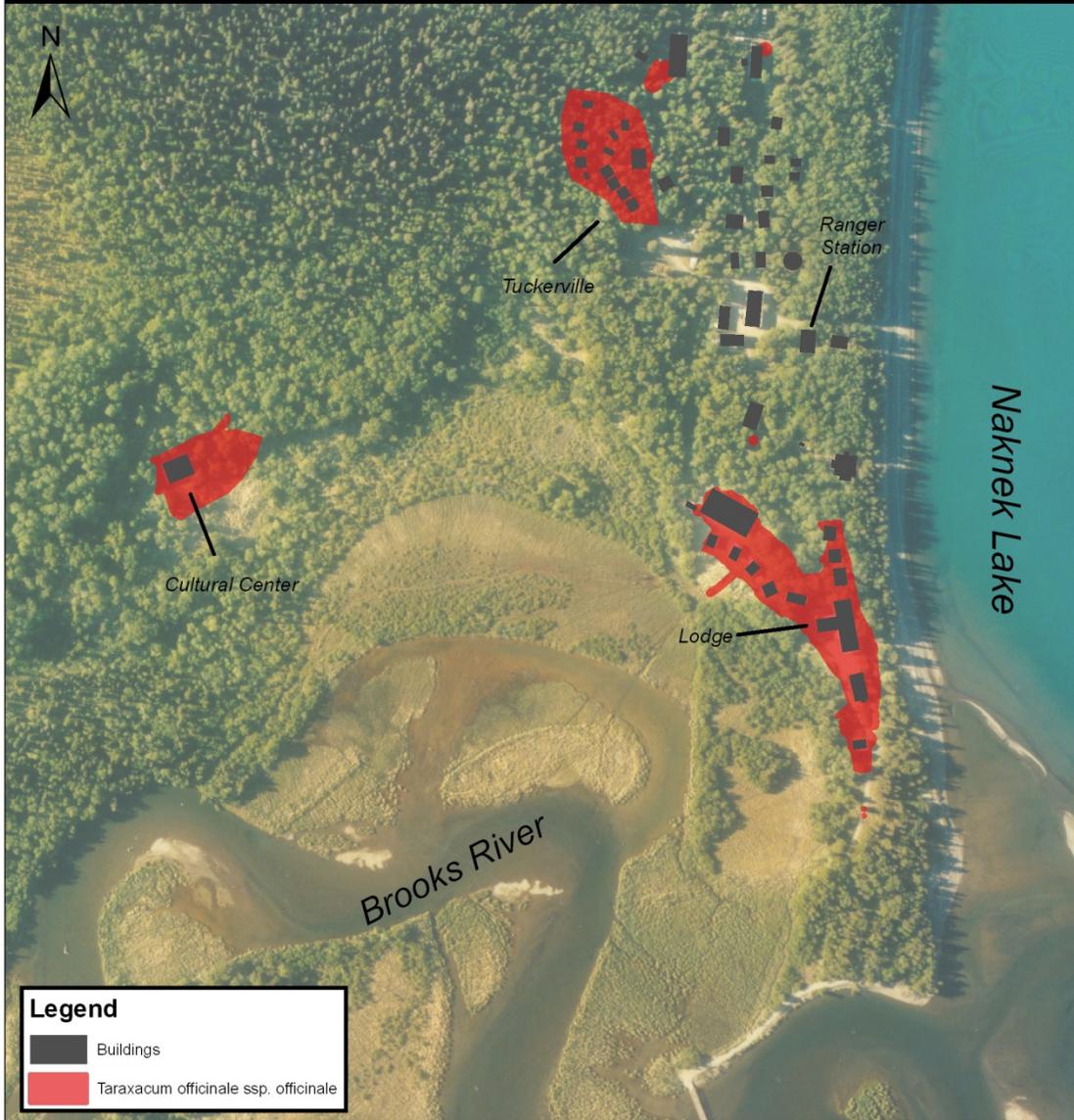
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Appendix A – Maps



MAP 2A: Brooks Camp Lodge Area - 2010 Inventory

Locations of *Taraxacum officinale* spp. *officinale* (common dandelion)



Legend

- Buildings
- Taraxacum officinale* spp. *officinale*

Coverage Collected With:
Trimble GeoXT 2008 GPS unit
Data Collection and Map By:
Crystal Shepherd and Devin Bartley
Projection: **Alaska Albers**
Datum: **NAD 83**
Aerial Photo Date: **6/15/2002**



National Park Service

Katmai National Park
Exotic Plant Management Team

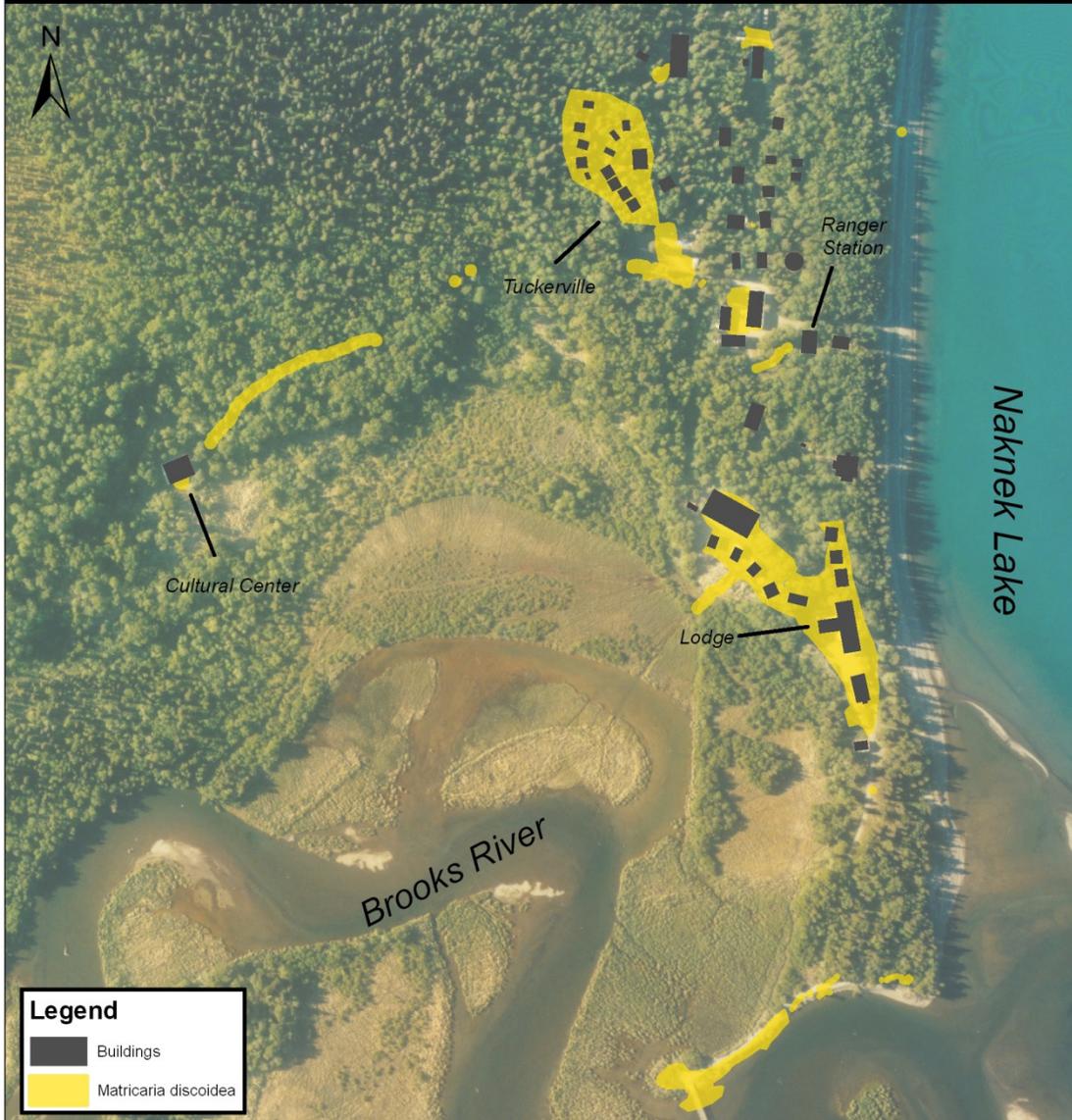
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0 25 50 100 Meters



MAP 2B: Brooks Camp Lodge Area - 2010 Inventory

Locations of *Matricaria discoidea* (pineappleweed)



Legend

- Buildings
- Matricaria discoidea*

Coverage Collected With:
Trimble GeoXT 2008 GPS unit
Data Collection and Map By:
Crystal Shepherd and Devin Bartley
Projection: **Alaska Albers**
Datum: **NAD 83**
Aerial Photo Date: **6/15/2002**



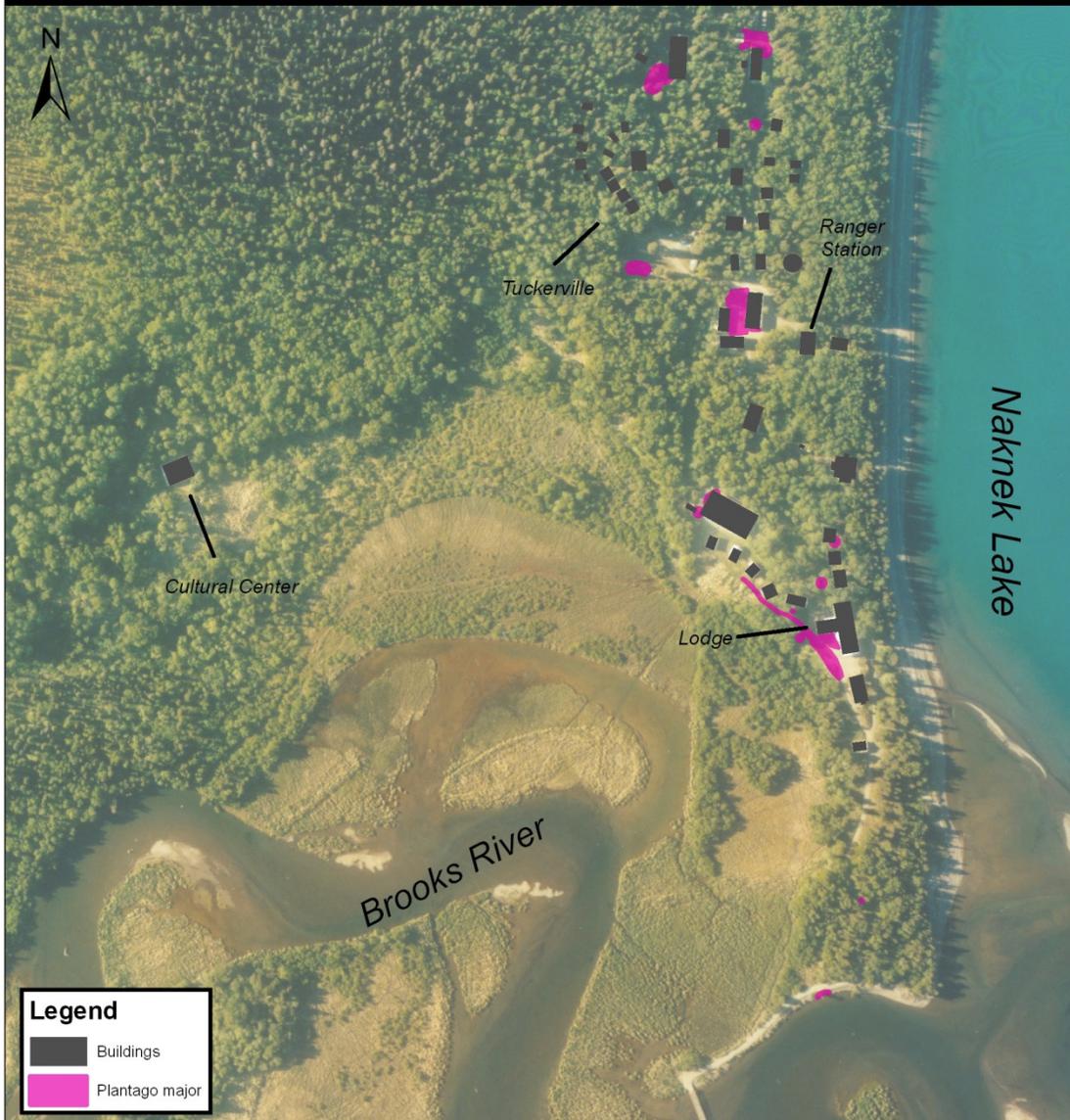
National Park Service
Katmai National Park
Exotic Plant Management Team

1:2,700



MAP 2C: Brooks Camp Lodge Area - 2010 Inventory

Locations of *Plantago major* (common plantain)



Legend

- Buildings
- Plantago major*

Coverage Collected With:
Trimble GeoXT 2008 GPS unit
Data Collection and Map By:
Crystal Shepherd and Devin Bartley
Projection: **Alaska Albers**
Datum: **NAD 83**
Aerial Photo Date: **6/15/2002**



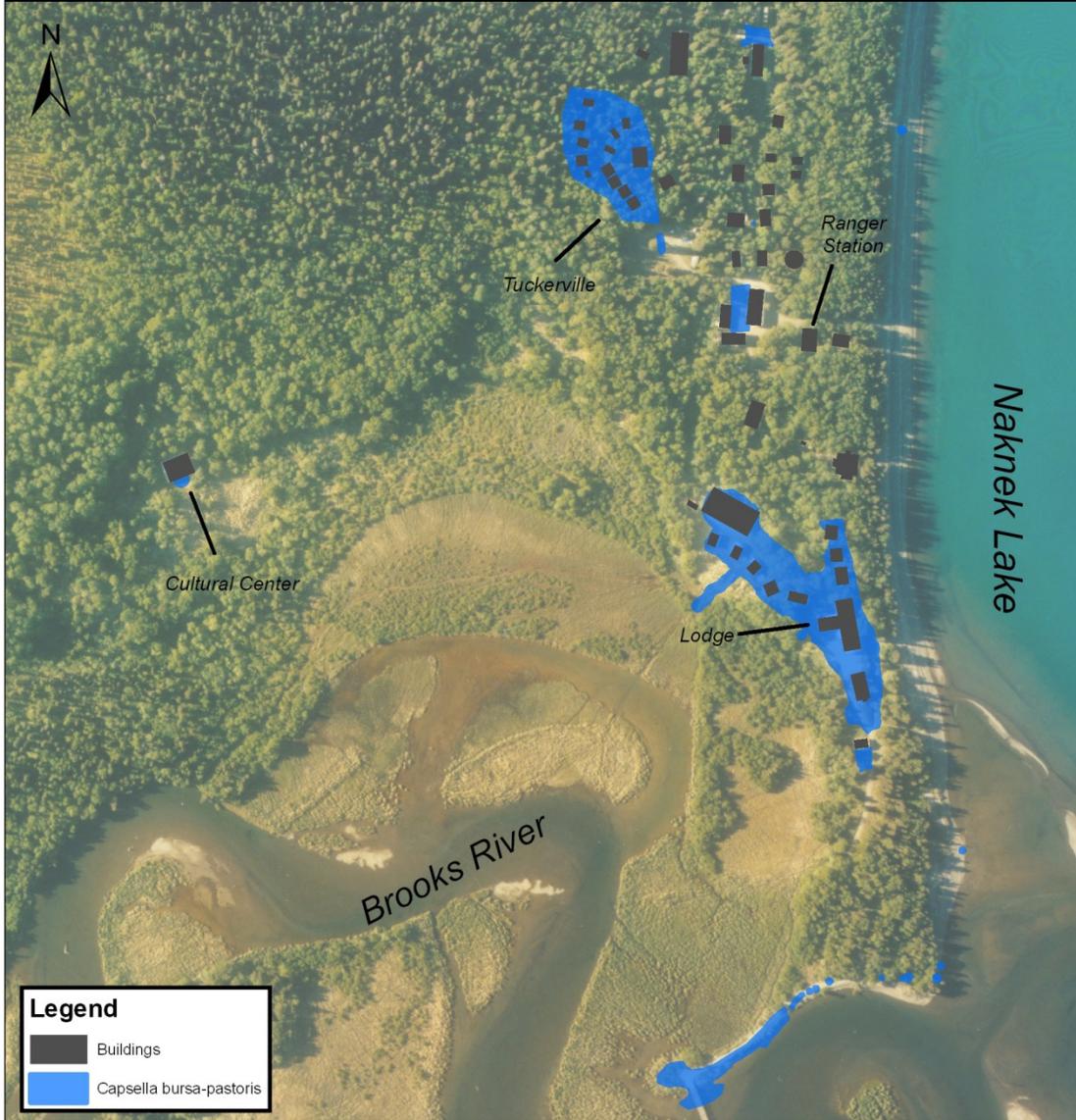
National Park Service
Katmai National Park
Exotic Plant Management Team

1:2,700

0 25 50 100 Meters

MAP 2D: Brooks Camp Lodge Area - 2010 Inventory

Locations of *Capsella bursa-pastoris* (shepherd's purse)



Legend

- Buildings
- Capsella bursa-pastoris*

Coverage Collected With:
Trimble GeoXT 2008 GPS unit
Data Collection and Map By:
Crystal Shepherd and Devin Bartley
Projection: **Alaska Albers**
Datum: **NAD 83**
Aerial Photo Date: **6/15/2002**



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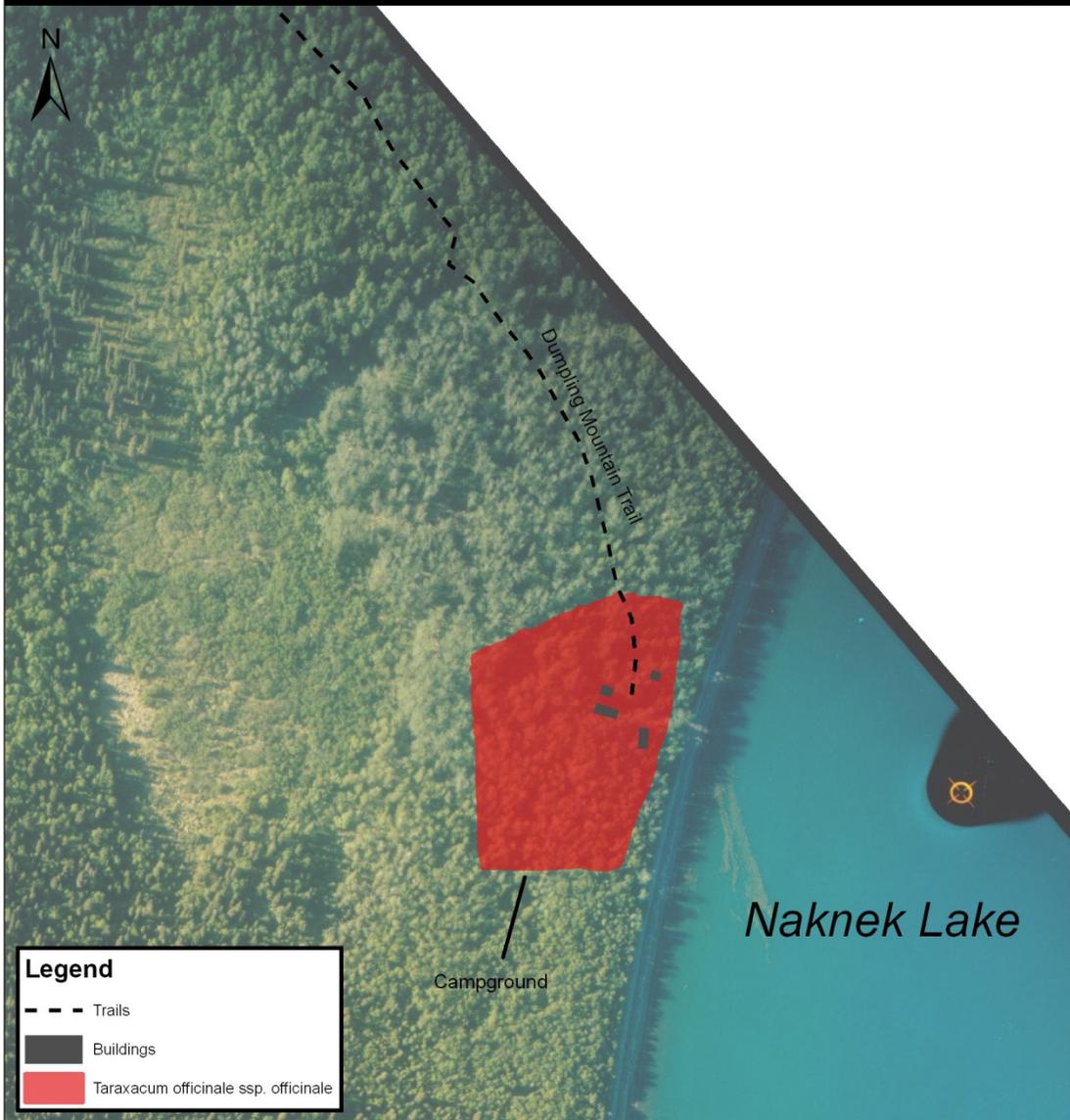
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MAP 3A: Brooks Camp Campground Area - 2010 Inventory

Locations of *Taraxacum officinale* ssp. *officinale* (common dandelion)



Legend

- Trails
- Buildings
- *Taraxacum officinale* ssp. *officinale*

Coverage Collected With:
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Projection: **Alaska Albers**
Datum: **NAD 83**
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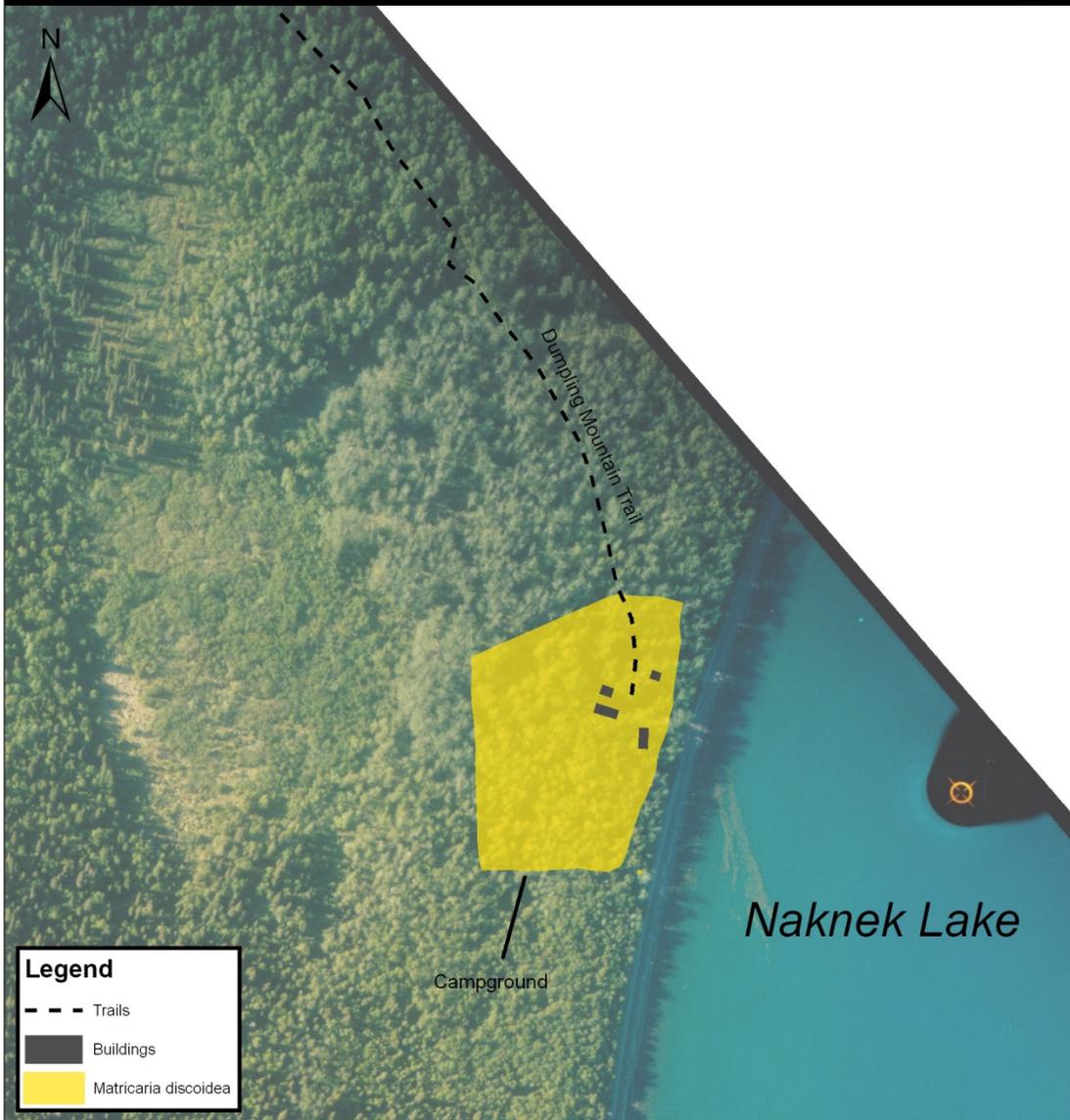
National Park Service
Katmai National Park
Exotic Plant Management Team

1:2,700



MAP 3B: Brooks Camp Campground Area - 2010 Inventory

Locations of *Matricaria discoidea* (pineappleweed)



Legend

- - - Trails
- Buildings
- *Matricaria discoidea*

Coverage Collected With:
Trimble GeoXT 2008 GPS unit
Data Collection and Map By:
Crystal Shepherd and Devin Bartley
Projection: **Alaska Albers**
Datum: **NAD 83**
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National Park Service

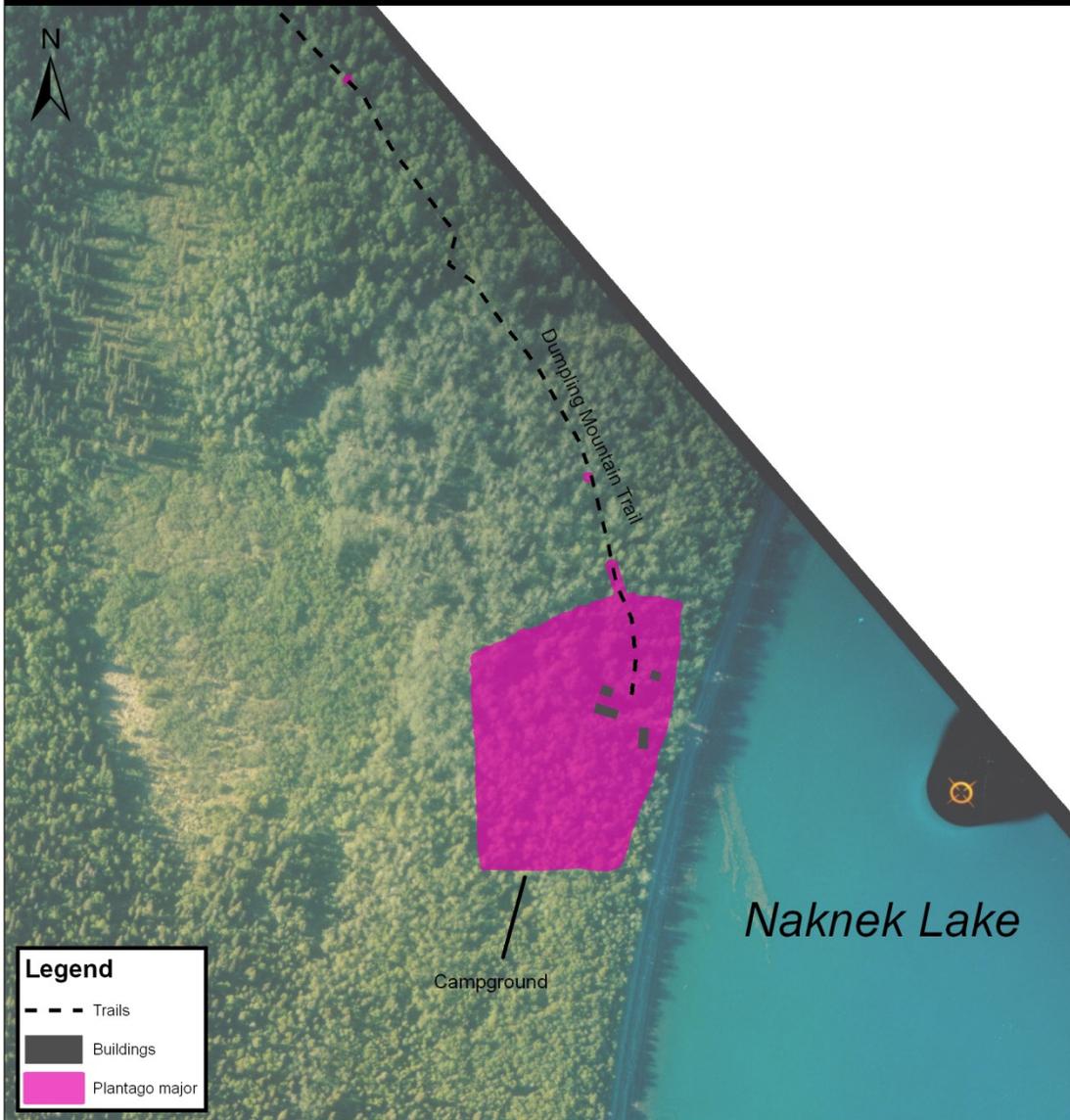
Katmai National Park
Exotic Plant Management Team

1:2,700



MAP 3C: Brooks Camp Campground Area - 2010 Inventory

Locations of *Plantago major* (common plantain)



Legend

- Trails
- Buildings
- *Plantago major*

Coverage Collected With:
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Data Collection and Map By:
Crystal Shepherd and Devin Bartley
Projection: **Alaska Albers**
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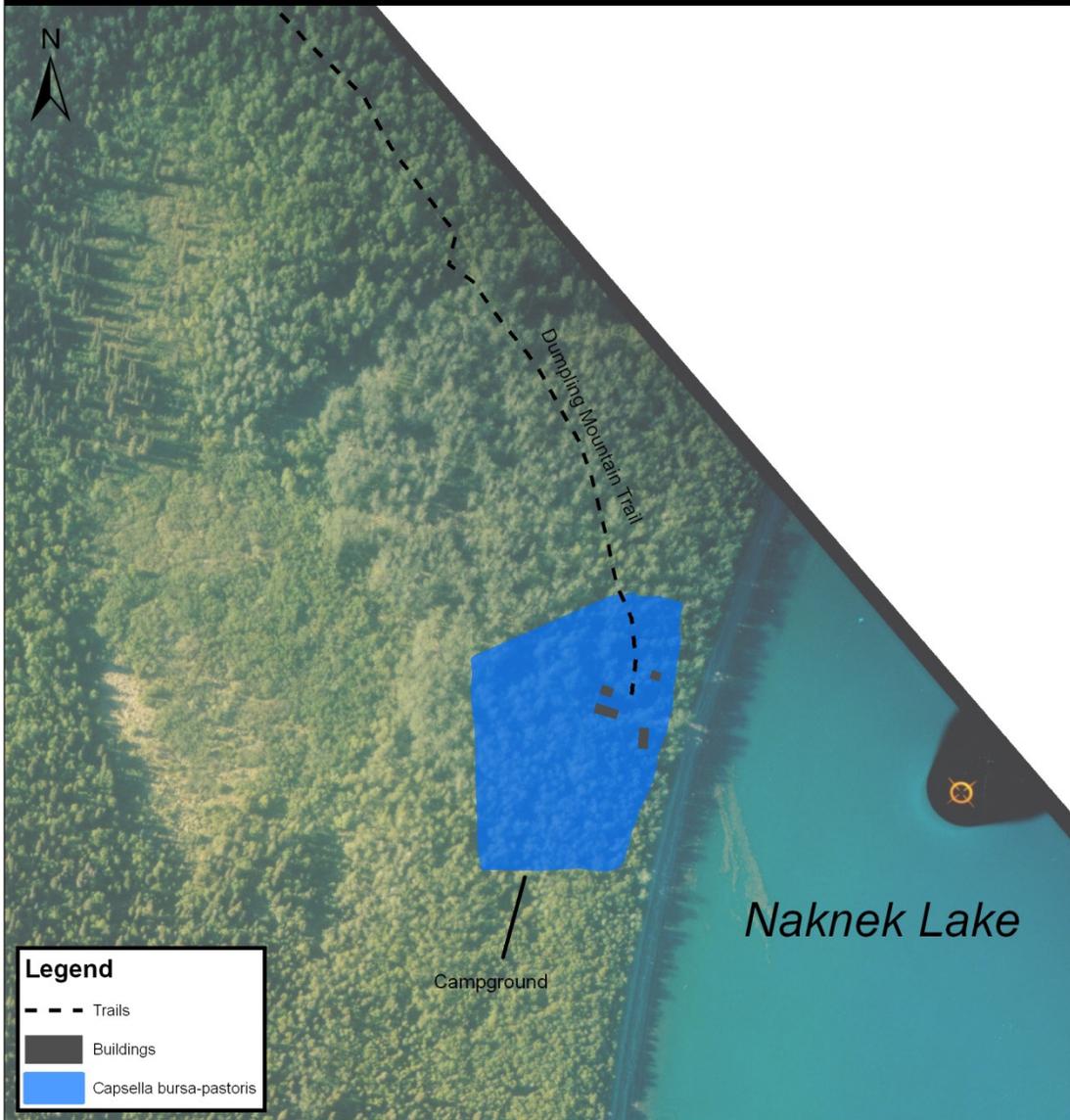
National Park Service
Katmai National Park
Exotic Plant Management Team

1:2,700



MAP 3D: Brooks Camp Campground Area - 2010 Inventory

Locations of *Capsella bursa-pastoris* (shepherd's purse)



Legend

- - - Trails
- Buildings
- *Capsella bursa-pastoris*

Coverage Collected With:
Trimble GeoXT 2008 GPS unit
Data Collection and Map By:
Crystal Shepherd and Devin Bartley
Projection: **Alaska Albers**
Datum: **NAD 83**
Aerial Photo Date: **6/15/2002**



National Park Service

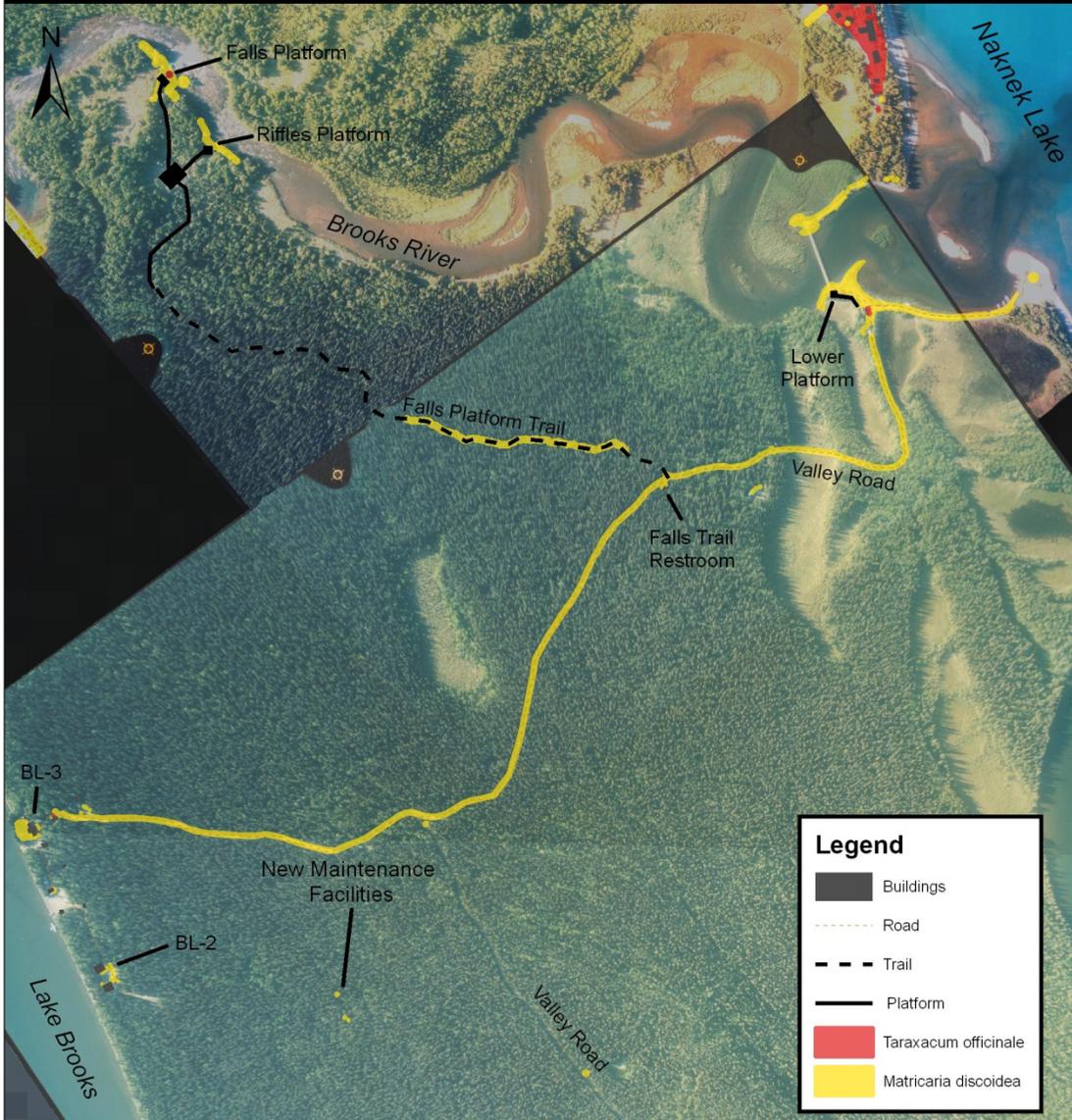
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Exotic Plant Management Team

1:2,700



MAP 4A: Brooks Camp South Side - 2010 Inventory

Locations of *Taraxacum officinale* ssp. *officinale* (common dandelion), and *Matricaria discoidea* (pineappleweed)



Legend

- Buildings
- Road
- Trail
- Platform
- Taraxacum officinale*
- Matricaria discoidea*

Coverage Collected With:
Trimble GeoXT 2008 GPS unit
 Data Collection and Map By:
Crystal Shepherd and Devin Bartley
 Projection: **Alaska Albers**
 Datum: **NAD 83**
 Aerial Photo Date: **6/15/2002**



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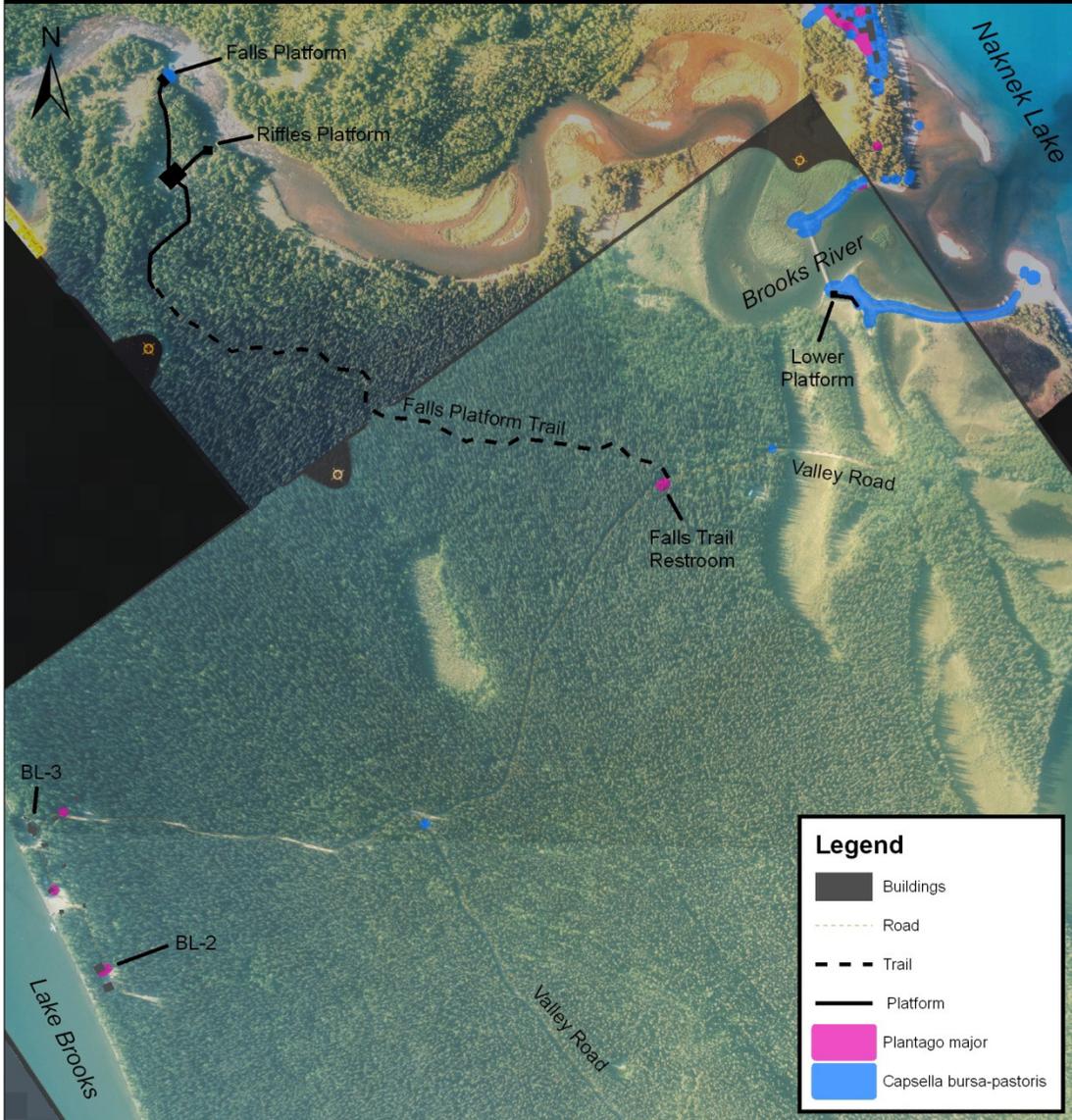
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MAP 4B: Brooks Camp South Side - 2010 Inventory



Locations of *Capsella bursa-pastoris* (shepherd's purse), and *Plantago major* (common plantain)



Coverage Collected With:
Trimble GeoXT 2008 GPS unit
 Data Collection and Map By:
Crystal Shepherd and Devin Bartley
 Projection: **Alaska Albers**
 Datum: **NAD 83**
 Aerial Photo Date: **6/15/2002**



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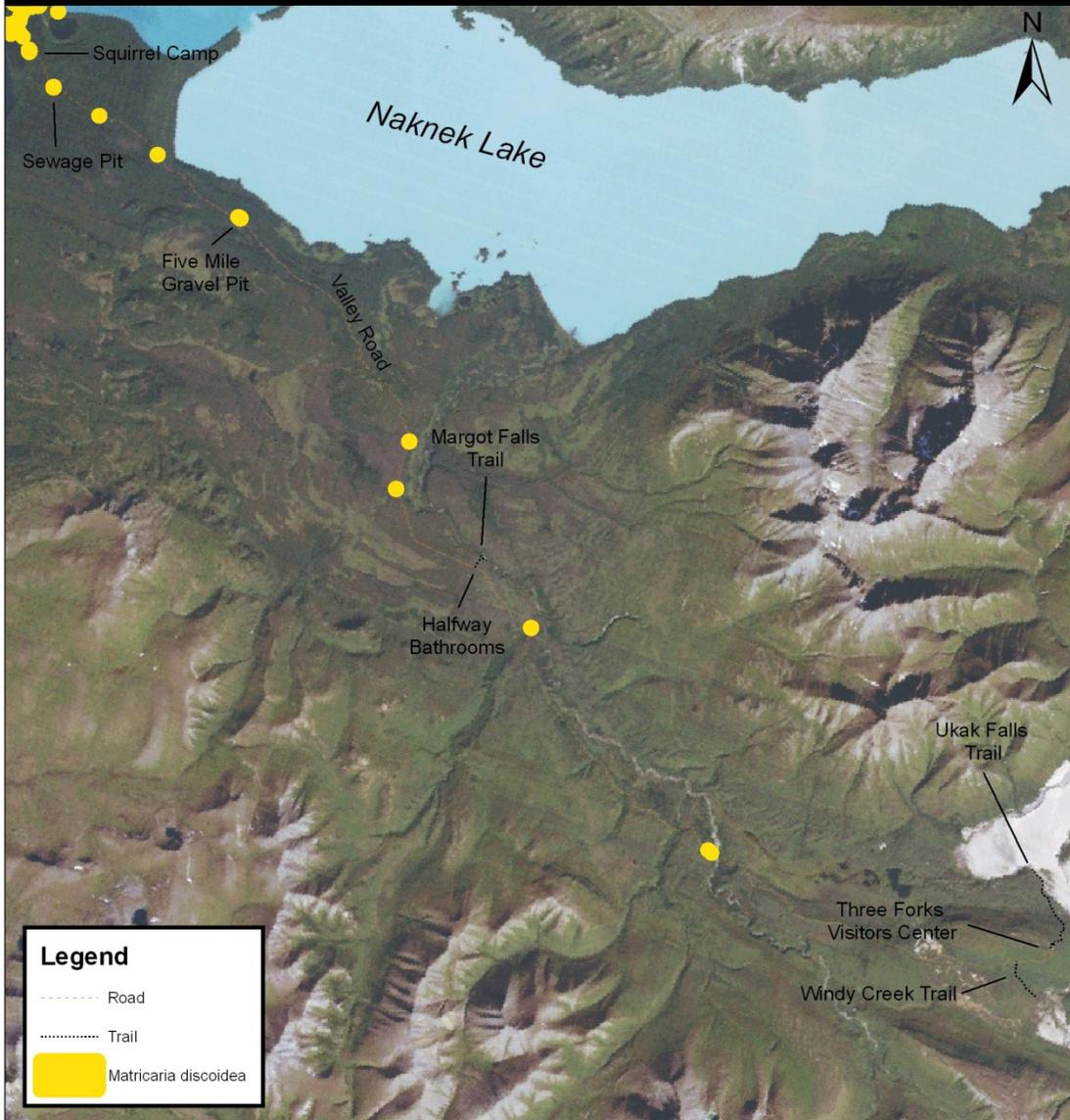
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MAP 5A: Valley of 10,000 Smokes Road - 2010 Inventory

Locations of *Matricaria discoidea* (pineappleweed)



Legend

- Road
- Trail
- *Matricaria discoidea*

Coverage Collected With:
Trimble GeoXT 2008 GPS unit
Data Collection and Map By:
Crystal Shepherd and Devin Bartley
Projection: **Alaska Albers**
Datum: **NAD 83**

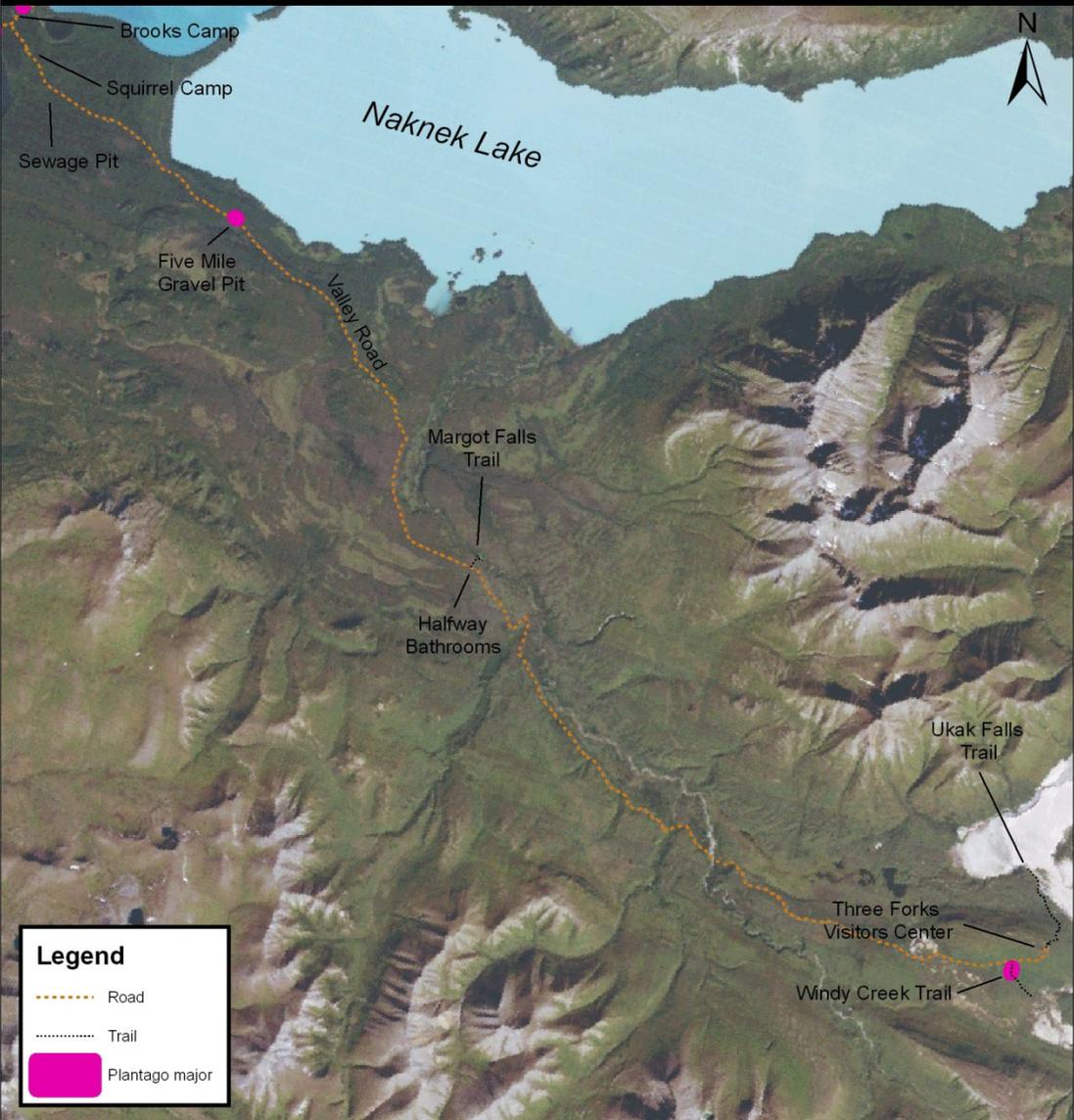


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Katmai National Park
Exotic Plant Management Team



MAP 5B: Valley of 10,000 Smokes Road - 2010 Inventory

Locations of *Plantago major* (common plantain)



Legend

- Road
- Trail
- Plantago major

Coverage Collected With:
Trimble GeoXT 2008 GPS unit
Data Collection and Map By:
Crystal Shepherd and Devin Bartley
Projection: **Alaska Albers**
Datum: **NAD 83**



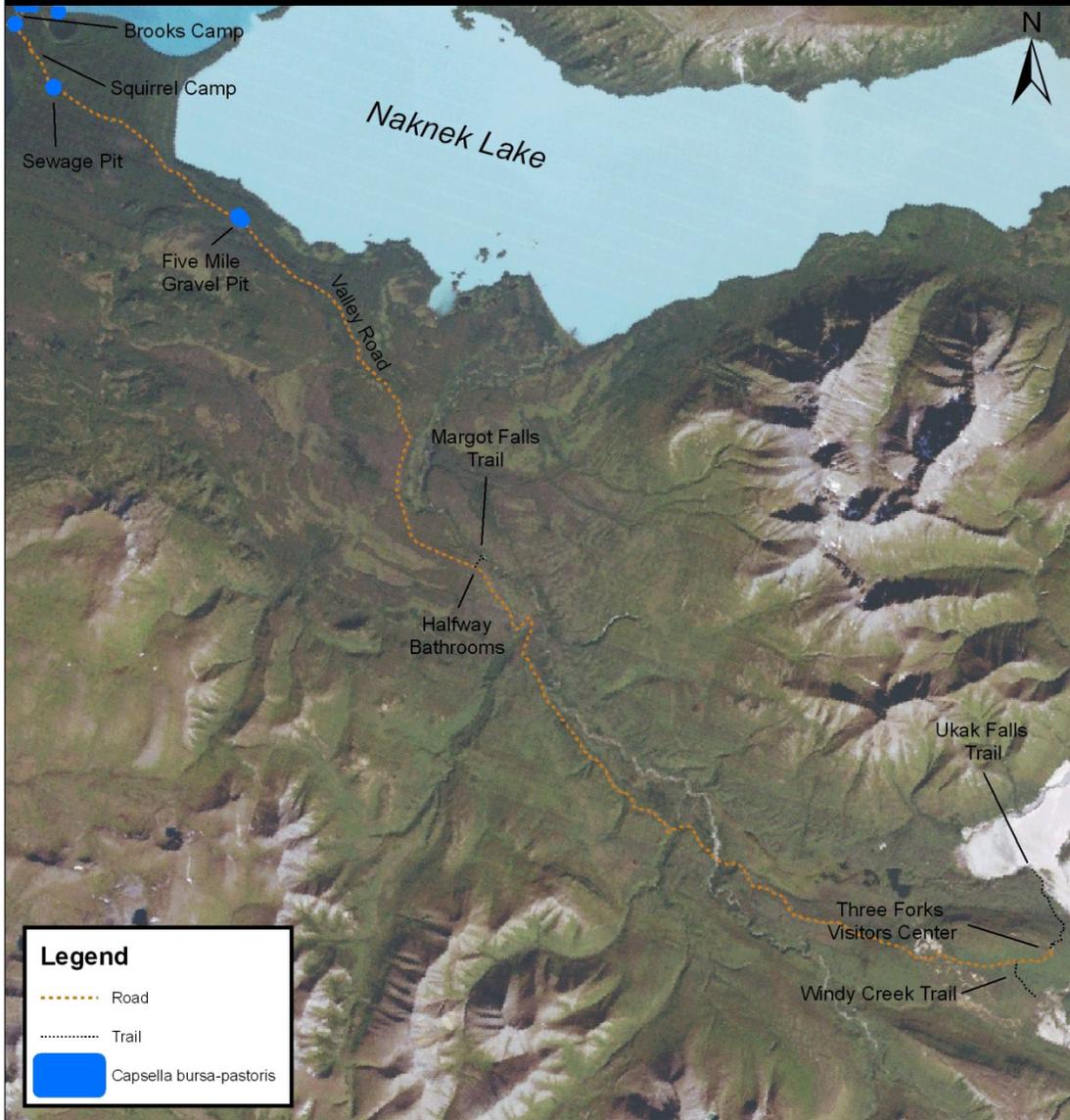
National Park Service
Katmai National Park
Exotic Plant Management Team

1:125,000



MAP 5C: Valley of 10,000 Smokes Road - 2010 Inventory

Locations of *Capsella bursa-pastoris* (shepherd's purse)



Legend

- Road
- Trail
- *Capsella bursa-pastoris*

Coverage Collected With:
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Data Collection and Map By:
Crystal Shepherd and Devin Bartley
Projection: **Alaska Albers**
Datum: **NAD 83**



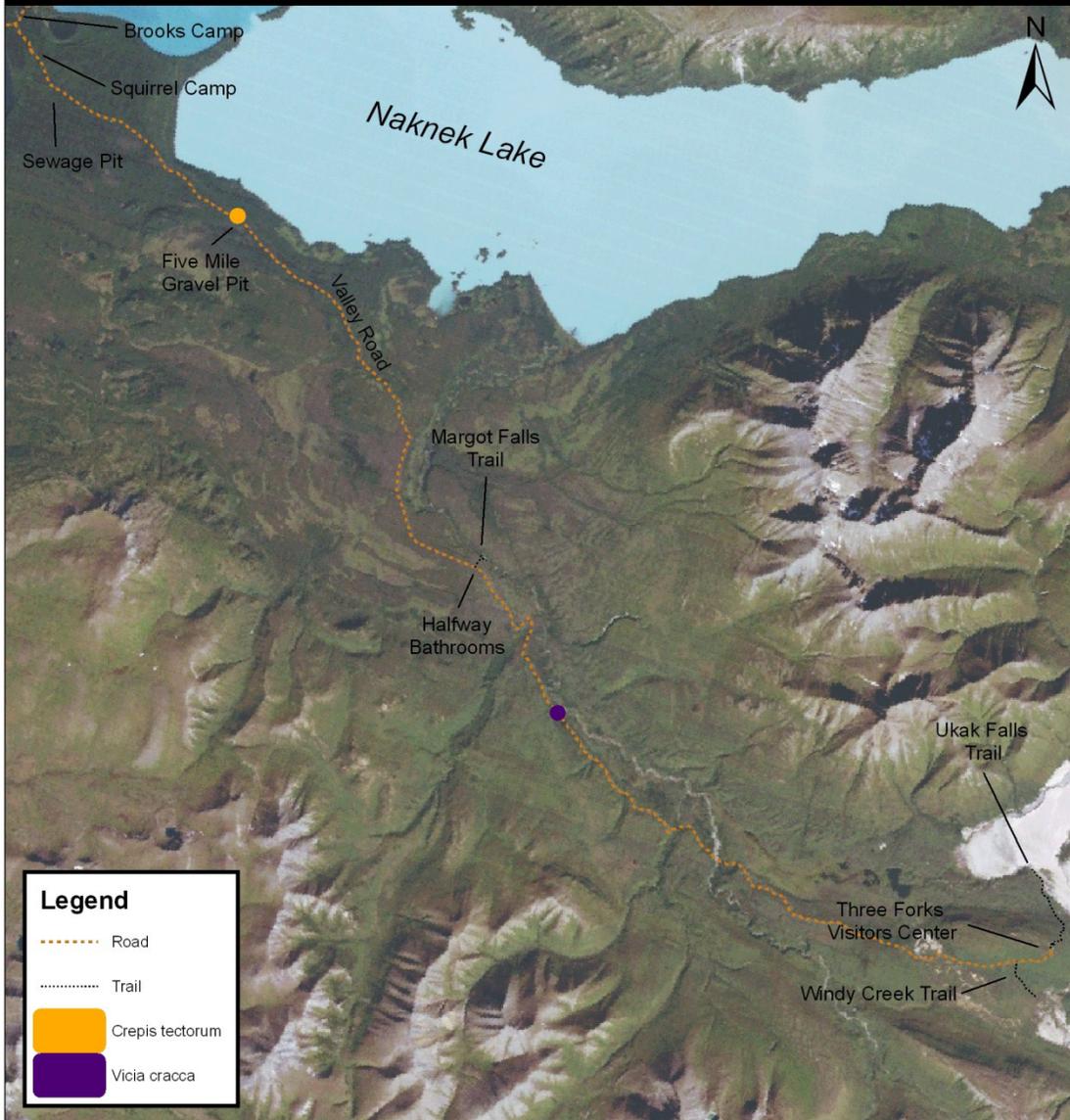
National Park Service
Katmai National Park
Exotic Plant Management Team



MAP 5D: Valley of 10,000 Smokes Road - 2010 Inventory



Locations of *Crepis tectorum* (narrowleaf hawksbeard) and *Vicia cracca* (bird vetch)



Legend

- Road
- Trail
- *Crepis tectorum*
- *Vicia cracca*

Coverage Collected With:
Trimble GeoXT 2008 GPS unit
Data Collection and Map By:
Crystal Shepherd and Devin Bartley
Projection: **Alaska Albers**
Datum: **NAD 83**



National Park Service
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Appendix B – Bristol Bay’s Most Wanted Posters

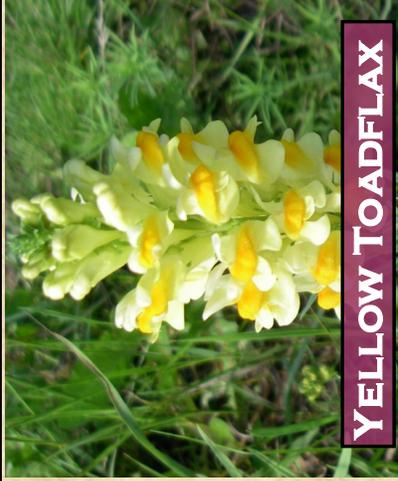
BRISTOL BAY'S MOST WANTED



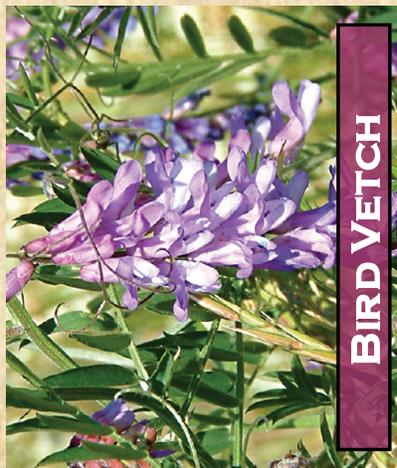
COMMON DANDELION



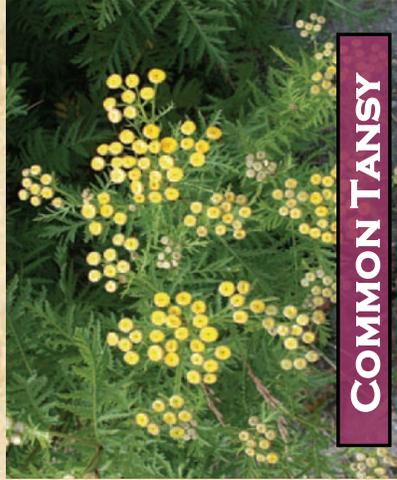
EUROPEAN BIRD CHERRY



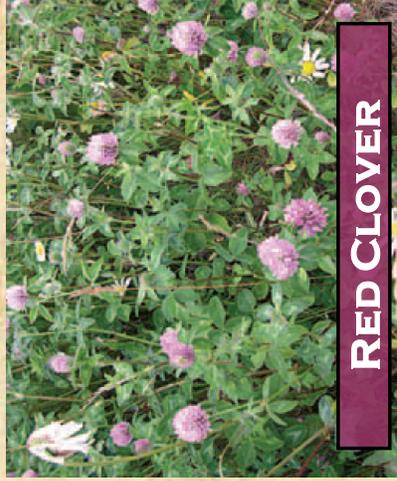
YELLOW TOADFLAX



BIRD VETCH



COMMON TANSY



RED CLOVER



WANTED: For destruction of native plant habitats.
Please contact the Exotic Plant Management Team at 246-2145 or
whitney_rapp@nps.gov with any information leading to the apprehension of these
felons.