



Invasive Plant Management in Wrangell-St. Elias National Park and Preserve

2016 Summary Report

Natural Resource Report NPS/WRST/NRR—2016/1362





ON THE COVER

From Top Left Clockwise: EPMT and SCA crew holding bags of recently pulled *Melilotus albus*, side-by-side of *Trifolium pratense/repens/hybridum*, Natalie Balkam and Jacob DeKraai at the EPMT booth in McCarthy on July 4th, *Bromus inermis* at the Marvelous Mill, bag of seed mix in McCarthy, *Cirsium arvense* in Yakutat, *Ranunculus repens* in Yakutat, Maura Schumacher collecting an eDNA sample.

Photographs by Jacob DeKraai, Natalie Balkam, Maura Schumacher and Peter Frank

ON THIS PAGE

The Copper River seen from a bluff along the Copper Lake Trail

Photograph by Peter Frank

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Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols. This report received formal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data, and whose background and expertise put them on par technically and scientifically with the authors of the information.

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Abstract

This report summarizes work conducted by the Exotic Plant Management Team (EPMT) in Wrangell-St. Elias National Park and Preserve (WRST) during the 2016 field season. This summer marked the twelfth consecutive year WRST staff have inventoried and controlled invasive plants in the park, preserve and adjoining gateway communities. The 2016 WRST EPMT consisted of two National Park Service (NPS) Biological Science Technicians and two CLM (Chicago Botanic Garden Conservation and Land Management) interns stationed at Park Headquarters in Copper Center. Field work was focused on the following objectives: Monitor and control known infestations; survey for and document new infestations; and prevent the spread of invasive species through NPS activities. A total of 280.2 acres were surveyed by EPMT staff during the 2016 field season, of which a total of 14.8 acres were found to be infested. Of the 14.8 infested acres, a total of 10.4 acres were treated by means of manual and chemical control. In total, 31 invasive species were documented by the WRST EPMT in 2016. Throughout the season, seed from 23 native plant species was collected with a combined weight of 35.1 pounds.

Acknowledgments

The authors would like to thank all the individuals who have dedicated their time and energy to make the 2016 Wrangell-St. Elias National Park and Preserve Exotic Plant Management Team's season a success. Peter Frank, for his knowledge of vegetation in the park, technical skills in ArcMap and GPS technology and endless effort toward field planning and logistics; Maura Schumacher, for her valuable experience with invasive plant management, which carried over into the field; and Chris Overbaugh for his overall expertise and assistance in all aspects of the EPMT program. We would also like to recognize all the partners involved in the Copper Basin Community Weed Management Area for their assistance in monitoring and controlling infestations in the park's gateway communities.

The authors would also like to acknowledge those who so generously volunteered their time to benefit the EPMT this summer; the Student Conservation Association Interns and Youth Conservation Corps interns whose hard work helped to control some of our largest and most persistent infestations; and all the community volunteers who helped with the annual Glennallen Weed Smackdown and Gakona Weed Pull.

Acronyms

AKNHP Alaska Natural Heritage Program

CB-CWMA Copper Basin Cooperative Weed Management Area

CLM Chicago Botanic Garden's Conservation Land Management

CRWP Copper River Watershed Project

DOT Alaska Department of Transportation

EPMT Exotic Plant Management Team

GNSS Global Navigation Satellite System

NHL National Historic Landmark

NPS National Park Service

ORV Off-road vehicle

RZ Reporting zone

SCA Student Conservation Association

WISE Wrangell Institute for Science and Environment

WRST Wrangell-St. Elias National Park and Preserve

YCC Youth Conservation Corps

Introduction

For much of its history, Alaska has remained relatively unaffected by the negative consequences caused by non-native plant establishment in many regions of the world (Carlson and Shephard 2007); unfortunately over the past decades, this has not been the case. In Alaska, 175 non-native plants have become naturalized, and additionally 139 are possibly ephemeral (Nawrocki et al 2011). These numbers are both alarming and indicative that action must be taken to suppress the invasion of economically and ecologically harmful non-native plants. In response to the spread of invasive plants in Alaska, land managers have begun to develop management plans to help minimize the influx of unwanted plants (Nawrocki et al 2011). Invasive plants are of concern due to their ability to threaten the existence of untampered gene pools through hybridization and competition with native flora, as well as their potential to alter the structure and function of ecosystems through changes in geophysical and nutrient dynamics (Vitousek et al. 1996, Gordon 1998). The increasing intensity of human caused disturbance has promoted greater susceptibility to non-native plant introduction in anthropogenically-affected areas (Nawrocki et al 2011). Once established, these non-native species can disperse into areas of limited human disturbance and particularly aggressive plants can spread into areas of natural disturbance.

In Wrangell-St. Elias National Park and Preserve (WRST), the Exotic Plant Management Team (EPMT) has been combating this influx of non-native plants to help protect the ecological integrity of the largest national park unit in the United States. As infrastructure and access to Southcentral Alaska and WRST has increased over the past century, it has brought with it an influx of non-native and invasive plants. The National Park Service (NPS) EPMT employs an integrated approach to invasive plant management which includes; inventory and monitoring, control, outreach, education, prevention and restoration. Since the establishment of the EPMT at WRST, the following four objectives have been identified: a) monitor known infestations of invasive plants; b) contain, control and where possible eradicate these infestations; c) inventory areas of known human disturbance where invasive plants are likely to appear and d) where possible, to prevent the further spread of invasive species in and around WRST.

Access to WRST is facilitated by the McCarthy and Nabesna Roads, numerous off-road vehicle (ORV) trails, maintained/unmaintained backcountry landing strips and floatplane lakes. These access points and areas of high human activity serve as vectors for non-native plant introduction into the park. Private land is also abundant in the park, and many in-holders cultivate nonnative plants for agricultural or ornamental value. These plants all retain the potential to spread into public lands and establish potentially damaging populations. Beyond the influence of anthropogenic disturbance, non-human disturbances such as fluctuating streambeds, de-glaciation, mudslides, game trails and other natural disturbances create suitable habitat where nonnative plants can colonize (Spellman and Wurtz 2010). Early detection of invasive species through comprehensive front and backcountry surveys is crucial for effective management. More recently, movement of aquatic invasive plants, particularly *Elodea canadensis*, into the Copper River Watershed, near Cordova, has been of concern to the WRST EMPT. This concern has warranted extensive surveys for aquatic invasive species in lakes receiving floatplane traffic throughout the park.

The following report details work conducted by the WRST EPMT during the 2016 season and provides recommendations for future invasive plant management in WRST.

Methods

Fieldwork at WRST was conducted between May 31st and September 9th, 2016. The core members of the 2016 WRST EPMT were; Peter Frank, NPS GS-7 EPMT field crew lead, Maura Schumacher, NPS GS-5 Biological Science Technician, Natalie Balkam, CLM intern, and Jacob DeKraai, CLM intern. One five person Youth Conservation Corps (YCC) crew and one SCA intern worked a total of 80 person hours assisting the WRST EPMT with manual control efforts. One six-person SCA crew worked a total of 720 person hours over the course of three weeks on manual control efforts, native seed collection and revegetation projects.

Defining Reporting Zones

To facilitate reporting efforts, the park and its environs have been divided into nine reporting zones (RZ) (Figure 1) based on the 2011 WRST Natural Resource Condition Assessment (Drazkowski et al. 2011). Given the size of this park, these divisions allow for more meaningful and focused reporting. Therefore, the results in this report are structured around these RZs. This report only addresses the RZs that were visited in 2016.

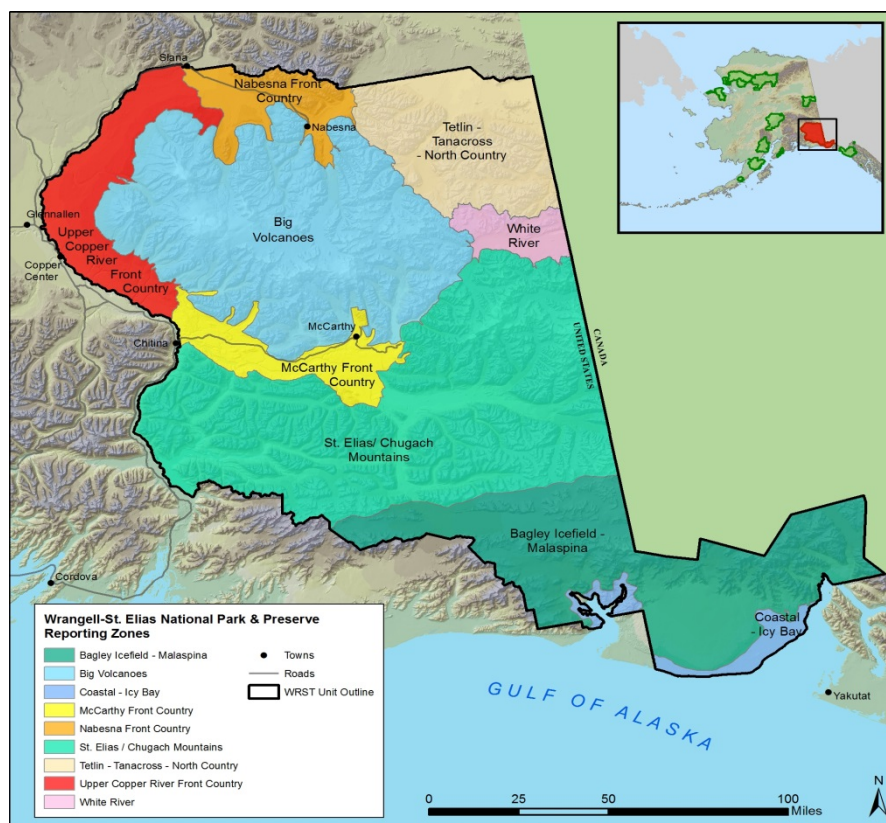


Figure 1. Map of the Reporting Zones used in Wrangell-St. Elias

Data Collection and Analysis

Methods of mapping and data collection followed the 2016 Alaska EPMT field protocol (Million et al. 2016). All inventory, control, and restoration work were mapped using two Trimble GeoExplorer

2008 Series GeoXT data loggers, one Trimble Geo7X, and one Trimble Juno 3D, all equipped with a standardized Alaska EPMT data dictionary. These units were used to record both spatial and attribute data for geographic information system (GIS) analysis. GPS data were differentially corrected and edited by field personnel using Trimble GPS Pathfinder Office 5.81. Post-processed GPS data were sent to the Alaska Regional office every two weeks to be converted into GIS data and entered into two geodatabases: the National Park Service's National Invasive Species Information Management System (NISIMS) and the Alaska Natural Heritage Program's Alaska Exotic Plant Information Clearinghouse (AKEPIC). GIS data were used to calculate the number of acres surveyed, infested and treated during the 2016 field season. Acres surveyed represents the total area mapped. Acres infested represents the area of a mapped infestation multiplied by the percent cover of invasive plants in that mapped area. Acres treated represents the area of a mapped infestation multiplied by the percent cover of invasive plants in that mapped area and by the percent of the infestation treated. These acreage numbers are used in reporting by the Alaska EPMT and will be used throughout this report.

Prioritizing Fieldwork

The WRST EPMT utilized existing data and reports from previous years to prioritize inventory and monitoring efforts, identify species for control and select appropriate control methods. In developing a course of action, this season's phenology, available work force and resources were also taken into account.

Inventory and Monitoring

Inventory and monitoring efforts focused on transportation corridors and areas of high human activity. Terrestrial invasive plant surveys within the park were focused on the McCarthy and Nabesna Front Country RZs. The roads, trails and airstrips in these areas receive the majority of the parks visitation and are therefore the primary targets for survey work. Survey efforts outside the park focused on the park administered lands in Copper Center, Glennallen and Slana. The WRST EPMT used multiple modes of transportation including hiking, biking, Off-Road Vehicles (ORVs) and vehicles to complete surveys.

Inventories for aquatic invasive species, specifically *Elodea*, focused on water bodies known to receive heavy float plane traffic from infested areas such as Cordova or Anchorage. Water bodies that support spawning habitat for salmon were given the highest priority. Inventories were conducted by paddling the perimeter of the lake in an inflatable raft or canoe and visually surveying the littoral zone. Unknown plants were retrieved with a double-headed rake and identified in the boat. In 2016, EPMT staff surveyed aquatic plants in a total of 14 lakes including; Beaver, Carden, Jack, Long, Mesa, Peninsula, Pippin, Sheep, Silver, Solo, Strelna, Tanada, Tebay, and Willow Lakes.

Control Work

Under direction of NPS Management Policy Section 4.4.4 (2006), high priority is given to managing invasive species which have or could have a substantial impact on park resources and that can reasonably be expected to be successfully controlled. Lower priority is given to invasive species that have limited impact on park resources or that cannot be successfully controlled. Where an invasive species cannot be successfully managed, EPMT seeks to monitor and contain the invasive species to

prevent further spread or resource damage (NPS 2006). The WRST EPMT expands upon these national standards by assessing additional variables (Table 1) to further refine the prioritization of control work. One of these variables, the invasiveness rank (as defined by Carlson et al. 2008), is used to understand the intensity of invasiveness of each species in relation to one another. Higher values indicate higher invasiveness capability in Alaska.

Table 1. Variables used to prioritize invasive plant management.

Variables	High Priority	Low Priority
Invasiveness Rank *	Greater than 55	Less than 55
Geographic Location	Backcountry	Frontcountry
Potential Impacts on Park Resources	Significant	Limited
Potential for Dispersal	Strong	Weak
Extent	Small Extent (<1 acre)	Large Extent (>1 acre)
Feasibility of Successful Control	High	Low

*The invasiveness rank is a 1 to 100 scale, developed by the Alaska Natural Heritage Program (AKNHP), in which higher scores denote greater invasiveness (Carlson et al. 2008).

Infestations given top priority for control in 2016 included: white sweetclover (*Melilotus albus*) at the intersection of the Nabesna Road and Tok cutoff, narrowleaf hawksbeard (*Crepis tectorum*), common tansy (*Tanacetum vulgare*) and yellow toadflax (*Linaria vulgaris*) at the Glennallen park maintenance yard, oxeye daisy (*Leucanthemum vulgare*) in Kennecott, and narrowleaf hawksbeard and white sweetclover at the Kuskulana gravel pit (McCarthy road, mile 17).

Control Methods

Manual control methods, such as hand pulling or digging, were the primary means of invasive plant removal employed by the 2016 WRST EPMT. Field personnel occasionally focused on removing flowering individuals if infestations were too large to uproot with allocated resources; though this does not help reduce the density or extent of the infestation, it does help to prevent the further spread of the population or the potential for distribution to new areas through seed dispersal.

All invasive plant material removed through manual or mechanical control was bagged and weighed using a hanging scale. Plant material removed prior to seed set was deposited at the Copper Basin Sanitary landfill, while plant material removed during seed set were stored and periodically transported to Anchorage for incineration at a commercial incinerator. These methods minimize the potential for propagule dispersal while disposing of the invasive plant material.

Chemical control was utilized by the 2016 EPMT staff in accordance with the 2010 NPS herbicide Environmental Assessment's (EA) Finding of No Significant Impact (FONSI) (NPS 2010). Chemical herbicides have been employed in WRST since 2011 to control high priority infestations around the park. In 2016, EPMT staff conducted the first herbicide applications in the Alaska Department of Transportation (AK-DOT) right-of-way at the intersection of the Nabesna Road and Tok cutoff. These applications were done in partnership with the Copper River Watershed Project (CRWP) and

followed the procedures laid out by the AK-DOT Integrated Vegetation Management Plan (Coffey 2016). The herbicide Milestone, a broadleaf specific herbicide containing the active ingredient aminopyralid, was used for the majority of treatments in 2016. Additional herbicides used included Aquamaster and 2,4-D. All herbicide operations were performed by crew members who had received training and earned certification as State of Alaska Licensed Pesticide Applicators.

Restoration and Prevention

The most efficient and cost effective strategy for managing invasive species is to prevent their introduction. NPS management policies state that park staff should strive to limit impacts on natural systems within the parks, such as introduction of invasive species (NPS 2006). Restoration of native plant communities not only precludes invasive species, but can accelerate the recovery of biological functions and physical components of the parks ecosystems.

Restoration and prevention efforts within the park have focused on ongoing construction projects and trail maintenance (NPS 2011). In Kennecott, restoration efforts were identified in the Kennecott Operations Plan (NPS 2013) and involved collecting seed for herbaceous re-vegetation around the Kennecott National Historic Landmark (NHL), and planting seed mixes consisting of various grasses and forbs along gravel slopes (Figure 2). For the rest of the park, restoration and prevention efforts have focused on ongoing construction projects and continuing trail maintenance. In 2016 these efforts were focused around the Copper Lake Trail and included native seed collection and planting, as well as transplanting along old trails. Prevention efforts have been focused on monitoring and controlling non-natives found in material storage and extraction sites, such as the Glennallen Maintenance Yard and Kuskulana gravel pit.



Figure 2. The gravel slopes beneath the General Manager's office in Kennecott NHL has been identified as a target for revegetation.

The WRST EPMT manages the parks seed bank, which provides native plant material for park restoration and outreach projects. Seed collection is done in the late summer and fall, and focuses on early successional species or species which are prevalent in the area. Seed cleaning and preparation is

done in house, depending on the type of seed and the available work force. Seed needing further processing with specialized equipment, such as grasses, will be processed by the Alaska Plant Material Center in Palmer. Seeds are stored at the park headquarters in Copper Center in freezer kept at 0°F, to prolong viability.

In an effort to limit the spread of invasive plants through park related maintenance projects, the WRST EPMT attempts to inspect and clean machinery, equipment and ORVs before they enter the park. These efforts are accomplished through cooperation with park maintenance staff and contractors to determine when and where the equipment or ORV will be coming into the park and who will perform the inspections and cleanings.

2016 Field Season Summary

In 2016, the WRST EPMT and volunteers spent a total of 2,378 hours in the field surveying for, mapping and controlling invasive plant species. Through these efforts, 280.2 acres in and around the park and preserve were surveyed and mapped. These surveys resulted in the documentation of 31 invasive plant species covering 14.8 acres (see Table 2). The WRST EPMT treated a total of 10.4 infested acres in 2016 resulting in 2,912 lbs of plant material physically removed and 254.97 gallons of mixed herbicide applied containing a total of 45.1 fl oz of Milestone concentrate, 13 ml AquaMaster concentrate and 0.24 ml 2, 4-D.

Seven SCA volunteers and five YCC crew members worked a total 816 hours on invasive plant removal and seed collection projects. A total of 27 volunteers assisted with various projects during the season working a total of 78 hours.

Table 2. Presence of Exotic Invasive Plants in WRST Reporting Zones 2016

Scientific Name	Common Name	AKEPIC Ranking	Reporting Zone (RZ) ^A				
			Upper Copper River	McCarthy Front Country	Nabesna Front Country	Big Volcanoes	Coastal – Icy Bay
<i>Capsella bursa-pastoris</i>	shepherd's purse	40		X	X		
<i>Cerastium fontanum</i>	big chickweed	36					X ^B
<i>Chenopodium album</i>	common lambsquarter	37	X		X		
<i>Crepis tectorum</i>	narrowleaf hawksbeard	56	X	X	X		
<i>Cirsium arvense</i>	Canada thistle	76					X ^B
<i>Descurainia sophia</i>	flixweed	41			X		
<i>Elymus repens</i>	quackgrass	59	X				
<i>Euphrasia nemorosa</i>	common eyebright	42					X ^B
<i>Leucanthemum vulgare</i>	oxeye daisy	61		X			
<i>Linaria vulgaris</i>	yellow toadflax	69	X ^B				
<i>Matricaria discoidea</i>	pineapple weed	32			X		
<i>Medicago sativa</i>	yellow alfalfa	64	X				
<i>Melilotus albus</i>	white sweetclover	81	X	X	X		
<i>Melilotus officinalis</i>	yellow sweetclover	69		X ^B			
<i>Phleum pratense</i>	common timothy	54		X			
<i>Plantago major</i>	common plantain	44		X	X		X ^B
<i>Poa annua</i>	annual bluegrass	46			X		X ^B
<i>Ranunculus repens</i>	creeping buttercup	54					X ^B
<i>Ranunculus acris</i>	tall buttercup	54					X ^B
<i>Silene dioica</i>	red catchfly	42		X			
<i>Tanacetum vulgare</i>	common tansy	60	X				

^A Plants detected in the Glennallen WRST maintenance yard are included in the Upper Copper River RZ and those detected outside of Yakutat Ranger Station/Hanger are included in Coastal – Icy Bay RZ.

^B Documented in 2016 for the first time in this RZ

Table 2 (continued). Presence of Exotic Invasive Plants in WRST Reporting Zones 2016

Scientific Name	Common Name	AKEPIC Ranking	Reporting Zone (RZ) ^A				
			Upper Copper River	McCarthy Front Country	Nabesna Front Country	Big Volcanoes	Coastal – Icy Bay
<i>Taraxacum officinale</i> ssp. <i>officinale</i>	common dandelion	58	X	X	X		X
<i>Trifolium hybridum</i>	alsike clover	57			X		
<i>Trifolium repens</i>	white clover	59			X		X

^C Plants detected in the Glennallen WRST maintenance yard are included in the Upper Copper River RZ and those detected outside of Yakutat Ranger Station/Hanger are included in Coastal – Icy Bay RZ.

^D Documented in 2016 for the first time in this RZ

Coastal – Icy Bay RZ

Yakutat

In 2016 the WRST EPMT surveyed, for the first time, the areas surrounding the NPS hanger in Yakutat (Figure 3). This property, located adjacent to the Yakutat Airport, serves as a base of operations for staff travelling into backcountry areas of both WRST and Glacier Bay National Preserve (GLBA). Many different invasive species were found in the yard outside of the hanger, including white clover (*Trifolium repens*), common dandelion (*Taraxacum officinale*), mouse-ear chickweed (*Cerastium fontanum*), annual bluegrass (*Poa annua*), common plantain (*Plantago major*), creeping buttercup (*Ranunculus repens*), tall buttercup (*Ranunculus acris*), and common eyebright (*Euphrasia nemorosa*).

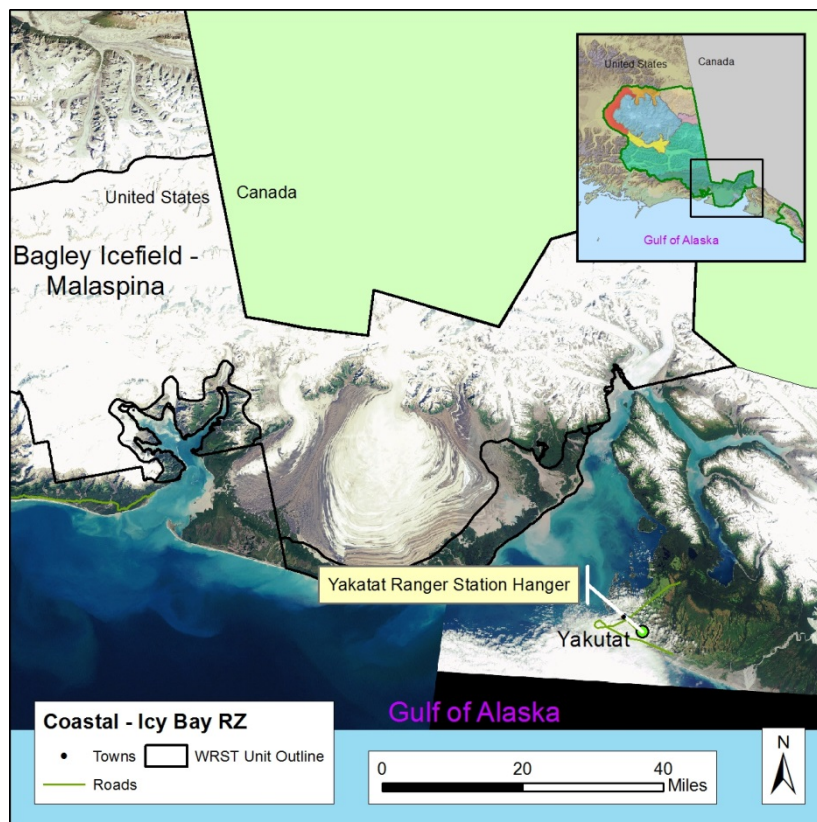


Figure 3. Map of Coastal – Icy Bay Reporting Zone

However, two species of primary concern, Canada thistle (*Cirsium arvense*) and reed canarygrass (*Phalaris arundinaceae*), were found in a roadside ditch across from the hanger. EPMT staff mapped, and manually removed as much of the Canada thistle infestation as possible, but given its complex and sturdy root system, removal was difficult, and the potential for regrowth is very high. Reviewing the AKEPIC database it appears that this is the first documented occurrence of Canada thistle (Figure 4) in Yakutat (AKEPIC 2016). Reed canarygrass was found in multiple locations along the roadsides near the NPS hanger and was not controlled. Though both species were found on

DOT property, given their close proximity to NPS property, the WRST EPMT should continue to monitor these infestations and consider plans for future management.



Figure 4. Canada thistle found outside of the hanger in Yakutat.

McCarthy Front Country RZ

McCarthy Road

The McCarthy Road is one of the two main access roads into WRST (Figure 5). Two individual white sweetclover plants were observed along the McCarthy road. Both were promptly mapped and removed.

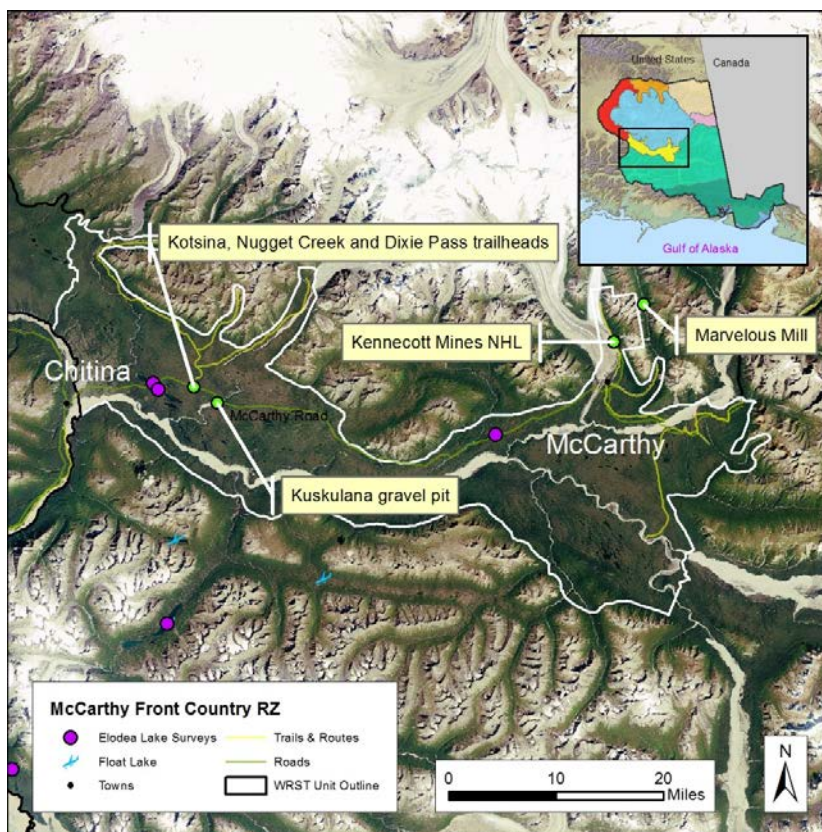


Figure 5. Map of the McCarthy Front Country Reporting Zone

Kuskulana Gravel Pit (Mile 17)

This DOT managed gravel pit is located on the south side of the Kuskulana Bridge off of the McCarthy road. Though it is not a public use area, the gravel pit receives heavy traffic from RV campers and visitors wandering in from the adjacent outhouses. The presence of invasive plants in this gravel pit is very concerning, as there is significant potential for dispersal from this pit on gravel which is used elsewhere along the McCarthy Road. In 2016, the WRST EPMT visited this site a total of 3 times throughout the season to map and manually control infestations in the gravel pit.

During the first site visit in early July, we mapped and pulled narrowleaf hawksbeard, white sweetclover, and yellow sweetclover (*Melilotus officinalis*). With the exception of a few individuals, most of the sweetclover was concentrated in one area near the entrance to the pit. Narrowleaf hawksbeard was found throughout the pit, but mostly concentrated toward the end opposite to the entrance. During the second visit in early August, we focused on the sweetclover patch, and only mapped and pulled the white sweetclover. In the final visit of the season in mid-August, we pulled all flowering narrowleaf hawksbeard, and all visible sweetclover rosettes.

Kotsina River Trail

Approximately 14 miles of the Kotsina River Trail, starting at the Nugget Creek trail head, were surveyed in 2016. The main invasive plant documented was common dandelion, with a few small patches of common plantain also observed. Common dandelion was found frequently along the Kotsina River Trail, with particularly dense patches located around areas of clear human activity, such as trailheads, gravel clearings or fire pits.

Kennecott Mines National Historical Landmark

The Kennecott National Historic Landmark (NHL), along with the nearby town of McCarthy, serves as a source of invasive plant species within the surrounding wilderness. In 2016, control efforts focused on oxeye daisy, which has been observed planted in multiple locations in the Kennecott Mill Town but has yet to escape into the surrounding areas. This year, the WRST EPMT focused on managing the oxeye daisy located on NPS lands on the hill side southwest of the Kennicott Glacier Lodge. This location has been treated every year since 2004, excluding 2005 and 2012 and was fully treated in 2016 during three trips to Kennecott. During each visit, there were seemingly new patches of dense rosettes. AKNHP has given oxeye daisy an invasiveness ranking of 61 out of 100. This is due, in part, to its difficulty to control, as it is highly rhizomatous (see Figure 6), and new individuals can grow from root fragments left behind after hand pulling (Frank 2015). With each progressive retreatment, the number of individuals observed and subsequently pulled appeared to decrease.

During a seed collection event in late August, we observed red catchfly (*Silene dioica*) at two points along the Jumbo Mine trail. These individuals were mapped and removed. This was the first sighting of red catchfly outside of ornamental plantings in Kennecott and McCarthy.



Figure 6. Rhizomatous oxeye daisy found at the Kennecott NHL.

Marvelous Mill

Marvelous Mill is a former homestead, located 8 miles northeast of McCarthy along McCarthy Creek, which is now a privately owned inholding. The primary intent behind this trip was to assess previously un-surveyed trails on NPS lands across McCarthy Creek from the inholding. On the bulldozer trail leading to the Mother Load Mine, common dandelion was found sporadically from the base of the trail just across McCarthy Creek approximately 1.1 miles up to the point where the trail crosses a large scree field. EPMT staff also surveyed an additional 2.3 miles of the ATV trail leading back to the town of McCarthy on the west side of McCarthy Creek. Sporadic patches of common dandelion and timothy grass (*Phleum pratense*) were found along this trail. The invasive plant timothy grass was often observed growing alongside its native counterpart, alpine timothy (*Phleum alpinum*).

On NPS lands adjacent to the homestead, including the air strip and associated trails, EPMT staff observed dense infestations of white clover, red clover (*Trifolium pratense*) alsike clover (*Trifolium hybridum*), timothy grass, common plantain and common dandelion (Figure 7). We also identified small patches of Kentucky bluegrass (*Poa pratensis*) and smooth brome (*Bromus inermis*) on NPS lands near the home site. We did not find the black bindweed (*Fallopia convolvulus*) or hempnettle (*Galeopsis tetrahit*) that had been mapped during previous surveys in 2012.



Figure 7. Timothy grass, white clover, and common dandelion found in property outside of Marvelous Mill homestead.

Nabesna Front Country RZ

The Nabesna Front Country RZ (Figure 8) is an area of the park with a patchwork of private and federal land containing, among other things: the entirety of the Nabesna Road, the highest density of trails in the park, the Slana Ranger Station, the Kendesnii Campground and several public-use cabins. As a mix of park and preserve, this area of the park is popular among subsistence hunters, thus backcountry travel via off-road vehicles is common on federally managed trails.

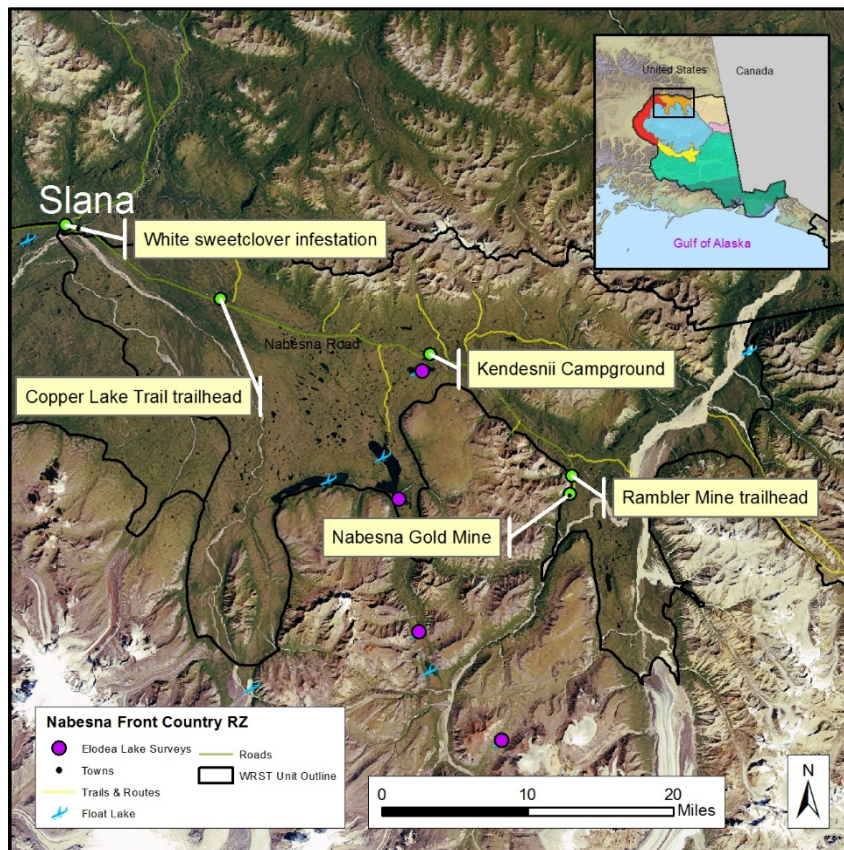


Figure 8. Map of the Nabesna Front Country Reporting Zone

Slana

Since 2005, control work has been performed on a large infestation of white sweetclover just outside of the RZ at the intersection of the Nabesna Road and Tok Cut-off. AKNHP invasiveness ranking system scores white sweetclover as 81 out of 100 (Carlson et al 2008), and it has proved a worthy adversary for the WRST EPMT. Due to the potential for this infestation to move into the park through the Nabesna Road, it has been one of the highest management priorities for the WRST EPMT. EPMT staff partnered with the CRWP to obtain the necessary permitting for herbicide treatments from the AK-DOT via their Integrated Vegetation Management Plan (Coffey 2016).

In June 2016, the initial herbicide treatments involved two WRST EPMT members, one Alaska Regional EPMT member, 1 CRWP staff member and one volunteer. Over the course of two days a

total of 3.15 infested acres were treated using 107.75 gallons of mixed herbicide containing 18.9 fl. oz. of Milestone concentrate.

A follow up visit was conducted in July, during which two WRST EPMT members, a 6 person SCA crew and one CRWP staff member spent two days manually removing all flowering white sweetclover at the intersection of the Nabesna Road and Tok Cut-off (Figure 9). During these treatments, a previously unknown patch of white sweetclover was found and partially treated at the southeastern extent of the infestation, outside of the initially treated area.



Figure 9. SCA crew members count and weigh bags of white sweetclover recently pulled at the Tok cutoff.

A final re-treatment was conducted in late August by 4 WRST EPMT members and one Alaska Regional EPMT member. An herbicide treatment, in combination with manual treatment, was conducted over 2 days. Manual treatment focused on flowering plants, while herbicide treatment focused on first year vegetative growth. During this final treatment, a total of 99 gallons of mixed herbicide were applied containing 17.5 fl. oz. of Milestone concentrate. A post-application site inspection was conducted a month after this treatment, and the treatment was generally effective.

Nabesna Road

The Nabesna Road stretches 43 miles into the park and is frequently used by hunters to access the northern part of the park and subsistence use areas. The Nabesna Road has been biannually surveyed via bike for invasive plants by the WRST EPMT. Due to time constrictions, the survey was not conducted in 2014, but surveyed in 2010 and 2012. In late July 2016, the Nabesna Road was once again surveyed for invasive plants (Figures 10 and 11). The focus of the survey was to inventory and, if possible, manually treat all invasive plants found on the road with the exception of the following; common dandelion, common plantain and pineappleweed (*Matricaria discoidea*), which have been previously mapped and were not a high priority to inventory or control.



Figure 10. The EPMT staff pause along the Nabesna road to identify an unknown plant.



Figure 11. The EPMT staff conducts bike survey along Nabesna Road.

Mile 0 - Mile 10

The survey began with a small patch of narrowleaf hawksbeard found and mapped near the post office at mile 1, and then at Betty Freed's property at mile 3, where a small infestation of shepherd's purse was discovered. The survey continued to mile 10, where the crew stopped and started back down the road to survey the opposite side of the road. No invasive plants were found on this stretch. On the return to Slana Ranger Station, a single white sweetclover was detected and manually removed around 0.25 miles from the station.

Mile 10 to Mile 30

Due to high waters, the crew did not cross Lost Creek at mile 30, so the next section of the road was started in the opposite direction, from Kendesnii Campground at mile 28, and back to mile 10. Small

patches of lambsquarter (*Chenopodium album*) were discovered, and mapped on both sides of the road. Periodic manual treatments of lambsquarter were also conducted to remove as much as possible along the roadsides. The final 2 miles up to Lost Creek and back to Kendesnii Campground were finished in the vehicle and no invasive plants were found. A small population of flixweed (*Descurainia sophia*) was discovered in the campground, along with one individual along the creek at mile 21; both were manually removed.

Mile 30 (Lost Creek) to Mile 43 (Nabesna Mine)

The remaining section of the road starting at Mile 30 was surveyed without bicycles in mid-August. A large section was conducted in a vehicle and no invasive plants were found until the Nabesna Road transitions into an ATV trail. At this point, the ATV trail leads to the abandoned Nabesna Mine. This remaining section of the road to the mine was surveyed on foot. No invasive plants, other than low-priority pineapple weed, annual bluegrass and common plantain, were found on the trail. The Rambler Mine Trail, which branches off of the ATV trail leading to Nabesna Mine, was also surveyed for invasive plants. Only the same low priority species were found on the trail, with decreasing abundance until the trail begins to approach treeline, at which point no invasive plants were observed.

Betty Freed Property

The Betty Freed Property is located a little over 2 miles past the Slana ranger station on the Nabesna road. It is used primarily for NPS housing. In early May of this year, herbicide was applied to the area surrounding the housing units to treat the common dandelion, narrowleaf hawksbeard, and scentless false mayweed (*Triplospermum inoderum*).

St. Elias/Chugach Mountains RZ

Iceberg Lake landing strip has been on the EPMT radar for years due to its high visitation from backpackers and sightseeing tours from McCarthy (Figure 12). The route from Iceberg Lake to Bremner Glacier is a popular trek in the Chugach Mountains of Wrangell-St. Elias. In 2016, the landing strip was surveyed with no invasive plants detected. The landing strip is on a large sandbar with little vegetation present. A poorly established trail was also surveyed up to the glacier between Iceberg Lake and Bremner Glacier. This particular trail had no invasive plants present, but it is assumed that other social trails exist in the area, which were not surveyed during this trip.

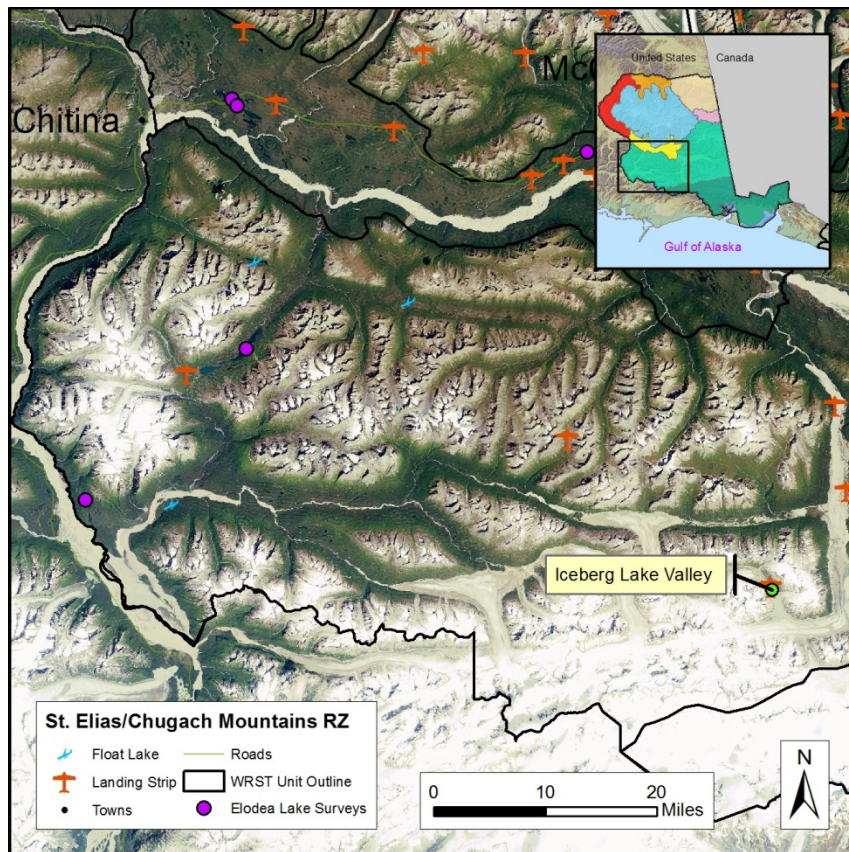


Figure 12. Map of the St. Elias/Chugach Mountains Reporting Zone

Upper Copper River Front Country RZ

The Upper Copper River Front Country RZ includes both the Wrangell-St. Elias headquarters and the Glennallen maintenance yard (Figure 13). Though both are not technically within park boundaries, they are included in this RZ. WRST headquarters and the Glennallen maintenance yard are important locations to continue monitoring and managing, as both areas have high usage and visitation rates from employees and tourists; the visitor center receives the highest number of visitors in the entirety of the park, and the maintenance yard is a centralized location for much of the equipment and gear utilized by employees.

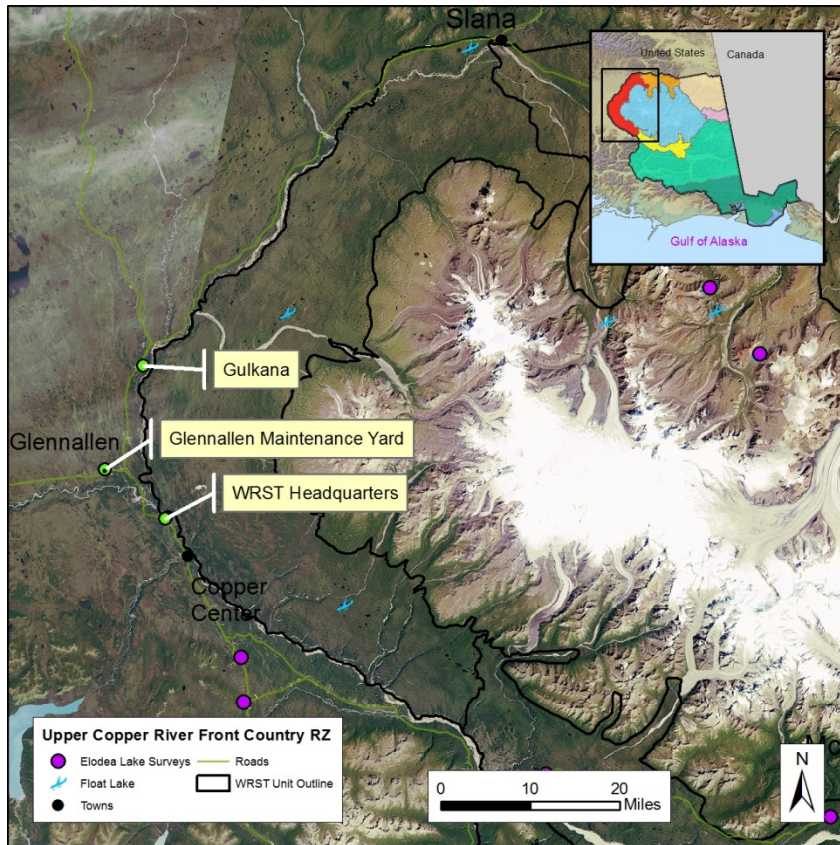


Figure 13. Map of Upper Copper River Front Country Reporting Zone

WRST Headquarters

In 2016, three main areas at WRST headquarters were monitored and treated; headquarters campus, seasonal housing, and the gravel pit in between seasonal housing and the headquarters campus. There are a multitude of invasive plants growing around the seasonal housing area, including narrowleaf hawksbeard, lambsquarters, common dandelion, common plantain, and pineappleweed. This year, the EPMT focused on controlling narrowleaf hawksbeard by manual removal of all flowering individuals. The gravel pit was attended to by the EPMT a total of two times this season, the first at the end of June, and the second in mid-August. In June, all visible narrowleaf hawksbeard was manually removed, resulting in about two garbage bags worth of plant material. In addition, a small population of yellow alfalfa (*Medicago sativa*) was chemically treated in June. No regrowth was observed in the treated area this summer. The manual removal of narrowleaf hawksbeard was less effective, and the area required a second round of manual treatment in mid-August, which resulted in approximately one garbage bag of plant material. This gravel pit is the primary locations for ATV training and therefore it should be continually monitored and maintained to prevent spread of these invasive plants.

Herbicide was applied to areas surrounding Copper Center headquarters in order to control the narrowleaf hawksbeard infestation. The treatment occurred in early May. In addition, the YCC crew manually removed common dandelion on the lawn outside of headquarters, in mid-June.

Glennallen Maintenance Yard

Though there are a variety of invasive plants in the Glennallen maintenance yard, narrowleaf hawksbeard, white sweetclover and quackgrass (*Elymus repens*) were the main focus for chemical and manual treatments (Figure 14). Four rounds of chemical treatment on narrowleaf hawksbeard occurred at the Glennallen maintenance yard during the 2016 season. These treatments occurred monthly starting in early May and ending in mid-August. These chemical treatments were supplemented by two rounds of manual control, in July and August, both of which focused on removing flowering plants.



Figure 14. The EPMT staff remove narrowleaf hawksbeard from Glennallen maintenance yard.

Another invasive plant that was treated in the maintenance yard was common tansy. Common tansy was first observed this season in the maintenance yard around mid-August, and individuals were manually and/or chemically treated during the last round of treatments that occurred there. The amount of tansy observed in this location has significantly decreased since 2009 when initial control efforts were made. A very small population of tansy has remained towards the lower entrance to the maintenance yard, but this population does not appear to have increased since 2015, as EPMT members treated approximately 5 individual plants.

Two populations of quackgrass were found in the maintenance yard, totaling an area of about 408 square feet. Both of these populations were chemically treated with AquaMaster in mid-June. No regrowth has been observed, but future monitoring will be needed to determine if the treatment was effective. Two populations of white sweetclover were also discovered in the maintenance yard in late August. Both populations were promptly manually removed.

One invasive plant of particular concern that was discovered in the maintenance yard was yellow toadflax. It was discovered growing outside of the garage that is utilized mainly by the WRST trail crew. This plant was of particular concern, as it was the first record of yellow toadflax in both the maintenance yard and the Copper Basin, and because it was discovered so close to the trail crew garage, which is a location that might increase opportunity to disperse to various areas within the

park. The EPMT only observed 5 individuals, including one in flower. These were promptly manually removed. This area will continue to be monitored for further growth of yellow toadflax.

Gakona and Gulkana

After the manual treatment of white sweetclover at the Nabesna/Tok cut-off intersection in July, two EPMT personnel, seven SCA, a volunteer from the Copper River Watershed Project (CRWP) and an additional 6-person YCC crew relocated to Gulkana, where a manual treatment of white sweetclover was conducted from a water access/gravel pit to the SE of the Gulkana River (Figure 15). The crew then relocated once more to the intersection of the Tok cut-off and Glenn Hwy for another manual treatment of white sweetclover. The crew collectively pulled a weight of 810 lbs. One EPMT staff member assisted the CRWP with a chemical treatment of white sweetclover east of the Gulkana River Bridge.



Figure 15. SCA intern and YCC crew assist in removing white sweetclover in Gulkana.

White River RZ

White River is a tributary of the Yukon River fed primarily by Russell Glacier and runoff from the Elias Mountains (Figure 16). The Solo Lake landing strip is used frequently by hunters and those on backpacking/packraft expeditions to access the backcountry. The landing strip is located within close proximity to a long-lived hunting guide service, and it is utilized by the owners for supply transport during hunting seasons. Consequently, there is a considerable amount of traffic coming in and out of this backcountry location. In 2016, the airstrip was surveyed for invasive plants by the EPMT. No invasive plants were found during this survey, but it remains an area of concern.

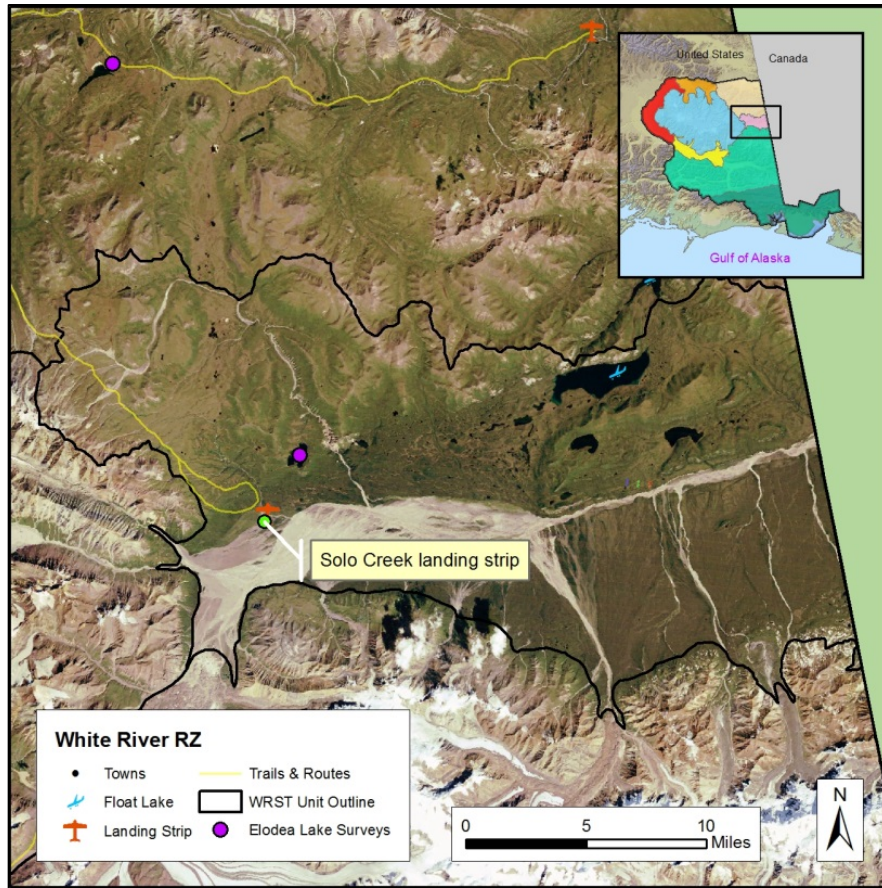


Figure 16. Map of the White River Reporting Zone

Elodea Surveys

In summer 2016, WRST EPMT surveyed 14 lakes for non-native aquatic plants species (Figure 17, Appendix B); Pippin Lake, Willow Lake, Carden Lake, Beaver Lake, Long Lake, Strelna Lake, Silver Lake, Solo Lake, Mesa Lake, Sheep Lake, Tanada Lake, Jack Lake, Peninsula Lake and Tebay Lake. Of these, eight required flights into the remote backcountry. Although the surveys were to document any aquatic invasive plants detected, the target species was *Elodea canadensis*. Elodea was not found during any of the surveys, but for further lab analysis, 4 environmental DNA (eDNA) samples were taken at 11 of the lakes surveyed with a total of 44 samples (Figure 18). A total of 78 miles of lake perimeter was surveyed during these trips.

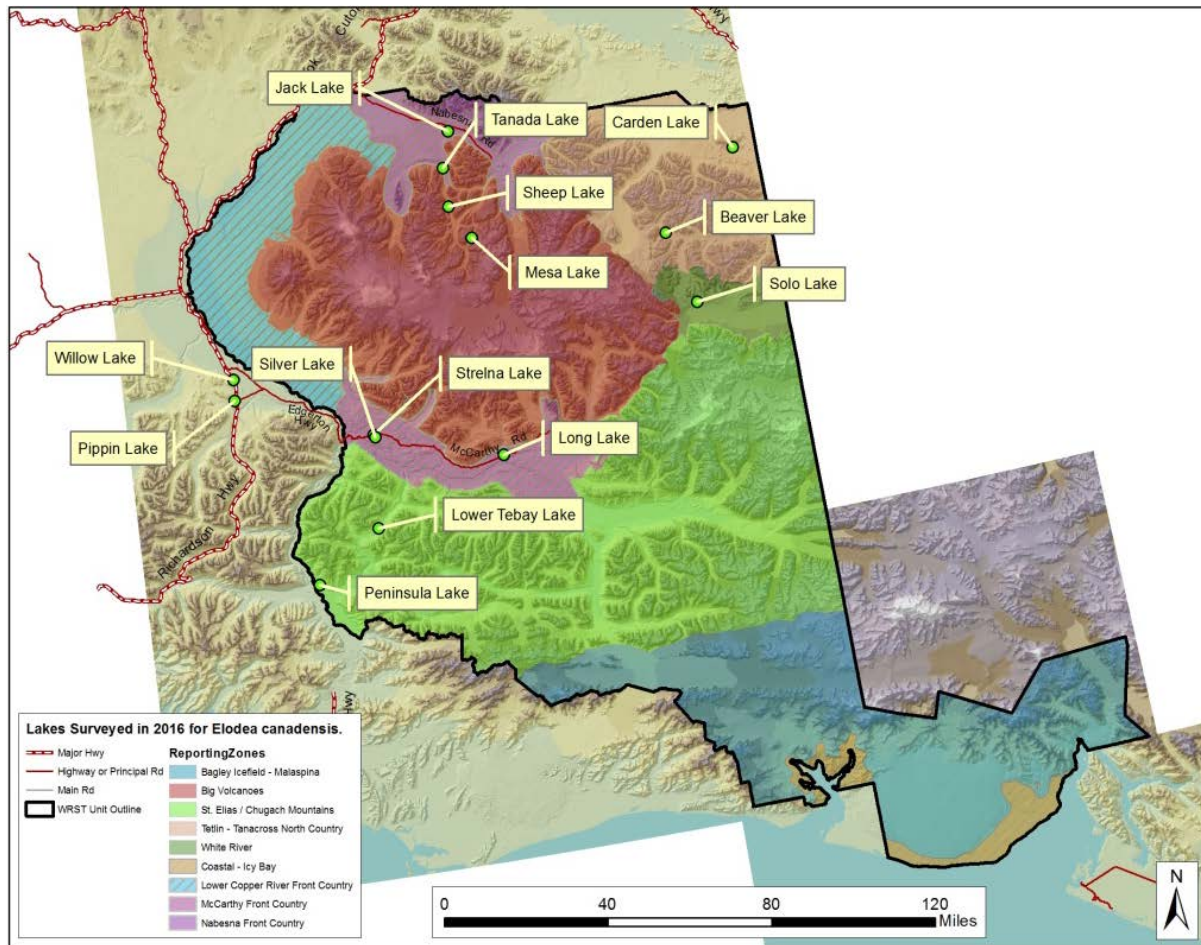


Figure 17. Map of lakes surveyed for *Elodea*



Figure 18. Sampling of aquatic vegetation in Solo Lake using a double-headed rake.

Lakes were surveyed with a combination of packrafts, inflatable canoes and hard sided canoes. Techniques and materials used for surveying can be found in the methods section of this report. In addition to surveys for invasive plants, inventories of native plant species were conducted whenever possible. Over the summer, a total of 29 native aquatic plant species were documented (Figure 19), and 61 herbarium vouchers collected. The majority of the identified species were submersed aquatic vegetation, although some shoreline plants, floating leaved rooted plants, free floating plants, macroscopic algae and aquatic mosses were also collected.



Figure 19. EPMT member collecting eDNA samples at Tebay Lake

Education, Outreach and Community Partnerships

For the Fourth of July celebration in McCarthy, members of the EPMT set up a booth along the parade route in downtown of McCarthy. The booth featured an educational poster of invasive plants and information on commonly found/high priority invasive plants specifically in the park and in Alaska. Many local residents, as well as several visitors in town for the holiday were very interested in learning about invasive plants. Overall, the booth was very well received by the community. During the annual Kenny Lake Fair, two members of the EPMT set up a booth with park interpretation staff (Figure 20). The set up was similar to the McCarthy booth, and was also well received by community members and visitors in the area.



Figure 20. EPMT crew lead discusses invasive plants with community members at the Kenny Lake Fair

Need for Seed

The EPMT partnered again with Wrangell Mountains Center to host the McCarthy community seed collecting event, “Need for Seed.” This event involved a brief presentation on some commonly found plants in the area of McCarthy, and was followed by demonstrations on seed collection and seed propagation. Though these activities were geared towards children, the event was open to the community and involved many kids, as well as a few adults (Figure 21).



Figure 21. EPMT staff educate McCarthy youth on plant identification at the Need for Seed event

Migratory Bird Culture Camp

In partnership with the Copper River Native Association for the annual Migratory Bird Culture Camp, EPMT members planned and facilitated a native plant identification activity (Figure 22). About 20 participants were involved, and most were children and teenagers, within the age range of 10 to 20 years of age. Groups walked around the Kendesnii campground (located off of the Nabesna road) and identified several plants based on certain characteristics.



Figure 22. EPMT staff leads plant identification activity at Migratory Bird Culture Camp

School Presentations

Under the direction of the Wrangell Institute for Science and the Environment, the EPMT helped lead stations in their annual Changing Seasons event, a program that educates elementary school students on various topics in environmental science. EPMT members also gave a presentation to middle and high school students at the Slana School. These students were given a presentation on the definition of invasive species and common invasive species found in the park. This session concluded with an activity using herbarium specimens that helped students to understand basic plant identification methods and terminology.

Community Weed Pull Events

Alongside Gakona community members, NPS volunteers, and CRWP crew members, WRST EPMT staff participated in the Gakona Weed Smackdown. This event focused on manually removing white sweetclover alongside the highway near the Gakona River Bridge. The event was a success, and many veteran volunteers commented that the infestation was smaller and more under control this year than it had been in previous years. The EPMT also participated in the 4th annual Glennallen Weed Smackdown. The event was centralized in the town of Glennallen, off of the Glenn Highway. 20 volunteers were present, including NPS and BLM volunteers, community members, and a six person SCA crew (Figure 23). This event drew numerous volunteers, which allowed us to remove a total of 870 lbs of white sweetclover.



Figure 23. EPMT field crew lead amongst a dense patch of white sweetclover during the Glennallen Weed Smackdown (left). EPMT staff, BLM volunteers, and SCA crew members pulling white sweetclover at the Glennallen Weed Smackdown (right)

Restoration and Seed Collection

This year, the EPMT collected seed from two main locations; McCarthy/Kennecott and the Copper Lake Trail. The EPMT was aided by a 6 person SCA crew for seed collecting at both locations (Figure 24). Seed collection in McCarthy and Kennecott took place at the end of August, while collections in Nabesna occurred at the beginning of September.



Figure 24. SCA crew members collect bluejoint reedgrass on the Copper Lake Trail.

In McCarthy and Kennecott, the EPMT and SCA crew collected a variety of native seeds, including wildflowers and various species of grass. The main focus was collecting bluejoint reedgrass, (*Calamagrostis canadensis*), which future crews can utilize in restoration projects. The bulk of the bluejoint collection occurred off of the Jumbo Mine Trail in Kennecott. After collecting seed, the EPMT and SCA crew began the process of cleaning the seeds (Figure 25).



Figure 25. EPMT and SCA crew members clean seed in McCarthy

On the Copper Lake Trail (mile 11 on the Nabesna road), the group spent the majority of the time collecting large amounts of bluejoint reedgrass (Figure 24), as well as some slough grass (*Beckmannia syzigachne*). Aside from bluejoint reedgrass and slough grass, we focused on collecting other grass species including slender wheatgrass (*Elymus trachycaulus*) and fringed brome (*Bromus ciliatus*).

Since the shift from primarily collecting forbs to focusing on collecting grasses, the amount of bluejoint reedgrass this year increased by a little over 6 times the amount collected in 2015. Much of the bluejoint reedgrass collected has already been used for restoration purposes in Kennecott and on the Copper Lake Trail. In addition to grasses, a number of forb species were collected, and in total from both locations, we collected seeds from 23 native plant species totaling 35.7 pounds (Table 3).

Table 3. Weight of native plant species collected in 2016

Scientific Name	Common Name	Seed Weight (g)
<i>Achillea millefolium</i>	common yarrow	1.0
<i>Aquilegia formosa</i>	western columbine	0.5
<i>Aconitum delphinifolium</i>	monkshood	0.1
<i>Arnica alpina</i>	alpine arnica	2.7
<i>Artemisia tilesii</i>	wormwood	2.0
<i>Beckmannia syzigachne</i>	slough grass	300.2
<i>Bromus ciliatus</i>	fringed brome	323.3
<i>Calamagrostis canadensis</i>	bluejoint reedgrass	11,296.4
<i>Chamerion angustifolium</i>	fireweed	35.8
<i>Delphinium glaucum</i>	larkspur	2.0
<i>Dryas drummondii</i>	yellow dryas	335.0
<i>Elymus trachycaulus</i>	slender wheatgrass	819.1
<i>Erigeron acris</i>	daisy fleabane	0.8

Table 3 (continued). Weight of native plant species collected in 2016

Scientific Name	Common Name	Seed Weight (g)
<i>Eurybia sibirica</i>	siberian aster	1.4
<i>Geum macrophyllum</i>	large leaf avens	335.7
<i>Hedysarum alpinum</i>	wild potato	118.0
<i>Heracleum maximum</i>	cow parsnip	1961.9
<i>Oxytropis campestris</i>	oxytrope	264.4
<i>Polemonium boreale</i>	jacob's ladder	0.2
<i>Potentilla multifida</i>	staghorn cinquefoil	2.0
<i>Poa alpina</i>	alpine bluegrass	2.0
<i>Solidago multiradiata</i>	northern goldenrod	1.2
<i>Veratrum viride</i>	false hellebore	92.0

Revegetation

Two main restoration projects took place this year; one at Kennecott, and the other on the Copper Lake Trail. In Kennecott, revegetation occurred on the gravel slopes beneath the General Manager's office (Figure 26). This site was outlined in the 2015 WRST annual report as a main target for restoration in Kennecott. For this revegetation, a seed mix was created consisting of seed collected from 2014 to 2016, and was a mixture of both grasses and forbs. The gravel slopes were prepared by loosening the gravel and soil and was indented slightly to catch seeds. After the seed mix was spread on the gravel, fertilizer and water was applied.



Figure 26. EPMT staff and SCA crew work together to plant seed mix on gravel slopes beneath the General Manager's office in Kennecott NHL.

On the Copper Lake Trail, the EPMT worked with 2 6-person SCA crews to decommission old trails. Soil on old trails was loosened with hand tools by the majority of the crew, while a few people followed to spread bluejoint reedgrass seed that had been collected near the area that day.

Recommendations

Inventory and Surveys

One of the highest priority areas for 2017 should be conducting surveys and monitoring Icy Bay RZ and Yakutat. While 2016 EPMT was able to survey the area around the Yakutat hanger, baseline surveys need to be conducted on remaining park land, especially since surveys have not been conducted in Icy Bay RZ since 2009. Monitoring the extent of Canada thistle should be a top priority, as it is one of the highest rated invasive plants in Alaska. Other invasive species observed in the area surrounding the hanger should be monitored as well, such as the reed canarygrass (Figure 27) and creeping/tall buttercups.



Figure 27. EPMT member acknowledges the need to monitor the reed canarygrass growing near the hanger in Yakutat.

The biannual bike survey of the McCarthy road should be continued as well. EPMT staff should focus on recent construction projects conducted by the AK-DOT, such as the Lakina Bridge project, which disturbed a significant amount of ground around the river and was hydroseeded, potentially with non-native grass species. The priority of this survey should be finding and removing high priority species such as narrowleaf hawksbeard and white sweetclover. Low priority species, such as common dandelion, should not be mapped as they are relatively ubiquitous along the length of the road.

Surveys in 2017 should continue to visit sites where recent trail work has been done. Even though a survey was conducted on the Kotsina River Trail this year, the remainder of the trail should be surveyed, as trail crew performed work on it this past season, and since the dandelion infestation has continued to expand within the last few years. A large section of new trail was constructed on the Copper Lake Trail in 2016, which should be a target for surveys in 2017. Trail crews on the Copper Lake Trail transport and utilize heavy equipment, ATV and UTVs during trail work. This equipment is stored in the Glennallen Maintenance yard, meaning there is a high potential for dispersal between the two locations

Elodea Surveys

The 2016 EPMT Elodea survey protocol was very successful, and should continue to be utilized in the future. Aside from monitoring for Elodea, the EPMT was able to obtain consistent data from each of the surveyed lakes, including weather conditions, water visibility, and composition of native vegetation (Figure 28). These efforts will help provide information for future reference.



Figure 28. EPMT member using a bathyscope to perform a visual survey of Strelina Lake.

As in the past, lakes that have higher rates of float plane traffic and visitation should be considered for baseline and repeat surveys. Lakes to survey in 2017 include Paxson Lake, Braye Lake, Chelle Lake, Dadina Lake, Ptarmagin Lake, Rock Lake, Ross Green Lake, Situk Lake, Lake Redfield. The annual survey of Long Lake and Jack Lake should continue as well.

Control Work

Manual Control

Consistent and efficient manual control continues to be a significant component in managing non-native plants in WRST. In order to gauge effectiveness of the control method, regular monitoring and surveying needs to occur, especially if considering whether chemical control needs to be applied as well.

Specifically, oxeye daisy should continue to be controlled throughout Kennecott NHL, and particularly at the slope beneath the Kennicott Glacier Lodge. In addition, the Glennallen maintenance yard and Copper Center HQ should be manually controlled for narrowleaf hawksbeard, white sweetclover, and common tansy.

Chemical Control

In 2016, the EPMT was able to conduct chemical control at multiple new sites. Since the beginning of herbicide use in WRST in 2011, it has proven to be an effective and efficient method of control. Chemical control should be utilized in locations where infestations are too large to control manually, or for populations that are small and contained, to prevent further dispersal. Chemical control, if

possible, should be utilized in conjunction with manual control. In 2016, the EPMT was able to conduct chemical control methods at new sites, such as at the intersection of the Nabesna road and Tok cutoff. These areas should continue to be monitored for effectiveness of herbicide. This year, the EPMT was able to use a mixture of manual and chemical control at multiple sites, including the Glennallen maintenance yard and the intersection of Nabesna and Tok cut-off. This seems to be an efficient method, as it ensures that flowering individuals will be removed, and small rosettes will be inhibited from growing.

Chemical control should be conducted at the Kuskulana gravel pit for both narrowleaf hawksbeard and white sweetclover. Application of herbicide should ideally be done in early May or June with retreatments in July or August. Chemical control should also be used to control invasive plants found along the Nugget Creek Trail and Kotsina River Trail. As mentioned earlier, surveys along the Kotsina River Trail revealed that a considerable amount of new infestations have grown since 2010. Manual control would be too time intensive and much less effective than chemical control. Additionally, herbicide applications at the Glennallen Maintenance Yard and Tok-Cut-Off should continue in 2017. Both sites should be treated in May or Early June and should receive at least one retreatment in July or August.

Education, Outreach, and Partnerships

Community outreach and education are necessary aspects in the prevention and control of invasive plants and should continue to be an important part of the WRST EPMT. 2016 was a successful year for outreach and education events, and effort should be made to continue partnerships and generate overall community support.

This year's "Need for Seed" event was successful; the EPMT should continue to partner with Wrangell Mountains Center and hold the event in early August to encourage community participation, particularly with McCarthy youth. The EPMT staff should also participate in the Migratory Bird Culture Camp and Wrangell Institute of Science and Education's Changing Seasons; both of these events had good participation from community youth, and allowed staff to interact with young students and teach them about plants and environmental science. 2016 was the first year EPMT members were asked to speak to middle school and high school students at the Slana school (off of the Nabesna road); these presentations should be continued in the future if the school requests it.

In efforts to increase public education about native plants, the EPMT should plant a native plant garden at Kennecott NHL. As the Kennecott NHL receives a large number of the parks visitors, it has the potential to be an extremely effective mode for educating the public about native versus invasive plants. The EPMT staff should utilize seed collected from SCA-aided seed collections, and create signs and informational posters to teach about identification of native plants in addition to information about the negative impacts of invasive plants.

Restoration and Seed Collection

Sites from 2016 revegetation and restoration should be monitored and recorded for success. These areas include the gravel slopes beneath the general manager's office in Kennecott, and old trail cuts on the Copper Lake Trail. Future EPMT crews should monitor the relative successes of each of the species planted, which will inform staff and help to ensure the success of future restoration projects. Future crews should also monitor these areas for potential infestations of invasive plants during the varying stages of growth and succession.

SCA field crews should continue to aid in annual seed collections in both McCarthy/Kennecott and Nabesna. 2016 was a successful year for seed collection, particularly in grass seed collection. Revegetation efforts from this year must continue to be monitored; successful species should have particular focus for seed collections in future years. Mass collection of bluejoint reedgrass should continue if it establishes successfully on the Copper Lake Trail and on the gravel slopes in Kennecott, and is an effective species for regrowth in disturbed areas.

Transplanting methods, including the process of collecting and planting, needs to be improved. More standardized techniques should be established, and conveyed between departments. As trail crews and SCA crews perform transplants, it will be important to have more communication with these crews, and discuss effective methods of transplanting and revegetation.

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Appendix A: Elodea Surveys and Lake Information

Lake Name	Access	Reporting Zone	Inside the Park	Last Year Surveyed	Native Species Documented
Carden Lakes	Plane	Tetlin-Tanacross-North Country	Yes	2016	2
Chelle Lake	Plane	Upper Copper River Front Country	Yes	-	-
Copper Lake	Plane	Nabesna Front Country	Yes	2014	-
Crystall Lake	Plane	Upper Copper River Front Country	Yes	-	-
Donoho-Upper/Lake	Foot	McCarthy Front Country	Yes	-	-
Jack Lake	Road	Nabesna Front Country	Yes	2016	11
Grizzly Lake	Plane	Wrangell Mountains	Yes	2014	-
Hanagita Lake	Plane	St. Elias-Chugach Mtns	Yes	2015	-
Lake Louise	Road	Upper Copper River Front Country	No	-	-
Lake Redfield	Plane	Coastal-Icy Bay	No	-	-
Long Lake	Road	McCarthy Front Country	Yes	2016	6
Long Lake	Road	Nabesna Front Country	Yes	-	-
Ptarmigan Lake	Plane	Tetlin-Tanacross-North Country	Yes	-	-
Rock Lake	Plane	Tetlin-Tanacross-North Country	Yes	-	-
Ross Green Lake	Plane	St. Elias-Chugach Mtns	Yes	-	-
Situk Lake	Foot	Coastal-Icy Bay	No	-	-
Steamboat Lake	Plane	St. Elias-Chugach Mtns	Yes	-	-
Summit Lake	Plane	St. Elias-Chugach Mtns	Yes	2015	-
Tanada Lakes	Plane	Nabesna Front Country	Yes	2016	2
Tebay Lakes	Plane	St. Elias-Chugach Mtns	Yes	2016	10
Tolsona Lake	Road	Upper Copper River Front Country	No	2014	-
Twin Lakes	Road	Nabesna Front Country	Yes	2014	-
Miller Lake	Plane	Upper Copper River Front Country	Yes	-	-
Mesa Lake	Plane	Big Volcanoes	Yes	2016	1
Sheep Lake	Plane	Big Volcanoes	Yes	2016	6

Lake Name	Access	Reporting Zone	Inside the Park	Last Year Surveyed	Native Species Documented
Beaver Lake	Plane	Tetlin-Tanacross-North Country	Yes	2016	9
Strelina Lake	Road	McCarthy Front Country	Yes	2016	-
Silver Lake	Road	McCarthy Front Country	Yes	2016	6
Peninsula Lake	Plane	St. Elias-Chugach Mtns	Yes	2016	9
Pippin Lake	Road	Upper Copper River Front Country	Yes	2016	6
Willow Lake	Road	Upper Copper River Front Country	Yes	2016	6
Solo Lake	Plane	White River	Yes	2016	3

Appendix B: List of Maintained Trails and Survey Efforts

Name	Use Type	Location	Last Year Surveyed	Invasive Species Documented
Batzulnetas and Fish Wier	ORV	Nabesna Rd mile 8.5	2014	common plantain
Bonanza Mine	Hiking	Kennecott Mines NHL	2015	common dandelion, common plantain, white clover and alsike clover
Caribou Creek	ORV	Nabesna Rd mile 19.2	2015	none
Chititu Camp	Hiking	May Creek	2015	common dandelion, common plantain and white clover
Copper Lake	ORV	Nabesna Rd mile 12.2	2015	narrowleaf hawksbeard, common plantain, Shepherd's purse, common chickweed and prostrate knotweed
Crystalline Hills	Hiking	McCarthy Rd mile 34.7	2010	none
Dan Creek	Hiking	May Creek	2009	common dandelion, common plantain and white clover
Dixie Pass	Hiking	McCarthy Rd mile 14.5	2010	none
Donoho Basin	Hiking	Kennicott Valley	2015	none
Erie Mine	Hiking	Kennecott Mines NHL	-	-
Iceberg Lake to Bremner Glacier	Hiking	St. Elias/Chugach Mountains RZ	2016	none
Jumbo Mine	Hiking	Kennecott Mines NHL	2016	common dandelion, common plantain, white clover and alsike clover, red catchfly
Kennecott Glacier Toe	ORV	McCarthy	2014	common dandelion and white clover
Kotsina Trail	ORV	McCarthy Rd mile 14.5	2016	common dandelion
Lost Creek	ORV	Nabesna Rd mile 30.8	2014	none
McCarthy Creek	Hiking	Nazina Road mile 1	2014	common dandelion
Nugget Creek	ORV	McCarthy Rd mile 14.5	2014	common dandelion, common plantain, white clover, alsike clover and pineapple weed
Old Wagon Road	ORV	McCarthy -Kennecott	2009	common dandelion
Public Use Cabin	Hiking	May Creek	2015	common dandelion
Rambler Mine	Hiking	Nabesna Rd mile 42	2016	none
Reeve's Field	ORV	Nabesna Rd mile 40.2	2015	none
Root Glacier	Hiking	Kennecott Mines NHL	2015	common dandelion, common plantain, common timothy

Name	Use Type	Location	Last Year Surveyed	Invasive Species Documented
Skookum Volcano	Hiking	Nabesna Rd mile 36.2	2009	none
Solo Lake Route	Hiking	White River RZ	2016	none
Soda Lake	ORV	Nabesna Rd mile 31.8	2014	none
Suslota Lake	ORV	Nabesna Rd mile 11	2009	none
Tanada Lake	ORV	Nabesna Rd mile 24	2010	none
Trail Creek	ORV	Nabesna Rd mile 29	2010	none
Viking Lodge	Hiking	Nabesna Rd mile 21.8	2014	common plantain
West Glacier Trail	Hiking	McCarthy	2009	common dandelion
Young Creek	ORV	May Creek	2015	common dandelion, white clover and alsike clover

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