



Invasive and Exotic Plant Management in Klondike Gold Rush National Historical Park

2016 Summary Report

Natural Resource Report NPS/KLGO/NRR—2016/1343



**ON THIS PAGE**

Photograph of the Skagway Recreation Center Summer Camp children carrying invasive plants during the weed-pull activity.
NPS Photo/ S. Muether

ON THE COVER

From top left moving clockwise: orange hawkweed found at the Lower Dewey Reservoir, photo by Kylie Mosher; Irises and tall buttercup at Nelson Slough in Dyea, photo by Kylie Mosher; dandelion infestation near Skagway Airport, NPS Photo/S. Muether

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2016 Summary Report

Natural Resource Report NPS/KLGO/NRR—2016/1343

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Abstract

The summer 2016 season was the Exotic Plant Management Team's (EPMT) 13th year at Klondike Gold Rush National Historical Park (KGLO). The four main methods to prevent the spread of invasive plants around the park and the surrounding area were monitoring and mapping new and previous infestations, manually removing invasive species, restoring areas of disturbance, and providing education and outreach to the public. Monitoring invasive species is important to track progress and identify new or growing infestations. A portion of the work by the EPMT was remapping past infestations and surveying for new infestations. Depending on priority, EPMT then manually removed or treated invasive plants. In the Sheep Camp Restoration Project area, reed canary grass (*Phalaris arundinacea*) was manually pulled instead of chemically treated at Sheep Camp because of poor weather conditions. A tarping project to eradicate orange hawkweed (*Hieracium aurantiacum*) from its only known location in Skagway was implemented this year and will be monitored in following years. Other species of note that were removed this year were white sweet clover (*Melilotus albus*), oxeye daisy (*Leucanthemum vulgare*), ornamental jewelweed (*Impatiens glandulifera*), and tall buttercup (*Ranunculus acris*). Over 350lbs of invasive plants were removed during the 2016 summer season. This year, a construction project on the Dyea Townsite Road required EPMT team participation. Partnering with a restoration team, EPMT staff partnered with a restoration team to promote native plant regeneration and prevent invasive plants from colonizing the disturbed construction areas. The EPMT also planned and participated in many outreach opportunities to educate the public about the problems invasive species inflict on the environment.

Acknowledgments

We would like to thank those that helped contribute to the success of the 2016 Exotic Plant Management Team season at Klondike Gold Rush National Historical Park: Jami Belt for providing guidance, expertise, and time to the projects of the EPMT; Haley Trefon and Kriss Jackson for their continued help throughout the season with pulling invasive plants and their work with the Dyea Road restoration project; Nicole Kovacs and Andrew Heger at Skagway Traditional Council and Taiya Inlet Watershed Council for their cooperation and partnership with NPS on multiple weed pulling and outreach projects; Shawn Jones and the Cultural Resources team for their support and cooperation in sharing vehicles and data collection tools; Johnny Powell and other maintenance crew for assisting the EMPT in our projects and allowing the use of their tools and vehicles at times; Doug Worley for his cooperation and help in reducing the amount of disturbance created by the Dyea Road project; Chris Overbaugh for his pre-season training; Peter Frank for assisting in the pre-season training and for his help with the Sheep Camp Restoration Project; Management at Packer Expeditions and Alaska Mountain Guides/Chilkat Guides (AMG/CG) for their cooperation in our search for orange hawkweed; NPS staff for their continued support throughout the season, and lastly to all the volunteers who participated in the community weed-pull as well as the volunteers who donated their time to various projects. Their hard work is appreciated and should be recognized. Their combined effort and perseverance have made it possible to have such a successful season to protect and preserve the diverse and native ecosystem of Klondike Gold Rush National Historical Park.

Abbreviations

AKNHP	Alaska Natural Heritage Program
AMG	Alaska Mountain Guides
CG	Chilkat Guides
EDRR	Early Detection and Rapid Response
EPMT	Exotic Plant Management Team
GPS	Global Positioning System
KLGO	Klondike Gold Rush National Historical Park
NPS	National Park Service
SCA	Student Conservation Association
STC	Skagway Traditional Council
TIWC	Taiya Inlet Watershed Council

Introduction

Klondike Gold Rush National Historical Park (KLGO) is located in Southeast Alaska at the northern terminus of the Lynn Canal. The park is approximately 13,000 acres that is divided between three separate units (Figure 1). Each of these units is located within the river valleys of the Taiya River and Skagway River. These three distinct units create an area rich in biodiversity, encompassing a unique ecological gradient that includes lowland tidal flats, coastal rainforest, sub-alpine boreal forest, high-alpine meadow, and alpine tundra. This gradient is largely due to varying elevation and aspect found within the park, ranging from sea level to about 6,000 feet at the peaks of the coastal mountains.

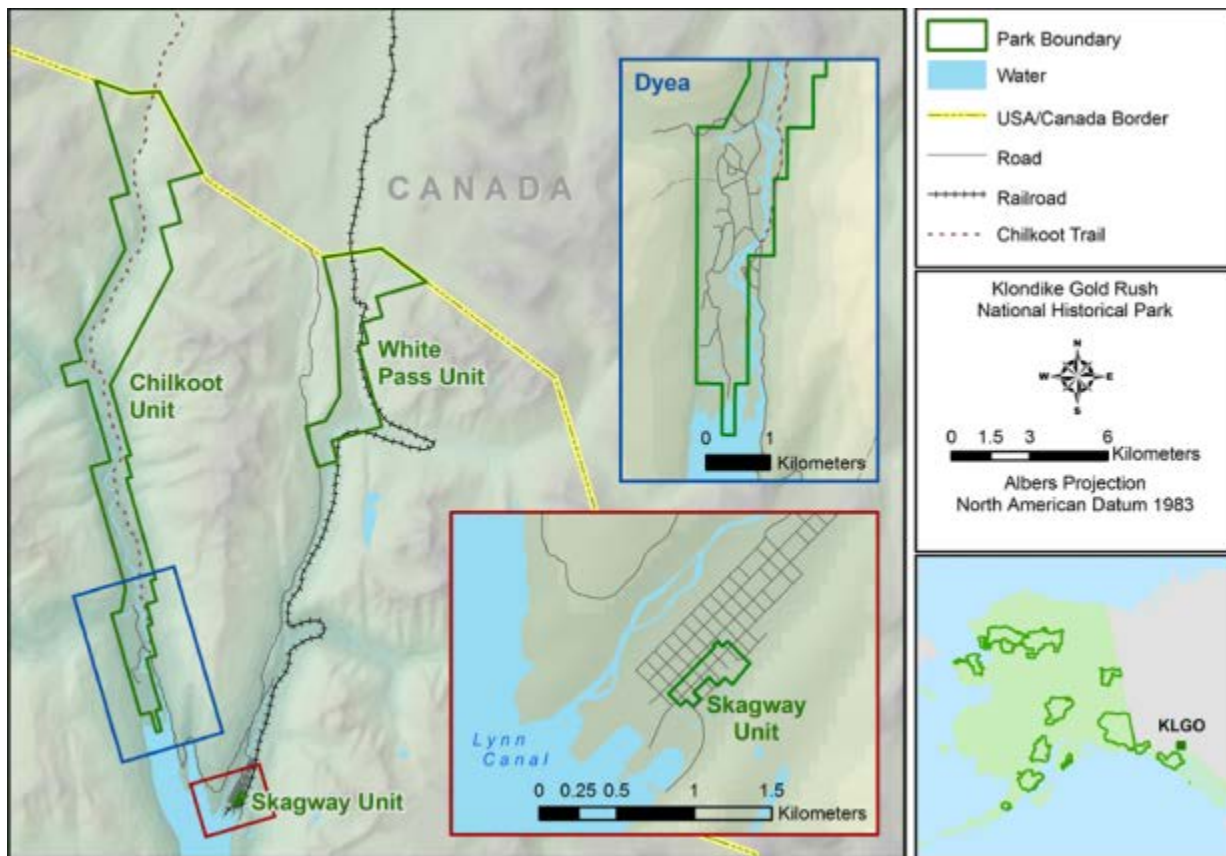


Figure 1. Boundary map of Klondike Gold Rush National Historical Park (Bernatz et al., 2010).

Though rich in biodiversity and ecotones, KLGO is highly vulnerable to the introduction and spread of invasive and exotic plant species. The park's geographic and ecological conditions are not only beneficial to the native plants that grow within the area, but also serve as an ideal habitat for non-native species. In addition to the parks' natural characteristics, the threat of exotic plants being introduced into the area is aided by the ever-growing anthropogenic influence in the region. There are three reasons that make KLGO particularly at risk of introduction of exotic plants due to human activity: 1) the influx of park visitors every year who intentionally or unintentionally transport exotic plants throughout the area, 2) local horticultural activities in Skagway using invasive plants as garden ornamentals, and 3) maintenance activities that lead to soil disturbance that fosters the introduction of

exotic plants. The multitude of ecological niches created by such diverse ecosystems and high annual visitation creates ideal conditions for the spread and establishment of exotic and invasive plants.

KLGO is unique in that there are three separate units of the park interspersed with private, municipal, USDA Forest Service, and state-owned lands. These three distinct units are as follows: the Skagway Unit, the Dyea-Chilkoot Unit, and the White Pass Unit. Each of these units is unique in terms of their visitor use, terrain, ecology, and vectors for plant introduction. Consequentially, each unit has a unique invasive and exotic plant management strategy. Many of the infestations of invasive plants are found on lands neighboring park boundaries, necessitating efforts to monitor and control invasive plants on non-NPS property.

According to Hodkinson et al. (1997), humans play a significant role in seed spread and dispersal. Exotic plant species are often voluntarily introduced due to garden throw-outs from horticultural stock, or have been introduced because of development and maintenance projects. These projects create disturbed areas ideal for invasive plant colonization. It has also been shown that seeds may be dispersed both short and long distances through epizoochory, the unintended external carrying of propagules via dispersal agents such as shoes and tires (Hodkinson 1997, Wichmann et al., 2009). The amount of foot and vehicle traffic that Skagway receives due to its high visitation creates an opportunity for invasive plant species introduction and spread. While the controlling present populations remains a high priority, the most effective method for controlling plants is to prevent the establishment of invasive species (USDA 2007).

The Alaska EPMT has been tasked with inventorying, monitoring, and controlling of invasive plants within the national parks of Alaska since 2004. Over the past 13 years, EPMT staff has collected baseline data that catalogs the dispersal and spread of invasive species, conducted annual monitoring surveys, established community outreach and prevention methods, and controlled emerging infestations throughout and surrounding the park. More specifically, KLGO EPMT has focused on the strategy of early detection and rapid response (EDRR), where species are prioritized on a system of triage. This system focuses first on small populations of species of high invasiveness, and later on larger populations of low invasiveness rankings (Carlson et al., 2008). This early response approach to emerging infestations, coupled with increased public education and awareness, has helped to keep the threat of invasive species manageable in KLGO.

Methods

Field work for the 2016 season was conducted between May and August. Methods for all data collection, data management, and mapping were in compliance with the protocol developed by the Alaska Region Exotic Plant Management Team (Million et al., 2016). EPMT staff utilized existing data, recommendations from previous years, this season's phenology, and available labor to prioritize treatment of species and infestations, select equipment, and choose appropriate control methods.

Given the cultural significance of many areas in KLGO, special care was taken to ensure that no cultural resources were disturbed during EPMT activities. Tools were selected that would minimize the amount of damage to any potential cultural resources that could be uncovered or buried under work sites.

Defining Work Areas

To facilitate planning control efforts, the park and surrounding areas were divided into six work areas (Figure 2). Fieldwork was organized and conducted using these work areas and the results were organized by such areas. The six work areas are as follows:

1. Skagway
2. Dewey Trail System
3. Dyea and Dyea Road
4. Chilkoot Trail
5. Klondike Highway
6. Laughton Glacier

Work areas were decided first based on land ownership, and secondly on the location of high-priority invasive species. Highly-ranked invasive species found adjacent to park property may invade park lands and reach unmanageable levels.

Work in Dyea and along the Dyea Road was largely dedicated to minimizing the impacts of the road construction. Since most of Skagway's invasive plants occur on private land or have reached unmanageable populations, most of the work there focused on containing current infestations and monitoring and mapping infestations. The work along the Chilkoot Trail and the Klondike Highway were largely monitoring and mapping, with the exceptions of reed canary grass (*Phalaris arundinacea*) treatment at Sheep Camp and manual treatment of oxeye daisy (*Leucanthemum vulgare*) and Canada thistle (*Cirsium arvense*) along the Klondike Highway. Laughton Glacier and the Dewey Trail System were focused on in the 2016 season because of the presence, or rumored presence, of the very highly-ranked invasive species orange hawkweed (*Hieracium aurantiacum*). Orange hawkweed has the potential to become a large problem in Skagway if allowed to spread, as it has already done in Haines and Juneau.

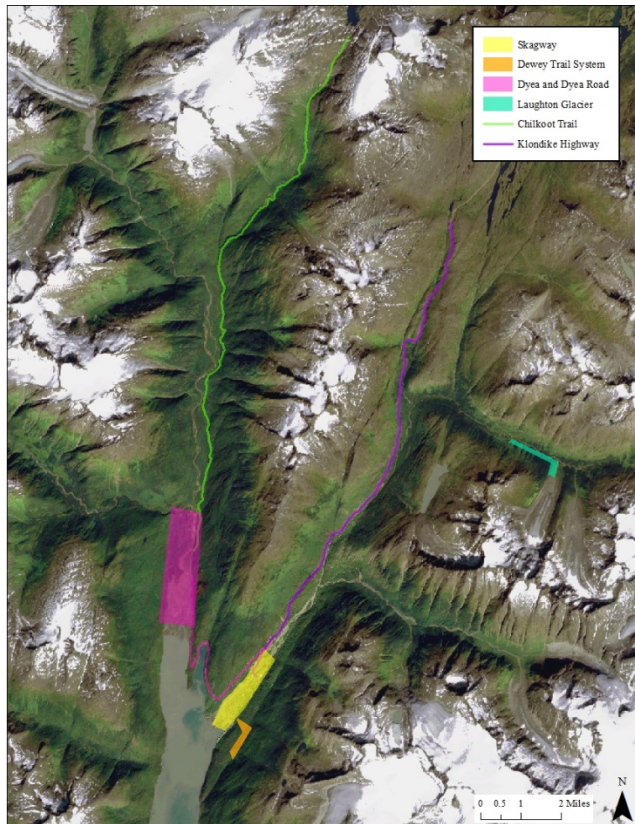


Figure 2. Work areas for the 2016 season.

Providing a wide array of outreach and education to staff and visitors can help the KLGO EPMT with reporting and early detection of invasive species, which could minimize their spread into park lands. While it is important to control invasive species once they have been introduced into an area, it is equally as important to control the source of invasive species. Human activity is a key vector for the spread of invasive plants.

Prioritization of Species and Treatment

Control work in KLGO was prioritized by geographic location, extent, and an invasiveness ranking system. The Alaska Invasiveness Ranking System is an index that provides rankings on a scale from 0 to 100 based on four subcategories for each species: potential ecological impacts, biological attributes and dispersal ability, distribution, and feasibility of control (Carlson et al., 2008). Species with a higher invasiveness rank and a smaller geographic extent were considered the highest priority for management. Conversely, species with a lower invasiveness rank and a larger geographic extent were considered lowest priority for management.

The species considered highest priorities in the summer 2016 were reed canary grass, white sweet clover (*Melilotus albus*), oxeye daisy, ornamental jewelweed (*Impatiens glandulifera*), Canada thistle, and orange hawkweed. Some species that had previously been considered high priority, such as yellow toadflax (*Linaria vulgaris*) and narrowleaf hawksbeard (*Crepis tectorum*), were not prioritized as highly this year because of their tendency to stick to disturbed sites and not outcompete

native plants. The species focused on this year threaten native species and have been shown to have a growing population or one that is at high risk of spreading to other areas.

Tools for Identification and Data Collection

The primary field guides referenced for plant identification were Flora of the Pacific Northwest (Hitchcock and Cronquist, 1973), Plants of the Pacific Northwest Coast (Pojar and Mackinnon, 1994), Flora of Alaska and Neighboring Territories (Hulten 1968), and Identification of Non-Native Plants in Alaska (Flagstad et al., 2015). Additional materials used for identification were A Field Guide to Alaska Grasses (Skinner et al., 2012).

All Spatial data on the invasive plant infestations were collected using two GPS units, the Trimble GeoExplorer 6000[®] data logger, and the Trimble GeoExplorer 2008[®] datalogger with either the Trimble Tornado L1[®] or Trimble Hurricane L1[®] antennas.

Control Methods

The primary control method employed for invasive plant removal was hand pulling combined with hand tools such as trowels. The largest concern with this method is that sometimes the entire root system must be removed for the treatment to be effective. Plants with a tap root are usually pulled easily and effectively, but those with rhizomatous root systems require special care to remove the entire root system. Many invasive plants in the region can regenerate from root segments left in the soil when proper hand pulling techniques are not employed. This is quite frequent with invasive species like yellow toadflax, oxeye daisy, and orange hawkweed. Since orange hawkweed poses such a high threat to Skagway, tarping (covering the infestation with heavy, opaque material to prevent photosynthesis) was implemented this year to eradicate it and prevent its spread.

All removed plants were bagged on site, weighed in the KLGO maintenance building, and transported by KLGO maintenance staff to the Skagway city incinerator to be burned. This method minimized the potential for seed dispersal while disposing of the invasive species.

Personnel

The full-time EPMT staff member at KLGO during the 2015 season was Kylie Mosher, a Student Conservation Association intern. The EPMT this year partnered with two restoration interns, Kriss Jackson and Haley Trefon, for a portion of the season. Jami Belt, the Natural Resources Program Manager at KLGO volunteered and dedicated a large amount of time toward the treatment of exotic and invasive plants within Dyea and Skagway. Many outreach opportunities and invasive removal projects were completed with the help of Nicole Kovacs, the Environmental Coordinator of STC and head of the director of the TIWC, and her assistant Andrew Heger. Two volunteers helped pull invasive plants on two separate occasions and a 6-person Student Conservation Association (SCA) work crew was utilized to treat invasive plants for one day.

Results

2016 Season Overview

The 2016 EPMT staff inventoried 41.53 acres and treated 0.08 acres in and around the park this season. Three large projects were the top priorities of the 2016 season: Sheep Camp restoration, covering orange hawkweed at the Lower Dewey Reservoir, and the Dyea Townsite Road restoration. EPMT staff was also involved in multiple outreach opportunities to engage the public in learning about invasive plants. Table 1 summarizes KLGO EPMT work conducted in 2016.

Table 1. Summary of Klondike Gold Rush National Historical Park Exotic Plant Management Work.

Year	Invasive GPS Data NPS Lands (non-NPS lands)		
	Species Acres Surveyed ¹	Species Acres Infested ²	Acres Treated ³
2004	43.531 (52.497)	7.838 (6.842)	0.792 (1.505)
2005	3.106 (6.45)	3.099 (2.617)	0.732 (2.436)
2006	63.145 (74.35)	4.577 (2.308)	2.912 (0.726)
2007	1.481 (7.673)	0.487 (5.513)	0.011 (1.676)
2008	5.842 (47.974)	2.063 (22.159)	0.235 (1.351)
2009	11.931 (83.259)	2.453 (21.645)	0.388 (2.504)
2010	34.638 (245.513)	3.914 (56.212)	0.502 (9.362)
2011	49.720 (98.718)	11.278 (50.695)	3.045 (8.583)
2012	31.430 (153.766)	20.987 (86.004)	0.911 (5.282)
2013	83.455 (182.7)	5.701 (36.220)	0.771 (2.431)
2014	0.63 (4.27)	0.19 (0.74)	<0.001 (0.09)
2015	3.97 (30.56)	0.27 (4.01)	0.10 (1.44)
2016	0.2 (41.33)	0.05 (1.2)	0.01 (0.07)

¹ Acres surveyed represent the total area mapped.

² Acres infested represent the area of a mapped infestation multiplied by the percent cover of invasive plants in that mapped area.

³ Acres treated represent the area of a mapped infestation multiplied by the percent cover of invasive plants in that mapped area and by the percent of the infestation treated.

Skagway

The town of Skagway (Figure 3) has a wide variety of invasive plants. Most are restricted to disturbed areas such as gravel alleys but there are many that are planted as ornamentals. Because most invasive plants around town are relatively non-threatening to native vegetation or are on private property, managing them was a low priority during the 2016 season. Some exceptions were where the invasive plants were at high risk of spreading to other areas outside of town or into areas of native vegetation such as Pullen Creek. Higher priority was given to species that may be new to the area and relatively unestablished or are very highly ranked by the Alaska Invasives Ranking System.

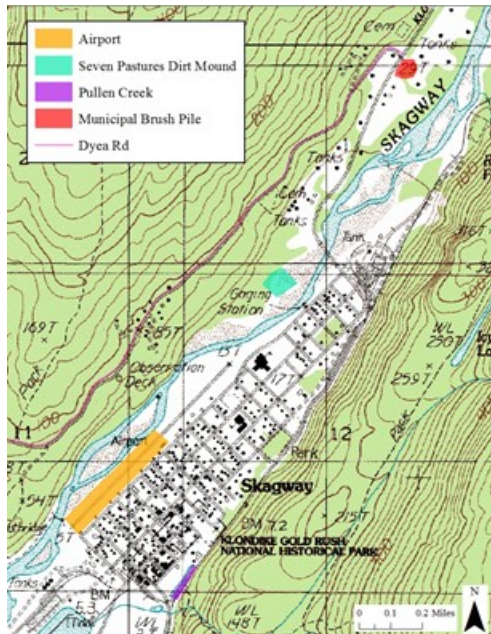


Figure 3. Town of Skagway showing main areas of treatment.

Pullen Creek

Pullen Creek continues to be infested by a dense population of reed canary grass near the Dewey Lakes trail system trailhead. This year all seed heads were clipped along the creek. While this will not decrease the population it will hopefully prevent it from spreading to new areas. Nicole Kovacs from STC and TIWC has submitted a grant proposal for more intense efforts to remove the reed canary grass in the future.

Farther north, there are areas of Pullen Creek that have been infested by ornamental jewelweed. Much of this is along private property and therefore is unable to be treated. However, EPMT staff had been given permission to pull the jewelweed on the north side of the alley between 20th and 21st street. Ornamental jewelweed has been planted as an ornamental on the southern side of the alley and has dispersed to the north side, along Pullen Creek. 568 stems were removed by hand by EPMT staff in 2016. Ornamental jewelweed is one of the highest ranking invasive plants found in Skagway, so removing it where possible is a high priority.

Municipal Brush Pile

The brush pile across the street from the turnoff for Dyea Road, is overrun with invasive plants. This year 199lbs of sweet clover were pulled at this location (Figure 4). There is also a large amount of scentless chamomile (*Tripleurospermum inodorum*) and pineapple weed (*Matricaria discoidea*). This location is a relatively high priority because of its close proximity to a large gravel source and crusher. The invasive plants at the brush pile run the risk of contaminating the gravel piles and allowing the invasive seeds to be transferred wherever the gravel is used.



Figure 4. Haul of white sweet clover (*Melilotus albus*) pulled at the municipal brush pile.

Seven Pastures

The large dirt piles at Seven Pastures are home to the largest and most diverse community of invasive plants in and around Skagway. The most prevalent here is scentless chamomile (Figure 5), which is not found most places around Skagway but is slowly making its way into and around town. There are also a number of species at this dirt pile that are not found many other places. Ornamental jewelweed was found at the dirt pile this year and was removed as well as nightflowering silene (*Silene noctiflora*). Other species found in abundance here are pineapple weed, curly doc (*Rumex crispus*), sheep sorrel (*Rumex acetosella*), shepherd's purse (*Capsella bursa-pastoris*), and narrowleaf hawksbeard, among others.



Figure 5. A dense infestation of scentless chamomile (*Matricaria perforate*) at the dirt pile at Seven Pastures.

Dewey Lakes Trail System

Because of its close proximity to town, the Dewey Lakes trail system receives a high amount of traffic from tourists. This opens the door for many invasive plants to become dispersed throughout the trail and to other areas. Fortunately, the trail system only has a few areas where invasive species are a problem. Since the trails are so highly traveled, this area is of high priority to keep free of invasive plants (Figure 6).

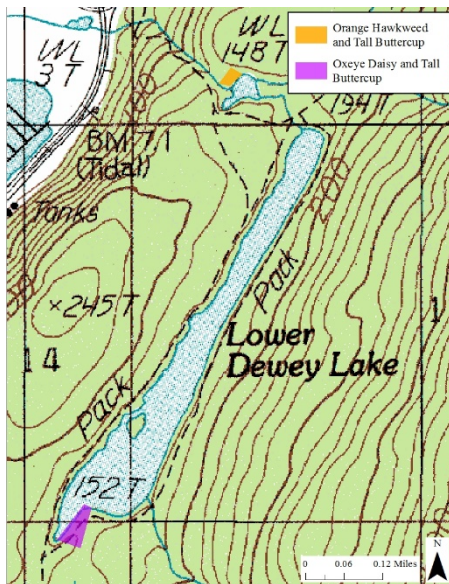


Figure 6. Locations of invasive plant treatment in the Dewey Lake trail system.

Orange Hawkweed

Orange hawkweed was found for the first time in Skagway at the Lower Dewey Reservoir in 2015 by EPMT staff. It is ranked 79 on Alaska's invasive plant ranking system and has already spread to unmanageable levels in Haines and Juneau. Because of its high ranking status and small, manageable population size in Skagway, it was one of the highest priorities of the 2016 season.

Last year the small patch at the reservoir was hand pulled with attempts to remove the entire root mass. However, when EPMT staff returned to the area this year, it was found with two more patches in addition to the one that was recorded last year. Orange hawkweed can sprout from any remaining root fragment left in the soil. Because of this, hand pulling this year was not considered and a project to smother the hawkweed was implemented instead. With help from NPS restoration interns and an SCA work crew, the hawkweed was covered with black plastic, stapling down the rolled edges with landscaping staples. A layer of weed block was then stapled down as a second layer. A buffer of two feet was given around the extent of the orange hawkweed to prevent it from growing around the edges of the covers. Where there were large rocks, holes were cut around the rocks and the tarp and weed block stapled as closely around the edges of the rocks as possible. The rocks were then capped with a one foot buffer with both the plastic tarp and the weed block. Rocks were laid on top of the weed block around the edges and in the middle of the tarped area to deter people from walking across the covers. This was done in two separate patches to cover three patches of orange hawkweed.



Figure 7. Before picture (on left) and finished product of covers for orange hawkweed at the Lower Dewey Reservoir.

Tall Buttercup

Tall buttercup (*Ranunculus acris*) was found in fairly dense patches at the reservoir, so while working on covering the hawkweed, a small team worked on removing the buttercup and covering the exposed ground with moss mats (Figure 8). The moss mats were fastened to the ground using stakes fashioned from alder branches and by laying rocks on top. Tall buttercup is also present at the southern tip of Lower Dewey Lake but was not treated in 2016.



Figure 8. Location where tall buttercup (*Ranunculus acris*) had been removed and replaced with moss mats at the Lower Dewey Reservoir.

Oxeye Daisy

Oxeye daisy was the only other invasive that was treated on the Dewey trail system (Figure 9). It was found at the southern tip of the lake in a manageably-sized patch. The municipality trims the area and the oxeye was chopped before EPMT staff was able to cut the seed heads. However, since the plant material was left on-site after it was cut, EPMT staff removed all flower heads from the area to prevent them from going to seed. This is important to do since flowers of members of the Asteraceae family will continue to go to seed even after cut.



Figure 9. Oxeye daisy (*Leucanthemum vulgare*)

Dyea and Dyea Road

Dyea is the most heavily used and accessible natural area within the park, making it vulnerable to the introduction of new invasive species. While there are few high priority species located within NPS-administered land in Dyea, there are several high priority species found just outside park boundaries. Due to this, it is important to monitor and control them before they can spread into the park. Of the species that are located on park property, most are concentrated along highly disturbed sites along roads and trail systems.

Dyea Townsite Road Restoration

A large road construction project to raise and widen the Dyea Townsite Road was scheduled for summer 2016. With any road project comes disturbance, which opens opportunities for invasive plants to move in. To prevent this, a restoration project was constructed that involved removing invasive plants and harvesting native plants prior to construction and restoring the area with native plants and seeds (Figures 10 and 11). Problems with the contractors caused the project to move at a much slower pace than expected and most of the restoration could not be completed before the EPMT's season was over.

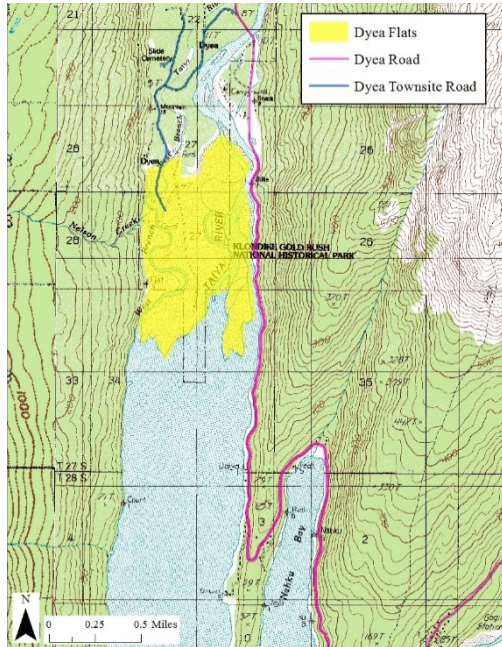


Figure 10. Main treatment locations near Dyea



Figure 11. Native plants harvested by NPS restoration interns with the help of EPMT staff, waiting to be out-planted along the Dyea Road after road construction is finished.

However, most of the invasive plant management did not depend on the contractors and invasive plants removal was largely unaffected. The road was initially surveyed for problematic invasive species to be removed. The only species of concern found along the construction zone were tall buttercup, and in one small area, oxeye daisy. The tall buttercup and oxeye daisy were pulled along the entire Dyea Townsite Road where the patches were manageable. Along one stretch of the Townsite Road the tall buttercup was too dense to pull, and this area was instead flagged off for the contractors to follow a different procedure than for the rest of the road. Instead of removing the topsoil and redistributing it elsewhere, here the contractors were instructed to leave the topsoil and simply push it back onto itself, hopefully effectively burying the tall buttercup and preventing its spread elsewhere.

To restore the few areas that had been worked on before the end of the season, fireweed seed was distributed in disturbed areas and in the pile of topsoil to encourage establishment of fireweed.

Dyea Flats

The Dyea Flats is a low, flat, inter-tidal zone where the Taiya River empties into the Lynn Canal. Though there are not many invasive species located within the area, the majority of invasive species are concentrated along the road margins and are primarily of low priority. Oxeye daisy had been previously documented on the Dyea flats, but upon closer inspection this shorter flower is actually a native wildflower, arctic daisy (*Chrysanthemum arcticum*; Figure 12). Tall buttercup is very prevalent especially at the entrance to the flats just past the Nelson Slough Bridge. It appears to be spreading and competing with the native irises. No action was taken this year to treat this tall buttercup because the infestation is too dense and requires a large project in order to tackle such a large area.



Figure 12. Arctic daisy (*Chrysanthemum arcticum*) on the Dyea flats.

Dyea Road

Dyea Road is the only route into Dyea, a popular destination for hikers and tourists. The road sees relatively heavy traffic throughout the day and there are many invasive plants found along the

roadside. The three main species treated along the Dyea Road were oxeye daisy, white sweet clover, and common tansy (*Tanacetum vulgare*). White sweet clover was found on the side of the Dyea Road where it runs along the flats, and all three stems were pulled—making sure to pull the entire taproot. Common tansy was found in two spots where the road runs along the east side of Naku bay and was removed manually. Both stems were pulled and care was taken to remove as much of the root mass as possible as common tansy can sprout from remaining root fragments. Bigleaf lupine (*Lupinus polyphyllus*) was found for the first time along the Dyea Road just before Naku Bay but was not treated due to a question of whose property it lies on. Bigleaf lupine is only known to occur in one other location around Skagway and Dyea.

Oxeye daisy was found in several locations along the Dyea Road. Everywhere oxeye daisy was documented growing in and around Dyea in past seasons was revisited this season, including areas along the Dyea Road. A relatively large infestation of oxeye daisy on private property in the first stretch of road was inventoried by EPMT and was removed later in the season presumably by the landowners. A large infestation of oxeye daisy past the Taiya River Bridge in Dyea was treated this summer by removing the seed heads (see Figure 13). Large infestations near east side of Naku bay and at the curve between Naku Bay and the flats were also treated by removing the seed heads in order to prevent further dispersal. A few locations along the paved section near the beginning of the road were revisited this year without finding any oxeye daisy.



Figure 13. Before and after from removing flower heads from oxeye daisy (*Leucanthemum vulgare*) in Dyea just past the Taiya River Bridge.

Chilkoot Trail

The US side of the historic Chilkoot Trail (Figure 14) was surveyed during the 2016 season. Common dandelion (*Taraxacum officinale*) and white clover (*Trifolium repens*) were found in a few

locations, but the trail was mostly clear of invasive plants. There were a few specimens that could be European mountain-ash, but that could not be confirmed. There continues to be tall buttercup at Sheep Camp, and oxeye daisy was found there for the first time this year. A single stem was found outside one of the warming shelters and was manually pulled by EPMT staff.

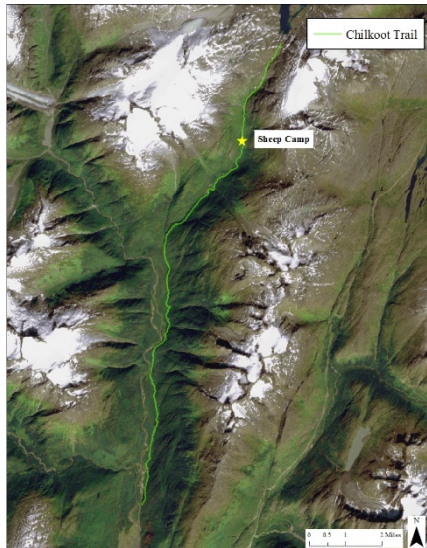


Figure 14. The historic Chilkoot Trail

Sheep Camp Restoration Project

Sheep Camp is one of the more popular campgrounds along the Chilkoot Trail and lies 13 miles up the trail. Since it was first detected at Sheep Camp in 2011, there has been an ongoing project to eradicate reed canary grass on the Chilkoot Trail. After tarping methods failed to kill the last culms, herbicide was applied in 2015. There were four small patches in two distinct locations and one larger patch of reed canary grass found at Sheep Camp in 2016. Another infestation was also found further up the trail just past Sheep Camp. The plan for the 2016 season was to spray the remaining reed canary grass with herbicide. However, consistent rainfall prevented any herbicide to be applied; instead all remaining reed canary grass culms were pulled by hand (Figure 15).



Figure 15. Pictures comparing Sheep Camp in 2015 (on left; photos by Kevin Hauser) from 2016.

Klondike Highway

The Klondike Highway (Figure 16) is one of the main corridors connecting the Yukon Territory and British Columbia to Skagway. Frequent maintenance creates disturbed soil and facilitates the introduction, establishment, and spread of invasive plant species. The US portion of the Klondike Highway extends 14 miles.

EPMT staff conducted a bike survey starting at the international border between Canada and the United States (the summit of the pass) and surveyed along the west side of the road until just past Liarsville Rd, immediately outside of Skagway. Dandelion was by far the most prevalent species and was ubiquitous along the entire roadside. Pineapple weed and common plantain (*Plantago major*) were also fairly ubiquitous especially at lower elevations. Groundsel (*Senecio vulgaris*) and narrowleaf hawksbeard were also very abundant at lower elevations. Other species of note were red and white clover (*Trifolium pratense* and *T. repens*), yellow toadflax, tall buttercup, sheep sorrel, and foxtail barley (*Hordeum jubatum*). Foxtail barley was especially prevalent in upper elevations. Of clovers, the upper portion of the highway had only white clover, with red clover not appearing until

almost to Skagway. White sweet clover was found along only one area of the road, where there is a blocked-off pullout that is completely lined with white sweet clover (Figure 17). Oxeye daisy was found in a few locations, with only the populations by US customs covering an area larger than 0.5m². Two populations of oxeye daisy found in previous seasons were revisited early in the season and manually treated by removing the seed heads. Other, less frequently found species were curly doc, shepherd's purse, and mouse-ear chickweed (*Cerastium fontanum*). Canada thistle remains in the patch near the Black Lakes, and was manually treated this year before going to seed.



Figure 16. View of the Sawtooth Range from the Klondike Highway.

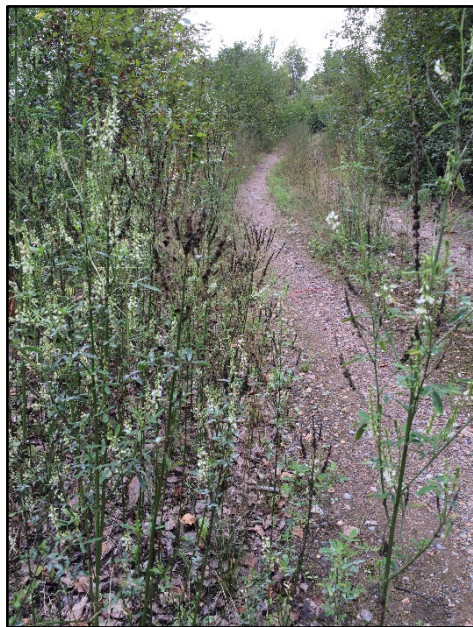


Figure 17. White sweet clover (*Melilotus albus*) infestation on a road off the Klondike Highway

Laughton Glacier

Laughton Glacier (Figure 18) is a popular hiking destination along the White Pass and Yukon Route Railroad, located approximately one mile east of the White Pass Unit of KLGO. The majority of invasive species found at Laughton Glacier were concentrated at the large clearing around the train stop. White clover and common dandelion accounted for most of the ground cover along with common sheep sorrel and common plantain. These infestations appear to be contained to the areas of high disturbance around the train stop.

The two mile trail leading to Laughton Glacier is largely free of invasive species. The trail was intensely surveyed in 2016 because of past, but unconfirmed, reports of orange hawkweed being present. An NPS volunteer who had reported seeing orange hawkweed the year prior came and helped on the survey. A total team of four people surveyed the entire trail for orange hawkweed but the only hawkweed found was white hawkweed (*Hieracium albiflorum*), a native hawkweed that was found in abundance.



Figure 18. Dwarf fireweed, also known as river beauty (*Chamerion latifolium*), by Laughton Glacier.

Outreach and Education

Educating the public can be an invaluable tool when trying to reduce the spread of invasive species. Most of the time invasive plants are spread unknowingly, because people don't realize what they are doing is harmful to the environment. By making people think about the problems invasive plants cause the environment, we can empower them to make knowledgeable choices to do what they can to prevent spreading seeds. A new interpretive sign was added to the boot brush at the Chilkoot trailhead that informs the public of the problem of spreading invasive seeds along the Chilkoot. More boot brushes are being installed next year at a variety of trailheads by the STC along with interpretive signs to go with them. This is just one example of a type of outreach that can be done to spread the word about invasive species. Throughout the summer, the EPMT also took advantage of activities and outreach opportunities to inform the public about invasive plants. A breakdown of the number of people who participated in each project and the hours spent can be found below (Table 2).

Table 2. Summary of results from different outreach projects in 2016

Outreach Project	Number of Participants	Hours Spent on Project
Blog and Facebook Posts	-	4
Community Weed-Pull	15	6
Junior Ranger Day	30	8
Edible Invasives Workshop	45	6
SCA Corps Team	6	10
Outreach to Local Guides	45	3
Total	141	37

Blog and Facebook Posts

This year the NPS Resources team resurrected the Golden Nuggets blog which was inactive in 2015. EPMT staff wrote blog posts throughout the season about invasive plants and what it is like to manage them. Writing blog posts allows the public to catch a glimpse inside what it is like working for natural resources for NPS and makes some of the work we do more accessible. Posts were also made and posted to the KLGO Facebook page which ranged from topics like advertising weed-pulls to information on invasive plants around Skagway.

Annual Skagway Community Weed-Pull

The annual community weed-pull was held for the 8th time at the Skagway Airport this year (Figure 19). A total of 15 people came out to help and a total of 48lbs of weeds were pulled. This is a significant reduction in plants pulled from last year despite having a similar number of volunteers, showing the positive effect the weed-pull has had over the past years. The invasive plants found and pulled this year were yellow toadflax, sheep sorrel, narrowleaf hawksbeard, white sweet clover, common dandelion, and red clover. The population of white sweet clover has decreased steadily throughout the years from being the most conspicuously prevalent species to finding only a small handful of stems at this year's weed pull. Bladder campion (*Silene vulgaris*), found for the first time at last year's weed pull, was not found this year. Due to time constraints, the western strip of the airport was not treated.



Figure 19. Volunteers pull invasive species at the Skagway Airport for the Annual Community Weed-Pull.

Summer Camp

Summer Camp is a program put on by the Skagway Recreation Center for children ages 8-12. This year EPMT led one of the days and created activities to teach the children about invasive species. There was a brief but informative background on invasive plants before the kids were instructed to make their own “wanted” poster for their favorite invasive plant. The children enjoyed a fun, interactive game teaching them about how invasive plants use up resources and push out native plants. For the second part of the afternoon the children came out and pulled invasive plants along State St. near the cemetery (Figure 20). A total of 21lbs of invasive plants were pulled. This was a great opportunity to get kids excited about learning about invasive plants and to get them thinking about ways they could help.



Figure 20. Summer Camp children and staff pulling invasive species by the Gold Rush Cemetery. NPS Photo/S. Muether

Junior Ranger Day

The EPMT paired up with another NPS staff member to create bookmarks from invasive plants for Junior Ranger Day (Figure 21). The plants were collected and pressed ahead of time and stored in Ziploc bags for the event. There were educational materials available to look at as well and the activity was popular among those who attended the activity fair.



Figure 21. Invasive plant bookmark-making table at Junior Ranger Day.

Edible Invasive Plants Workshop

This year for the first time, EPMT staff worked with Nicole Kovacs from STC and TIWC to put on a workshop on edible invasive plants for the community. It was an incredible success, with attendance exceeding 45 people. The workshop included a buffet-style dinner, with all dishes having invasive plants as ingredients. Examples of dishes served were dandelion pesto, pineapple weed cheesecake, common plantain chips, and red clover buttermilk soda bread. EPMT staff gave a presentation on invasive plants, with information ranging from what they are and where they came from to why they're so detrimental to the environment and how to go about harvesting them without further spreading their seeds.

SCA Corps

The EPMT and Restoration team worked with an SCA Corps team for one week during the 2016 season. The SCA Corps team helped install shade covers to smother orange hawkweed at the Lower Dewey Reservoir (Figure 22) and assisted in removing invasive plants around Skagway and along Dyey Road. It was a great moment to teach about invasive species as well as learn more about what the SCA Corps team did with the rest of their summer.



Figure 22. SCA work team and restoration interns lay down the plastic sheet to cover the orange hawkweed (*Hieracium aurantiacum*) at the Lower Dewey Reservoir.

Outreach to Local Guiding Tours

Because of the rumored existence of orange hawkweed at Laughton Glacier, the EPMT and the environmental coordinator from STC and TIWC scheduled to talk to employees from Packer Expeditions and Alaska Mountain Guides/Chilkat Guides (AMG/CG) during their employee meetings. Packer guides hike the Laughton and Denver Glacier trails almost daily and AMG travels to various areas not frequently traveled by others, such as International Falls. We instructed the employees to watch for orange hawkweed and the procedure to follow if it was found. We also distributed fliers that were to be hung up at Packer and AMG/CG employee housing Figure 22). The responses to these meetings were very positive with the employees eager to help and report any findings. Taking advantage of the resources of local guiding companies can be extremely useful in invasive plant monitoring in the future.

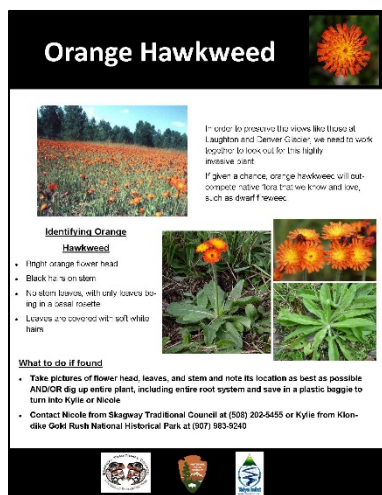


Figure 23. Flier distributed to Packer Expeditions and Alaska Mountain Guides to be hung at offices and employee housing.

Recommendations and Discussion

Next year's EPMT should focus on continuing the projects started and worked on in 2016 as well as continuing to focus on the highly ranked species in and around Skagway and Dyea. It is unnecessary to map areas of lowly ranked and common invasive plants in areas where they have already been known to occur. The focus should remain on new infestations and existing areas of highly ranked species. The effects of the Dyea Road construction will need to be assessed at the beginning of the 2017 season and an appropriate plan set in place to manage the invasive plants that have moved into the disturbed areas. Considerations for 2017 will be listed roughly in order of priority.

The cover to shade out orange hawkweed at the Lower Dewey Reservoir should be closely monitored in 2017. If new growth is seen extending from under the shade covers, additional shade cover should be added immediately. The same procedure as in 2016 should be followed, with additional improvements if needed. Even though orange hawkweed was not found at Laughton Glacier in 2016, EPMT staff should continue to communicate with Packer Expeditions and AMG to watch out for the plant in addition to taking ideally two trips out to Laughton to look for it personally. One trip should be made early in the season to ensure it will still be flowering and easier to locate if present.

Since the team was unable to treat the reed canary grass with herbicide this year, it is crucial the remaining culms are sprayed in 2017. A survey of Sheep Camp should be done early in the season and a return trip scheduled for later in the season. Spraying should be scheduled for when the risk of rain is relatively low, though late in the season (mid to late August) is ideal to maximize rhizome mortality (Reinhardt and Galatowitsch, 2004). If the oxeye daisy grows back after being pulled in 2016, this should be sprayed as well. Any remaining Italian ryegrass should be pulled.

Ornamental jewelweed is another plant that requires a close watch. This species is hard to manage in Skagway because it is mostly on private property. However, there are places where the jewelweed has spread from the private properties onto public land and these are the places that should be pulled. Specifically the alley between 20th and 21st streets should be a high priority and monitored to remove any jewelweed that returns after being pulled this year.

Canada thistle was pulled this year, but a new plan for management should be developed for future years. Since Canada thistle is susceptible to shading, a project similar to the one implemented this year for orange hawkweed should be considered. Since the location by Black Lakes is the only known location of Canada thistle and it is so highly ranked, this should be a top priority in 2017.

All previously mapped oxeye daisy locations were revisited in 2016 and their seed heads removed. This process should be continued in order to exhaust the seed bank and hopefully start to decrease the populations, or at least prevent them from increasing. If planning on manually pulling the oxeye plants instead of removing the seed head, future EPMT should take care to remove the entire root mass since they can sprout from remaining root nodes.

Reed canary grass at Pullen Creek is a large project to tackle, but clipping the seed heads would be a start to containing the population. This is a great project to do when volunteers or help is available, since it is close to the office, requires only scissors/clippers, and is easy for anyone to do.

Surveying trails should be a continuous project throughout the season. Early detection is key to combating invasive plants. The Chilkoot Trail should be surveyed at least once during the 2017 season as should other trails and roads in and around the park. The Dyea Road can easily be visually surveyed when travelling to and from projects in Dyea. White sweet clover, common tansy, oxeye daisy, and reed canary grass should be noted as specific species to watch for along the Dyea Road. The Klondike Highway should also be surveyed at least once during the season, with focus on the east side of the road, since the west side was closely surveyed in 2016.

The patch of bird vetch (*Vicia cracca*) in town should continue to be monitored and they should be prevented from going to seed. This is the only known location in Skagway but its close proximity to the railroad tracks gives it more cause to concern. Bird vetch is also very highly ranked by the Alaska invasive plant ranking system.

Outreach opportunities should be taken advantage of throughout the season. The Summer Camp activity was a great way to involve kids and next year's EPMT should coordinate getting involved in that program again. Future EPMTs should participate in other outreach events and opportunities such as posting to the Golden Nuggets blog, hosting a table at Junior Ranger Day, and hosting an edible invasive plants event as well as any additional events or publications.

Time is always the limiting factor in finishing all the projects necessary. It's important to set deadlines ahead of time for when different projects should be completed by. More logistically difficult trips should be planned further in advance, such as surveying trips for the Chilkoot or Laughton Glacier. Enlisting help from volunteers can also be a very useful resource that should be utilized. Certain projects such as clipping reed canary grass at Pullen Creek are easy but very time consuming and can be done in significantly less time with help. Communication with other organizations, specifically STC and TIWC is also key for completing projects and sharing information. Nicole Kovacs was instrumental in completing and pulling off many of the projects during the 2016 season, including the community weed-pull, the edible invasive plants workshop, clipping reed canary grass at Pullen Creek, and pulling sweet clover at the brush pile.

One discrepancy noticed in the 2016 season that could be improved in future seasons is the large variations in data from different styles of data collection. For example, if one year EPMT uses mainly polygons to document species and treatments, the total acreages are going to be significantly larger than a year when someone uses mainly points even though the infestations are roughly the same size. This makes it difficult to compare the sizes of infestations and determine whether or how much they are growing. It is recommended a more standardized protocol is used when collecting data, especially for commonly known patches or brand new infestations.

Changing timing of phenology

With the change in climate, most plants are beginning to flower and seed earlier in the season each year. It is imperative to get out and complete certain projects as early as possible in order to prevent the plants from going to seed and dispersing their seeds to new locations. This is particularly important for species such as oxeye daisy and Canada thistle.

Wind Dispersal Considerations

It is recommended that when manually removing these plants in open areas, work should begin on infestations from the north end, moving south. This practice will help to contain species with wind-driven seed dispersal mechanisms to their southern limit, as north winds during the summer and early fall are rare.

Cultural Resources Integration

KLGO is located within two National Historic Landmarks, one in each river valley, and therefore is host to extensive archaeological remains. Due to the historical significance of many areas in KLGO, a meeting concerning proper cultural resource field methods should occur annually. Artifacts or archaeological sites found while conducting surveys should be photographed, mapped, and discussed with the Cultural Resources Department.

KLGO Natural Resources Exotic Plant Collection

The following species, which have been documented around the Skagway area, need to be added to the herbarium collection:

Anthemis arvensis

Bromus inermis

Cerastium fontanum

Collomia linearis

Galeopsis tetrahit

Galeopsis bifida

Lepidium densiflorum

Medicago lupulina

Poa pratensis

Polygonum convolvulus

Potentilla gracilis

Silene cucubalus

Stellaria media

Thlaspi arvense

Tripleurospermum inodorum

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