



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

2018 Summary Report

Natural Resource Report NPS/KLGO/NRR—2018/1821





ON THIS PAGE

Common dandelion overtaking White Pass & Yukon Route train yard (LAURA GOULD)

ON THE COVER

From top left moving clockwise: orange hawkweed found at Dewey Reservoir; common dandelion on riverbank trail in Skagway; iris, monkshood, red columbine, and dandelion at the Lower Dewey Lake meadow (LAURA GOULD)

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Natural Resource Report NPS/KLGO/NRR—2018/1821

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Abstract

Summer 2018 marked the Exotic Plant Management Team's (EPMT) 15th year at Klondike Gold Rush National Historical Park (KLGO). The four main methods used by EPMT to prevent the propagation of invasive plants were: surveying new and old infestations, manual removal of infestations, restoring disturbed areas, and providing public outreach and education. It is important to monitor invasive species in order to track their spread and identify new infestations as they arise for rapid response treatment. Part of the EPMT's work was to remap past infestations while surveying for new infestations. Using priority guidelines, EPMT helped manage multiple ongoing projects such as removing reed canary grass (*Phalaris arundinacea*) from Pullen Creek, pulling white sweet clover (*Melilotus albus*) from the municipal brush pile, pulling bird vetch (*Vicia cracca*) from the bus depot, and removing oxeye daisy (*Leucanthemum vulgare*) from locations along the Dyea Road. A new patch of Canada thistle (*Cirsium arvense*) was inventoried and removed near Pullen Pond. After encountering new orange hawkweed (*Hieracium aurantacum*) growth, the 2016 tarping project at the Lower Dewey Reservoir was monitored, repaired, and expanded over the 2018 season. Restoration conducted in 2017 after the reconstruction of the Dyea Townsite Road was revisited. The EPMT also took part in multiple outreach events to educate the public about invasive plant species. More than 350 pounds of invasive vegetation was removed this year including other notable species such as tall buttercup (*Ranunculus acris*), yellow toadflax (*Linaria vulgaris*), and narrowleaf hawksbeard (*Crepis tectorum*). In 2018, 6.91 acres were surveyed, 0.28 acres were infested and 0.17 acres were treated.

Acknowledgments

Thank you to all those that helped contribute to the success of the 2018 EPMT field season at KLGO. Within the park, Jami Belt was instrumental in planning and providing guidance to EPMT efforts at the start of the season. Thanks also goes out to Anne Matsov and Jen Larsen for their supervisory roles throughout the season, and Greg Clem for his guidance in herbicide application. Work of volunteers Andres Santini-Laabes, Kirby Delgado, Claire Wilber, and Tyler Young in weed pulls and surveys around the park was also valuable to the work accomplished this summer. Thanks to Deb Boettcher for her expertise and help in preparing and coordinating the annual Junior Ranger Day outreach project. Thanks also to park archaeology staff for companionship in the field. In addition, we would like to thank Nicole Kovacs and Stephanie Palmer at the Skagway Traditional Council (STC) for their partnership and assistance in numerous projects this year. The Skagway Rec Center's summer camp offered their time to remove invasive plants as well, which was much appreciated. At the Alaska Regional Office, Peter Frank and Christopher Overbaugh were instrumental in providing training and guidance throughout the summer. Without all of the support from these people, the EPMT program would not be where it is today.

Acronyms

EPMT:	Exotic Plant Management Team
GPS:	Global Positioning System
GIS:	Geospatial Information System
KLGO:	Klondike Gold Rush National Historical Park
NPS:	National Park Service
SCA:	Student Conservation Association
STC:	Skagway Traditional Council
DOT:	Department of Transportation

Introduction

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.

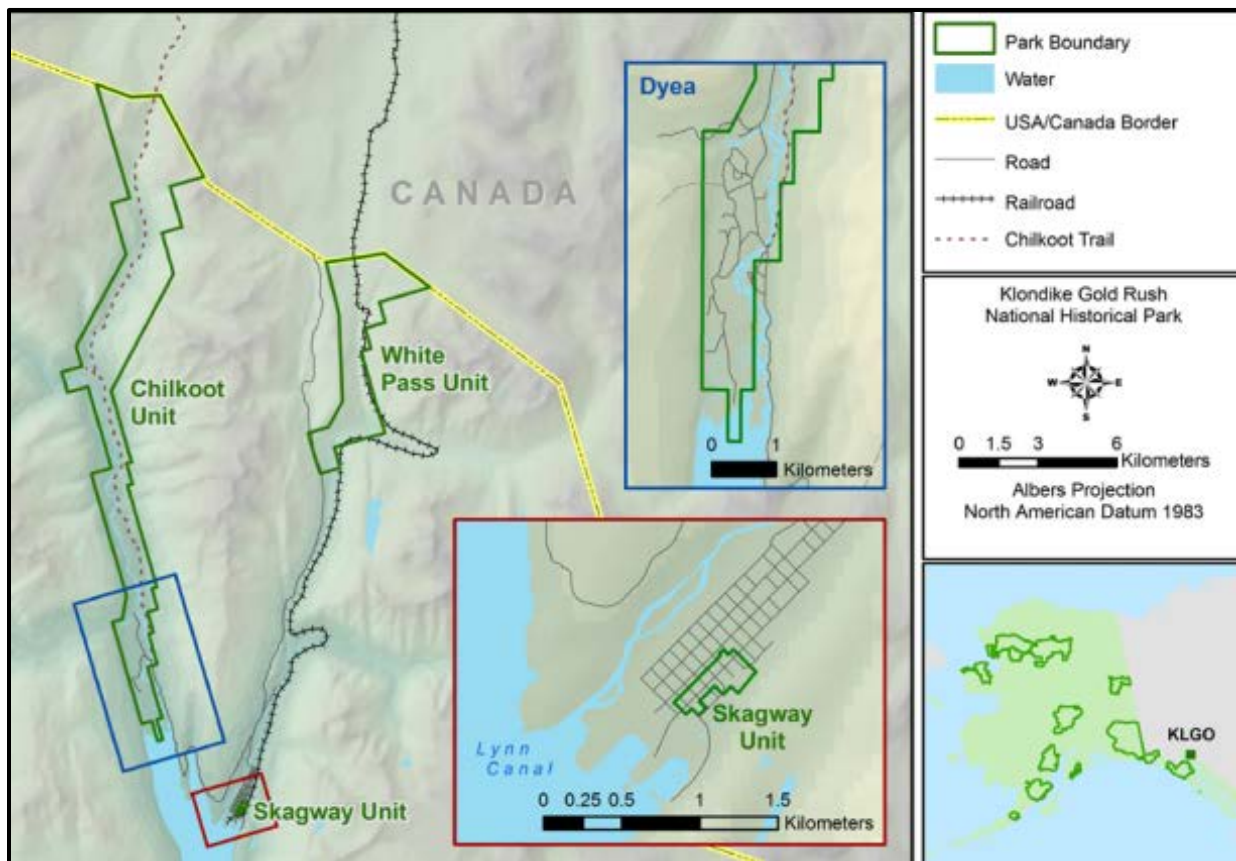


Figure 1. Boundary map of Klondike Gold Rush National Historical Park (Bernatz et al., 2011).

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 via a variety of different methods, 2) the local horticultural interest in

Skagway of landowners planting invasive plants as ornamentals for gardens, and 3) maintenance activities to help improve and build infrastructure of the park and the surrounding areas, oftentimes leading 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.

The boundaries of KLGO are 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 and Thompson (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 through the vector of development and maintenance projects. These projects create disturbed areas and therefore ideal locations 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 and Thompson 1997, Wichmann et al., 2009). KLGO receives over 100,000 visitors annually, largely from cruise ships that originate from locations worldwide. 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 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 invasive plants within the national parks of Alaska since 2004. Over the past 14 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. 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 ranking, and later on larger populations of low invasiveness ranking (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.

Compared to other NPS units in Alaska, KLGO is second only to Glacier Bay National Park and Preserve in the number of exotic plant species documented (48 species as of 2011). KLGO is in a vulnerable position due to high visitation and anthropogenic vectors that create potential routes for invasive plant species establishment and dispersal. Therefore, appropriate steps must be taken to ensure that more species are not allowed to colonize and current populations are not allowed to spread.

Methods

Field work for the 2018 season was conducted between June and September. Methods for all data collection, data management, and mapping were in compliance with the field and office protocols developed by the Alaska Region Exotic Plant Management Team (Overbaugh et al., 2018a, b). 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 seven work areas (Figure 2). Fieldwork was organized and conducted using these work areas and the results were organized by such areas. The seven work areas were as follows: Skagway, Dewey Trail System, Dyea, Laughton Glacier, Chilkoot Trail, Dyea Hill, and Klondike Highway.

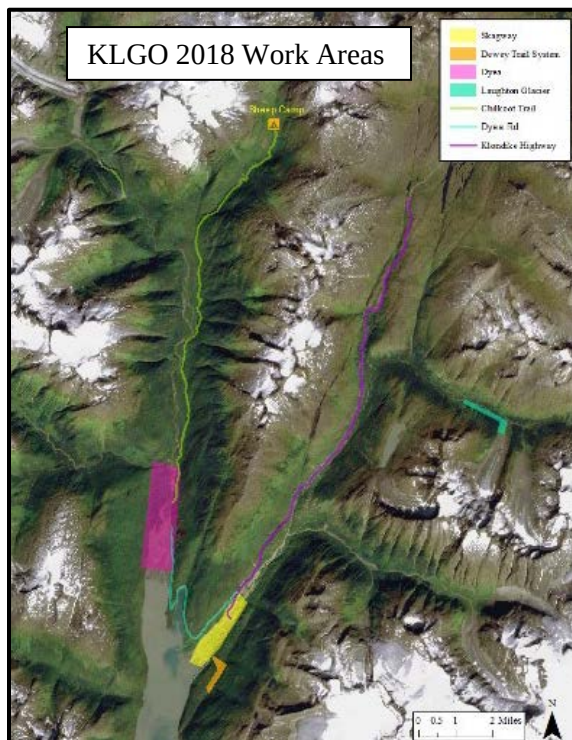


Figure 2. Work areas around KLGO

Work areas were decided first based on land ownership, and secondly on the proximity of high-priority invasive species to park lands, but other areas were also selected based on the availability of

labor support to the project. Careful considerations were made to avoid conflicts with the local community. Management was performed with consideration to private property ownership.

Work in Skagway centered on performing stewardship on NPS land to remove invasive plants from the KLGO maintenance yard, and assisting the municipality with high-profile locations in collaboration with STC. The nearby Dewey Trail System is home to the orange hawkweed tarping project and a small meadow at the southern end of Lower Dewey Lake, where the team surveyed invasive plants and managed oxeye daisy. Dyea Road was surveyed by EPMT to track the spread of invasive plants, with most work being done within the DOT right-of-way, carefully considering private land rights at the same time. Dyea was a focus this year, in particular around the Dyea Townsite Road where land was disturbed during road reconstruction in 2016 and restoration performed in 2017. The Chilkoot Trail was surveyed fully this year with the primary focus at Sheep Camp where ground was disturbed during the construction of a new warming cabin. Reed canary grass, tall buttercup, and common dandelion were found along the trail and in the campground, as well. Laughton Glacier was surveyed for orange hawkweed that was reported in 2015 and 2018, but has yet to be verified. Finally, the Klondike Highway was resurveyed along the west side of the road. The Black Lakes site along Klondike Highway was of specific concern due to a growing Canada thistle infestation.

To garner support for EPMT efforts from both staff and visitors, outreach was performed through weed pulls, education events, social media posts in collaboration with KLGO staff, and fliers to help reduce misidentification and encourage reporting of invasive plant infestations to EPMT staff.

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). The index is specific to the Alaska region and was used extensively to prioritize treatment in KLGO. 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 priority in 2018 were white sweet clover, reed canary grass, oxeye daisy, narrowleaf hawksbeard, Canada thistle, orange hawkweed, bird vetch, and tall buttercup. One species that is considered high priority but was not managed to the same extent this year was ornamental jewelweed (*Impatiens glandulifera*). There are numerous infestations of this species in town, but they did not spread to any areas not previously documented by EPMT. 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 Plants of the Pacific Northwest Coast (Pojar and Mackinnon, 1994), Identification of Non-native Plants in Alaska (Flagstad et al., 2017), and A Field Guide to Alaska Grasses (Skinner et al., 2012).

Spatial data on invasive plant infestations were collected using two GPS units, the Trimble GeoExplorer 6000 GeoxH[®] datalogger and the Trimble Geo 7X[®] datalogger. At times the Trimble Hurricane L1[®] or Trimble Tornado L1[®] were used as external GNSS receivers.

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 for certain species the entire root system must be removed for effective treatment. 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, Canada thistle, and orange hawkweed.

Herbicide was applied to treat an infestation of tall buttercup at the Dyea Townsite.

Manually removed plants were bagged, weighed, and discarded in appropriate garbage receptacles to be brought to the Skagway city incinerator for burning. 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 2018 season was Laura Gould, a Student Conservation Association intern. The EPMT mostly performed surveying and management solo, but had the occasional support from a volunteer. Multiple volunteers assisted with the community weed pull which was led by STC staff Nicole Kovacs and Stephanie Palmer. Nicole and Stephanie with the STC devoted extensive time this season to monitoring and removing invasive plants in other areas as well. Volunteers from within the park were also invaluable, especially in the success of outreach activities such as Junior Ranger Day and the Skagway Rec Center's summer camp.



Physical and Biological Sciences intern Andres Santini-Laabes assists in Dewey Reservoir tarp maintenance and posting signage.

Results

2018 Season Overview

The 2018 EPMT intern surveyed 6.91 acres and treated 0.17 infested acres in total this season, with efforts not limited to the KLGO boundaries (Figure 3). Over 350 pounds of invasive plant matter was removed from the various sites this season. Ongoing restoration projects such as the restoration project for reed canary grass at Sheep Camp were continued and areas mapped for future restoration at disturbed sites from construction in 2018. The restoration project along Dyea Townsite Road, with 11 sites revegetated in 2017, was monitored. Oxeye daisy has begun to spread in isolated roadside patches in this area. The orange hawkweed tarping done in 2016 to restrict spread of the plant at Lower Dewey Reservoir was expanded after escaped individuals were found. A new infestation of Canada thistle was located within Skagway near the confluence of Pullen Creek and Pullen Pond. Table 1 summarizes KLGO EPMT work conducted up to 2018. Table 2 provides a list of the invasive plant species detected inside the park.

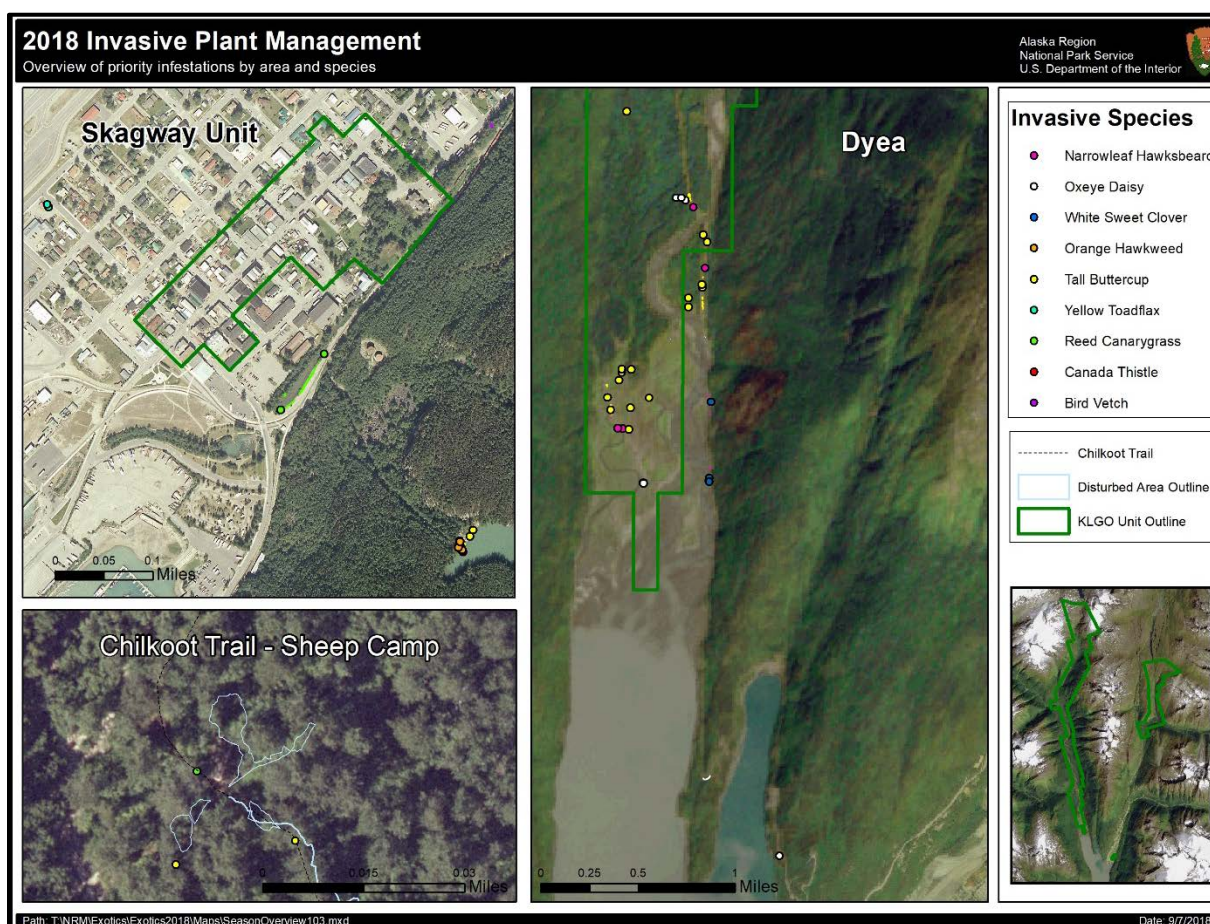


Figure 3. Map of 2018 infestations in and around KLGO park units.

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)
2017	1.18 (56.01)	0.38 (15.06)	0.12 (0.76)
2018	6.38 (0.53)	0.15 (0.127)	0.09 (0.077)

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.

Table 2. Summary of detected invasive plant species by 2018 EPMT. An “X” denotes detection of that species at that location.

Common name	Scientific name	Skagway	Dyea Road	Dyea	Chilkoot Trail	Klondike Hwy	Dewey Trails
Alsike clover	<i>Trifolium hybridum</i>	X	X	X	–	–	X
Bird vetch	<i>Vicia cracca</i>	X	–	–	–	–	–
Canadian thistle	<i>Cirsium arvense</i>	X	–	–	–	X	–
Chickweed	<i>Stellaria media</i>	X	–	X	–	–	–
Common dandelion	<i>Taraxacum officinale</i>	X	X	X	X	X	X
Common groundsel	<i>Senecio vulgaris</i>	X	X	–	–	X	–
Common plantain	<i>Plantago major</i>	X	X	X	–	X	X
Common tansy	<i>Tanacetum vulgare</i>	X	–	–	–	–	–
Curly dock	<i>Rumex crispus</i>	X	X	–	–	X	–
European mountain ash	<i>Sorbus aucuparia</i>	X	–	–	–	X	–
Narrowleaf hawksbeard	<i>Crepis tectorum</i>	X	X	–	–	X	–
Ornamental jewelweed	<i>Impatiens glandulifera</i>	X		–	–		–
Oxeye daisy	<i>Leucanthemum vulgare</i>	X	X	X	–	X	X
Pineapple weed	<i>Matricaria discoidea</i>	X	X	X	–	X	–
Red clover	<i>Trifolium pratense</i>	X	X	X	–	X	X
Reed canary grass	<i>Phalaris arundinacea</i>	X	–	–	X	–	–
Scentless false mayweed	<i>Tripleurospermum perforatum</i>	X	–	–	–	–	–
Sheep sorrel	<i>Rumex acetosella</i>	X	X	X	–	X	X
Shepherd's purse	<i>Capsella bursa-pastoris</i>	X	X	X	–	X	–
Tall buttercup	<i>Ranunculus acris</i>	X	X	X	X	X	X
White campion	<i>Silene latifolia</i>	X	–		–	–	–
White clover	<i>Trifolium repens</i>	X	X	X	X	X	X
White sweet clover	<i>Melilotus officinalis</i>	X	X	X		X	–
Yellow toadflax	<i>Linaria vulgaris</i>	X	X	–	–	X	–

Inventory and Control Accomplishments

Skagway

The municipality of Skagway is riddled with invasive plant species from ornamentals in planted gardens to plants growing in abandoned gravel lots. Many of these infestations fall on private property, are relatively non-threatening to native vegetation, and are at relatively low risk of spread to natural areas of KLGO and adjacent land. Because of this, a thorough survey of the municipality was not done this season with the exception of priority species and locations where dispersal to natural areas is likely. Small white sweet clover plants were found along the inside of the airport fence between 2nd Street and the airport building.

Bird Vetch at 9th Avenue & Spring Street

Bird vetch was found at 9th and Spring St. and remains the only location of this species in the area. The site is co-managed between the EPMT and the STC. One major bird vetch weed-pull took place in late June this year with three follow up visits to remove any late blooming individuals (Figure 4). The vetch has remained within a similar extent since it was first found in 2005. A photo point was taken at the site for future monitoring (coordinates 59.4568333, -135.309500).



Figure 4. Bird vetch before management (left) and after management (right)

KLGO Maintenance Yard

The KLGO maintenance yard was visited once per month this season to monitor and manually treat invasive species. Yellow toadflax, narrowleaf hawksbeard, shepherd's purse (*Capsella bursa-pastoris*), tall buttercup, common sheep sorrel (*Rumex acetosella*), and common dandelion (*Taraxacum officinale*) were inventoried and managed here. Special care was taken during a survey in early August to get an accurate stem count of these major species for future management considerations. Volunteer Claire Wilber assisted in manual treatment during the month of July.

Jeff Smith's Parlor

This site was surveyed in June. Common chickweed (*Stellaria media*), dandelion and yellow toadflax were found.

Municipal Brush Pile

The EPMT intern participated in the STC 10th annual community weed pull at the municipal brush pile. White sweet clover and a small amount of narrowleaf hawksbeard were pulled by the eight individuals in attendance, totaling 164 pounds of plant matter.

Pullen Creek

In June, US Army Corps of Engineers completed a project to restore and enhance the stream channel for aquatic species, affecting the area along the lower extent of Pullen Creek between the culvert at Congress Way and the footbridge to the Dewey Lakes Trail System (Figure 5). The project included the placement of 100 cubic yards of gravel (1-1.5 inch) and 60 cubic yards of fine materials (sand/silt to 1 inch gravel), and reseeding of areas impacted by loader and excavator presence. The seed mix used contained:

- 46.12% Nortran Tufted Hairgrass
- 39.46% Arctared Fescue
- 9.96% Annual Rye
- .95% Other crop seed
- 1.47% Inert matter
- 0.03% Weed Seed
- No Noxious Weeds



Figure 5. Pullen Creek gravel bars after Army Corps restoration project.

Pullen Creek and pond were surveyed in early August as a follow up to reed canary grass management efforts by STC Stephanie Palmer at the end of June. Infestations were mapped and inflorescences were clipped where found (Figure 6). The infestation appears to be confined between the footbridge and the culvert.



Figure 6. Reed canary grass at Pullen Creek.

Canada thistle was found at Pullen Pond at the intersection of the footpath and the sidewalk on the west side of the creek as it reemerges in the culvert. This is the first infestation of Canada thistle recorded in town since 2009 when it was manually treated at the northernmost median of the airport. The 97 individuals found in the 2018 season were contained to the small area of overgrown grass between the fence and the footpath and all were removed before flowering (Figure 7). The infestation is near the start of the Dewey Lakes Trail System and along the Pullen Creek Streamwalk which are popular among visitors and locals alike, making it a priority location for management.



Figure 7. New infestation of Canada thistle near Pullen Pond.

Seven Pastures

The Seven Pastures site is a popular local area where events including live music or sporting events are held. In collaboration with STC, one outreach event was conducted here. Thirty four pounds of invasive plants including scentless false mayweed (*Tripleurospermum perforatum*), curly dock (*Rumex crispus*), common plantain (*Plantago major*), and narrowleaf hawksbeard were pulled.

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 species 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 species. The first and most commonly traveled section of the trail systems was surveyed by 2018 EPMT.

Lower Dewey Reservoir

This season included significant efforts to contain orange hawkweed at the Dewey Reservoir. This is the only verified location of orange hawkweed in the Skagway area. In 2016, two tarps were set up to shade out the orange hawkweed infestation. These tarps were maintained in 2017 with no escapees observed. In 2018 the tarps were repaired and tarp 1 extended after the discovery of plants creeping beyond the southern and western border of the tarp. Plants were also found a few meters along the social trail down the hillside. The new tarping extent does not cover the individuals located down the social trail, so these plants were dug out with care to remove all root fragments. The site was

monitored closely every two weeks to ensure no escapees went to flower or seed and that the integrity of the tarps persisted. Repeat photo points were developed for the two tarps after this expansion took place. The tarp photo point locations are as follows: tarp 1 (NAD83 59.4505335, -135.3103567) and tarp 2 (NAD83 59.4505045, -135.3102568) (Figure 8). Additionally, an extensive infestation of tall buttercup, found north of the first tarp, was manually treated and revisited throughout the season. There was a dense patch of tall buttercup below the dam as well, but this was not treated due to poor accessibility. White clover (*Trifolium repens*), common dandelion, and common plantain were also present at the reservoir.



Figure 8. Photos of tarp 1 (left) and tarp 2 (right) after maintenance in 2018 at Lower Dewey Reservoir

Lower Dewey Lake

The entirety of the Lower Dewey Lake Loop Trail was surveyed twice this summer. On the first survey, common dandelion was managed at the footbridges at the north end of the lake and at the northernmost edge of the infestation at the meadow at the southern end of the lake. In early August, oxeye daisy was managed at the meadow. No invasive plant species were found along the loop apart from these two areas.

Dyea Road

The DOT right-of-way along Dyea Road is a highly disturbed area where construction has recently taken place. It's surrounded by private property, which makes management challenging. The three segments of the road, delineated by 2017 EPMT intern, are as follows: Beginning to AB Mountain Trail, AB Mountain Trail to Nahku Road, and Nahku Road to Taiya Bridge (Figure 9). The road was surveyed by car and occasionally foot.

The Dyea Road consists of three management sections: Skagway to the AB Mountain trailhead, the trailhead to Nakhu Bay, and Nakhu Bay to the Taiya River. In the first section, no management was conducted.

The next section of the Dyea Road included an infestation of oxeye daisy on the western side of the road that is too steep to manage safely. There were also a few isolated tall buttercup individuals.

Nakhu Bay was surveyed. An infestation of common tansy was found and removed at the first pull out with guard rails, but no white sweet clover was found.



Figure 9. Map showing Dyea Road survey segments used in 2017 and 2018.

The final section runs along the Dyea Flats. It includes a horseshoe turn where there is an infestation of oxeye daisy in the DOT right-of-way that extends onto private land (Figure 10). This site was visited twice to clip off flowering heads before the area was mowed in early July. Debris from mowing had been raked up prior to the EPMT visit. Tall buttercup was also found in this area and pulled at the same time as the oxeye daisy. Along the flats, a series of small white sweet clover infestations were inventoried and managed (Figure 11). Narrowleaf hawksbeard was found at the parking lot across from the raft pull out. There was also a small patch of narrowleaf hawksbeard at the corner of the turnoff into the campground and a few isolated individuals along the roadside before the start of the Chilkoot Trail. Tall buttercup heavily infests the roadside between the campground turnoff and the trailhead.



Figure 10. Oxeye daisy along Dyea Road, before (left) and after (right)



Figure 11. White sweet clover along Dyea Road, before (left) and after (right)

The KLGO Dyea Campground was mostly free of invasive plants aside from tall buttercup in a few campsites and on either side of the culvert located following the Chilkoot overnight parking lot.

An infestation of oxeye daisy was found north of the Taiya River on the east side of the road. This site was monitored twice each month to ensure timely manual treatment of individuals flowering at different times (Figure 12). Tall buttercup was found in the same area and along the road past the turn off to the Dyea Flats, but only treated at the edges closest to the turn off. No trace of the white sweet clover infestation located just past the bridge and treated during the 2017 season was found.



Figure 12. Oxeye daisy infestation before (left) and after (right) first treatment.

Dyea

A large construction project on the Dyea Townsite Road was completed in 2017, creating disturbed areas along the roadside. In 2017, staff seeded and planted 11 sites for restoration. The road was surveyed this season. A few small clusters of oxeye daisy were pulled just after the turn off from the Dyea Road and before the first pull out. Additionally, on the final turn before the split off with Slide Cemetery Road, a large infestation of tall buttercup was found. The fringes of this infestation were manually treated to contain the patch. There are also isolated patches of white clover along the road.

Slide Cemetery Road

The Slide Cemetery Road is mostly clear of invasive species except for a few isolated tall buttercup individuals between Slide Cemetery and the Lost Lake trailhead. A ditch near the turn off from the Dyea Townsite Road contained infestations of oxeye daisy and tall buttercup, which were manually treated and revisited twice during the season.

Dyea Townsite

At the parking pull off for the Dyea Townsite, an island of dirt was overgrown with white clover and common sheep sorrel among other plants. In August, a sign for the townsite was installed here. At the entrance to the townsite is a kiosk surrounded by tall buttercup. The infestation extends into the slough but was too large to effectively pull. The Pullen Barn site was surveyed and white clover and dandelion were found in small quantities nearby. The entire townsite was surveyed. Extensive infestations of common sheep sorrel were found along the pathway, especially in the open area at the southeast end (Figure 13). Additionally, isolated tall buttercup individuals were found and treated in the northern half of the townsite. An infestation of tall buttercup by the “Hurry, hurry, hurry” kiosk and north of the old hotel site was sprayed with herbicide by the EPMT intern and KLGO Maintenance employee, Greg Clem (Figure 13).



Figure 13. From left to right: common sheep sorrel at the Dyea Townsite, tall buttercup after herbicide application at Dyea Townsite

Nelson Slough and Dyea Flats

Nelson Slough was surveyed once in early June. Large infestations of common dandelion and tall buttercup were found within the slough, and on the surrounding land and roadside. The tall buttercup infestation is very extensive and proceeds out onto the beginning of the Dyea Flats up until the footbridge near the parking lot (Figure 14). The flats themselves are virtually free of invasive species. Native arctic daisy (*Chrysanthemum arcticum*) is widespread throughout the area and may be mistaken for invasive oxeye daisy (Figure 15).



Figure 14. Tall buttercup infestation near Nelson Slough Bridge after irises have gone to seed



Figure 15. Native arctic daisy found at Dyea Flats

West Creek Road

West Creek Road was inventoried during a driving survey. The road was mostly clear of priority invasive species apart from a small infestation of oxeye daisy and a few areas of tall buttercup along the road. All individuals of invasive species were found along the roadside and not in natural areas.

Chilkoot Trail

At the end of July a walking survey was done of the entire length of the Chilkoot Trail. At the trail head in Dyea common dandelion was found, but after the ascent up Saintly Hill the trail was clear of any priority species until Sheep Camp. Sheep Camp serves as a stopping place for almost all backpackers along the trail, is the site of a permanent ranger cabin, and was the location of KLGO trail crew and SCA crew work this season. Reed canary grass was first detected at the campground in

2011. After tarps failed to control or eradicate the species, herbicide was applied in 2015 and 2017. Jami Belt inventoried 11 culms in June 2018 along the trail's rock border, but no individuals were distinguishable at this location in July or August, potentially due to trampling from maintenance operations.

Tall buttercup in camp around the food and warming shelters was pulled in 2018 and should be pulled or chemically managed again in 2019. Tall buttercup was also found along the trail leading up to camp, but care should be taken to distinguish from native monkshood (*Aconitum sp.*) when not in flower (Figure 16).



Figure 16. Tall buttercup and white clover growing along the redone trail between Sheep Camp Ranger Station and Campground

The trail crew constructed a new warming shelter at Sheep Camp this year, requiring earth moving around the common area of the campground and the trail leading up to the campground as well as materials to be flown in from town (Figure 17, Figure 18). Rock walls lining the path were rebuilt by the 2018 EPMT intern and disturbed areas for future inventory and restoration were mapped.



Figure 17. Disturbed areas around the new Sheep Camp warming cabin

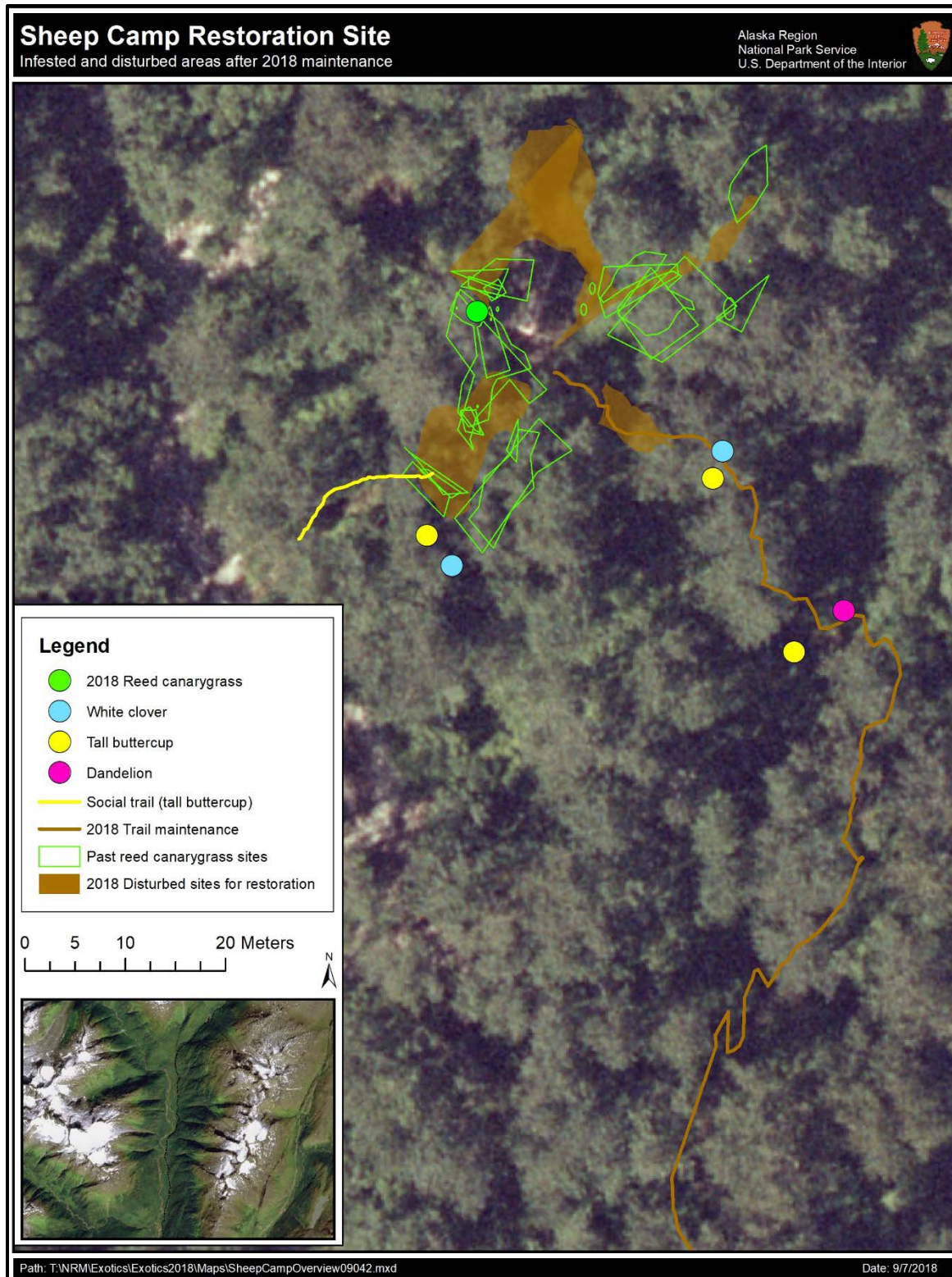


Figure 18. Disturbed areas and infestations in Sheep Camp

Along the Canadian side of the trail, no invasive species were observed except for common dandelion near the trail head in Bennett.

Laughton Glacier

Laughton Glacier is a popular hiking destination on Tongass National Forest land along the White Pass and Yukon Route Railroad, located approximately one mile east of the White Pass Unit of KLGO. Due to unconfirmed reports of orange hawkweed along the Laughton Glacier trail in 2015, the large disturbed area from glacial recession, and the proximity of the KLGO White Pass unit, we have conducted annual invasive plant surveys of the trail. After reports of sightings this year from a Packer Expeditions guide, a survey of the trail revealed the presence of native hawkweed (potentially *Hieracium triste*) as well as native orange agoseris (*Agoseris aurantiaca*) which could have easily been mistaken for orange hawkweed (Figure 19).



Figure 19. From left to right: native hawkweed, dandelion rosettes at glacial terminus, and native orange agoseris along Laughton Glacier trail

The train stop is infested with many common invasive plants such as dandelion, *Trifolium spp.* and curly dock.

Klondike Highway

The Klondike Highway is one of the main corridors connecting the Yukon Territory and British Columbia to Skagway, making it a primary pathway for invasive plant dispersal. Frequent maintenance along the road disturbs the soil and facilitates the introduction, establishment, and spread of invasive plant species. On August 17th, the west side of the Klondike Highway was surveyed on bike by the EMPT intern and volunteer Tyler Young for 14 miles from the summit of the pass to the intersection with the Dyea Road (Figure 20, 21). Special attention was paid to pullouts and turnoffs (Figure 22).



Figure 20. The view toward Skagway from the international border in early June



Figure 21. Volunteer Tyler Young surveys the cliff face and roadside ditch for invasive species at a truck escape ramp where yellow toadflax was found



Figure 22. Truck escape ramps and other pull outs were hotspots for invasive species

Dandelion and white clover were the most prominent invasive plant species throughout the length of the road. Pineapple weed was the dominant ground cover at gravel pull outs at lower elevations, and common plantain could also be found at most gravel areas. At mid and lower level elevations

groundsel (*Senecio vulgaris*) was very common, covering more area than narrowleaf hawksbeard and yellow toadflax at most large infested areas. Foxtail barley (*Hordeum jubatum*) and sheep sorrel were found in small amounts near the summit of the pass. Red clover and curly dock were common along the lowest reaches of the road. Shepherd's purse was found at lower reaches as well.

Narrowleaf hawksbeard and yellow toadflax were the two most common priority species, being found to some extent at all elevations and in greater abundance at pull outs as elevation declined. White sweet clover was found at a pullout nearing reentry through customs. Its largest infestation was interspersed along a 40 meter section near the Goat Lake overlook. Tall buttercup was found along the roadside between the Captain William Moore Bridge construction and Bridal Veil Falls, and in small quantities at lower elevations. Finally, oxeye daisy was only seen at two locations along the roadside: at the first turnout heading down from the summit, and at Bridal Veil Falls in small point infestations. An infestation of yellow toadflax was found at customs

Black Lakes

Ten pounds of Canada thistle was pulled at the pullout near the Black Lakes at the beginning of August (Figure 23). The site was revisited at the end of August to remove all new growth. Also managed at this site was white sweet clover found growing in and around the gravel pile (Figure 24).



Figure 23. Canada thistle at the Black Lakes site before (left) and after (right).



Figure 24. White sweet clover on gravel pile at the Black Lakes site.

Outreach and Education

Outreach and education about invasive species was conducted formally and informally. The EPMT intern and Jami Belt attended a maintenance meeting in early June to talk about invasive plants and share fliers with employees. The EPMT intern also dropped off fliers and talked informally with Packer Expeditions about keeping an eye out for invasive plants and orange hawkweed on their Laughton Glacier excursions in particular. Additionally, The EPMT intern frequently talked to inquisitive visitors about invasive plants and their management.

Skagway Rec Center Summer Camp

The EPMT intern assisted KLGO education and interpretation staff in leading two days of plant related activities for Skagway Rec Center's summer camp. Each session had approximately 30 students in attendance and focused on learning about native and invasive plants. The children and counselors also participated in a weed pull for tall buttercup, curly dock, creeping buttercup (*Ranunculus repens*), and common dandelion at Smugglers Cove (Figure 25). A total of 35.5 pounds of invasive plants were pulled.



Figure 25. Summer campers pull invasive plants at Smuggler's Cove

STC Weedwackers Summer Camp

The EPMT intern assisted Nicole Kovas and Stephanie Palmer with the annual STC Weedwackers camp, which included teaching children about invasive species through discussions, games, and cooking, and participating in a weed pull event at Seven Pastures. At Seven Pastures 34 pounds of invasive plants were pulled.

10th Annual Skagway Community Weed Pull

EPMT assisted at the 10th Annual Community Weed Pull organized by STC. White sweet clover and a small amount of narrowleaf hawksbeard were pulled by the eight individuals in attendance, totaling 164 pounds of plant matter.

Junior Ranger Day

EPMT teamed up with Deb Boettcher to collect and press invasive plants and teach visitors how to make bookmarks with invasive species at Junior Ranger Day (Figure 26). Close to 60 bookmarks were made, breaking the record from previous years.



Figure 26. Deb Boettcher shows visitors at Junior Ranger Day how to make invasive plant bookmarks

Invasive Plant Short Videos

Under the direction of SCA Communications and Media intern Renata Harrison, EPMT was involved in the making of a series of short videos to be shared over social media. Videos discussed invasive plant species such as yellow toadflax, tall buttercup, and reed canary grass, emphasizing their negative impact on native flora and fauna, means of dispersal, and identification.

Native Plant Garden

Created in collaboration between the Skagway Rec Center and KLGO, the First Bloom Native Plant Garden located next door to the Junior Ranger Activity Center is one of the most public exhibits on flora in the park. EPMT removed invasive species from the plant boxes and installed informational signs for the public about the native plants (Figure 27). Signs were adapted from those created in 2015 by EMPT intern, Kevin Hauser.



Figure 27. New signs located at the First Bloom Native Plant Garden on Broadway St

Recommendations and Discussion

Next year's EPMT should focus on continuing surveying efforts in areas missed by 2018 EPMT, on revisiting priority project sites from 2018 season, and expanding outreach to make fighting invasive species a community value. A greater focus on outreach should be performed with higher levels of collaboration with STC and other groups. Communication with STC should begin at the start of the season to plan outreach events such as community weed pulls. Additionally with STC, designate dates for monitoring and management at various sites that are not on NPS land. In the longer term, use of herbicide should be planned and permitted along DOT right-of-ways on Dyea Road and on NPS land in Dyea, primarily for oxeye daisy infestations. When possible, infestations should be collected using standard polygons in order to avoid discrepancies in data collection.

Continuing Projects

As a major conduit for plant dispersal across the international border, the east side of the Klondike Highway should be surveyed in mid-August of the 2019 EPMT season. Since 2016, this survey has taken place on August 17th, so for consistency that should be done again. Infestations from past years should be reassessed during this survey.

Although also along the Klondike Highway survey route, the Black Lakes Canada thistle site should be managed more often throughout the season. At the end of July and beginning of August, the infestation should be near fully grown and easy to find and pull or cut off flower heads. The site should be revisited as needed to ensure that none go to seed to keep weakening the seed bank.

The new Canada thistle infestation at Pullen Pond should be managed and surveyed through a similar process as the Black Lakes infestation.

As part of the ongoing Sheep Camp restoration project, a trip should be made up to Sheep Camp before the end of June to apply herbicide on the common dandelion, assess presence of reed canary grass, and begin restoration of disturbed areas around new warming cabin. An additional trip in late July should be made to apply herbicide to tall buttercup and reed canary grass, reapply to common dandelion, and complete any restoration work necessary. A backpack sprayer is stored at Sheep Camp for use.

Pending invasive plant management talks with Rick Turner from the Tongass National Forest, Laughton Glacier should be surveyed once during the season for orange hawkweed and other species. The 2018 survey took place on July 5th, but next season mid-late July may be more effective to ensure blooming of invasive species for ease of spotting and identification.

The reed canary grass infestation along Pullen Creek in town should be visited on a biweekly basis, when time allows, to prevent plants from going to seed. Seed heads should be clipped and nonflowering vegetation cut by weed whacker and removed. Recruiting volunteers for this and coordinating with STC will be essential due to the size of the infestation.

The biweekly surveys of Dewey Reservoir at the orange hawkweed tarping site should be continued and tarps should be repaired/replaced as needed. Escaped rosettes were found at the beginning of July during the 2018 season, so special care should be taken to closely survey the entire area at that time next year, with

particular focus along the social trail down the hill and at the tarp edges. The tall buttercup at this site can be managed on these visits as well.

Monthly treatment of invasive plants through manual and chemical means at the KLGO maintenance yard is important to preventing dispersal via park vehicles, machinery, and materials. An outreach meeting to maintenance staff should be scheduled for the beginning of June to educate them on invasive species, EPMT management plans, and solicit help from staff for management when they are not busy with other tasks.

The bird vetch patch should be monitored closely in mid-June to early July for blooms, at which point all vegetation should be removed as thoroughly as possible. The site should be revisited later on in the season to ensure no individuals remain.

Suggested Projects

Outreach projects should be set early to ensure time for advertising and planning. Outreach to guide services in Skagway, especially Packer Expeditions and Alaska Mountain Guides that travel to more remote areas, can be done informally or through organized presentations. Inviting the public to a presentation coupled with an edible invasive species workshop or pressed plant craft night in collaboration with STC are two potential ideas. Another key group to target is gardeners and private land owners who may have invasive species on their property. For high priority species that are not extensively distributed, such as ornamental jewelweed, it would be worth putting in the time to pull these plants on private property if permissions were acquired. Park seasonal and permanent staff can also be a great resource for volunteers and reporting invasive plant sightings as they are very active in the area on and off duty. Distribute invasive plant identification fliers widely.

Members of STC noted a decline in attendance to weed pull events, but this is still one of the best ways to remove large infestations of invasive plants. Areas for community weed pulls should be prioritized by phenology of species and location to encourage better turn out from community members. A few potential locations include the narrowleaf hawksbeard in the right-of-way along the start of the Dyea Road, the Dyea Townsite for sheep sorrel, the start of the Dyea Flats for tall buttercup, the Lower Dewey Lake meadow where native wildflowers are being overcrowded, and the municipal brush pile for white sweet clover. Weed pulls should be advertised heavily in multiple forms.

The length of Pullen Creek between the footbridge and the culvert where gravel bars were added by the Army Corps in 2018 should be surveyed closely for invasive growth in the disturbed areas.

The Dyea Road is a major avenue for invasive plants to travel from Skagway onto park land and natural areas. The white sweet clover infestation along the third segment of the road is a high priority and should be revisited after an initial pull to manage regrowth. A walking or biking survey is the best practice to make a thorough inventory.

All oxeye daisy locations should be treated by either removing seed heads or removing the entire plant, taking care to remove the entire root mass in order to avoid regrowth. Removing seed heads will require revisiting sites biweekly for management of new growth. Where possible, herbicide application should be used to manage this species.

Time is always a limiting factor in finishing all the projects necessary. It is important to set deadlines ahead of time for when different projects should be completed. 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 removing 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 Taiya Inlet Watershed Council, is also key for completing projects and sharing information. Collaboration with STC is vital for the success of outreach efforts.

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, Canadian thistle, and narrowleaf hawksbeard.

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:

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

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