



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

2014 Summary Report

Natural Resource Data Series NPS/KLGO/NRDS—2014/742



ON THE COVER

From top left to bottom right: KLGO EPMT staff removes the inflorescences from reed canarygrass infestation at Pullen Creek; reed canarygrass growing along the banks of Pullen Creek; NPS volunteer, Jade Cook, helps to remove a tall buttercup infestation; this image taken from the Dyea Flats provides an example of the variety of ecosystems found throughout the park. Photographs by: Ramsey Mauldin and Rachel Ford

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This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Abstract

In 2014 the Exotic Plant Management Team (EPMT) at Klondike Gold Rush National Historical Park (KLGO) focused on three primary objectives; accurately documenting the distribution and abundance of invasive species in and around the park, educating the community and park staff on invasive species, and controlling existing infestations in order to prevent their spread into or within the park. This summer marked the eleventh consecutive year of the EPMT program at KLGO. However, this year was the first year that the EPMT at KLGO put a larger emphasis on developing partnerships with entities operating in and around Skagway than on actual control work. In previous years, there have been more resources and volunteers devoted to the control of invasive species both inside and outside of the park. After a decade of park service effort devoted to controlling invasive species even outside of the park, it has been decided that the best method of control is to inform respective landowners of any infestations found on their land and what they can do to help avoid the spread of these infestations. The infestations outside of the park border are too extensive for the park service to be tending to on their own, and it is vital to enlist the community as active individuals seeking to limit the spread of exotic plants on their land. Therefore, much of EPMT efforts were focused on education as opposed to actual control work. Infestations were again monitored both on and off parkland; however, only priority infestations were controlled on parklands by EPMT staff alone. Community members and volunteers carried out other control efforts. Future EPMT staff should continue to focus on outreach and education while maintaining efforts to monitor the spread of infestations in and around the park.

Acknowledgments

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The author would also like to acknowledge those who have so generously volunteered their time to the benefit of the Exotic Plant Management program this summer; Joanne and Andrew Beierly for their continued dedication to the removal of white sweetclover in Skagway; All the volunteers who participated in the community weeds pull; as well as the numerous park staff and citizens that have provided their diverse support to the program by controlling invasive plants or educating others about the threats posed by invasive plants. Their combined dedication during the 2014 season has helped to protect and preserve the native ecosystems of KLGO and is greatly appreciated.

Abbreviations

AACD	Alaska Association of Conservation Districts
AKDOT	Alaska Department of Transportation
AKNHP	Alaska National Heritage Program
EDRR	Early Detection & Rapid Response
EPMT	Exotic Plant Management Team
ESRI	The Economic and Social Research Institute
GIS	Geographic Information System
GPS	Global Positioning System
KLGO	Klondike Gold Rush National Historical Park
NPS	National Park Service
TIWC	Taiya Inlet Watershed Council

Introduction

KLGO is located in Southeast Alaska at the northern terminus of the Lynn Canal. The total acreage of the park is around 13,000 acres, though this area is dispersed between three distinct park units (Figure 1). The Chilkoot Unit (approx. 9,670 acres) includes the Chilkoot Trail, Dyea, and the tidal flats. The White Pass Unit (approx. 3,320 acres) is located about seven miles north of Skagway, and includes portions of the White Pass Trail and White Pass City. The Skagway Unit is comprised of 12 square blocks in the town of Skagway (NPS 1996). These three units encompass a large collection of eco-tones between various ecosystems of coastal rainforest, lowland tidal flats, sub-alpine boreal forest, high-alpine meadow, and alpine tundra. The elevation and aspect gradients of these ecosystems are as diverse as they are numerous. The vertical range of KLGO spans from sea level to around 6,000 feet above sea level. This variability in environments creates a multitude of ecological niches and therefore a high biodiversity inside the park (Frank 2012).

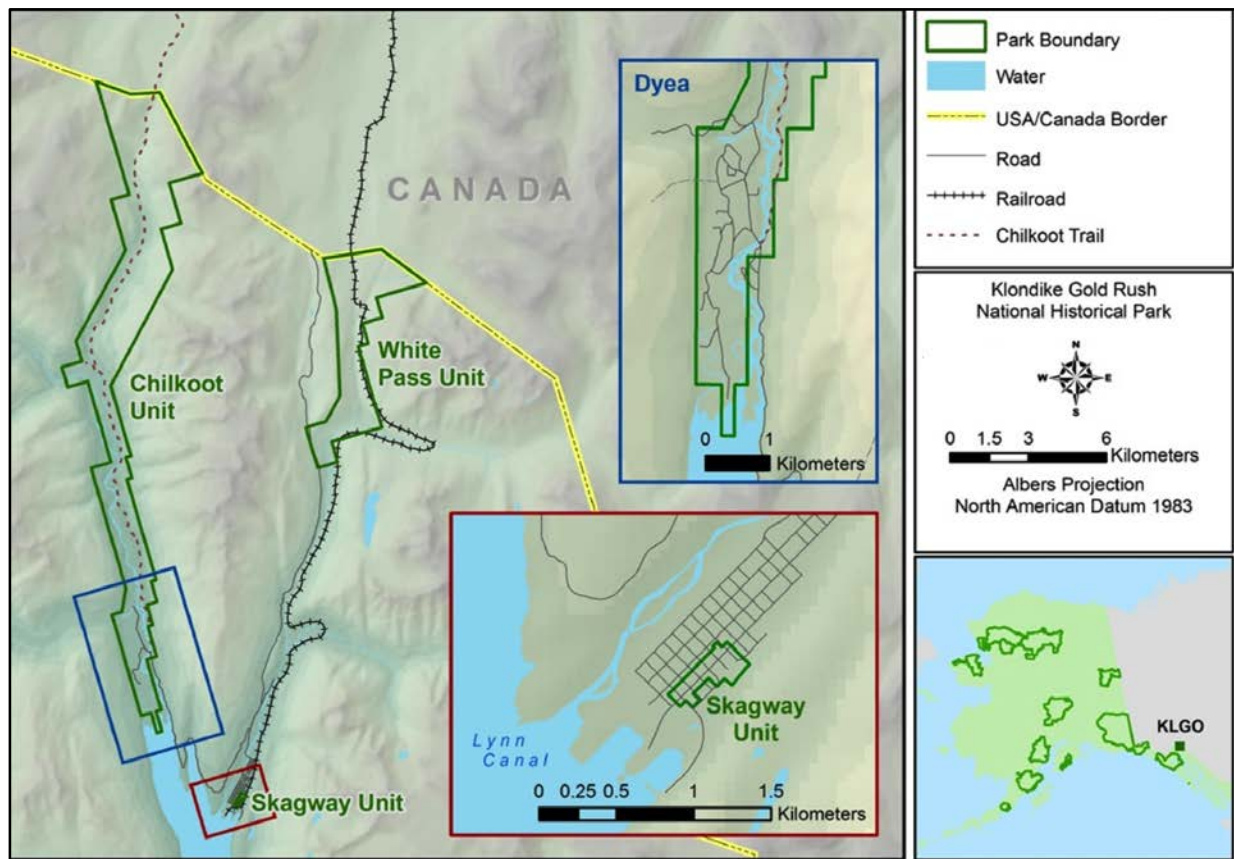


Figure 1. Boundary map of Klondike Gold Rush National Historical Park (Bernatz et al. 2012)

Skagway and Dyea, being popular tourist destinations, receive high levels of foot traffic. KLGO currently receives nearly one million visitors per season, and this number continues to increase annually (NPS 2013). The high number of visitors, combined with the multitude of ecological niches contained by the diverse ecosystem, provides an ideal vector for the establishment and spread of invasive plant species within the park and surrounding areas (Golden 2013).

Invasive plants can be defined as non-native plant species that have the potential to spread into and dominate previously un-colonized ecosystems, establish self-sustaining populations, and disrupt these ecosystems (USDA 2007). These species are capable of displacing native species, disrupting food webs and pollinator ecology, altering soil chemistry and hydrologic cycles, and changing natural disturbance regimes (Mack *et al.* 2000). The colonization of invasive species creates novel ecosystems that are often recognized as second only to habitat loss in the reduction of species biodiversity (Carlson *et al.* 2008). The cumulative effects of invasive plant establishment consequently pose significant economic threats, and these threats are further exasperated by a lack of understanding of the inseparable link between economy and nature (Mack *et al.* 2000).

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, horticultural stock, or 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 *et al.* 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 controlling existing populations remains a high priority, it is often agreed upon that the most effective method for controlling invasive plants is to prevent the spread or establishment of novel or already present invasive species populations (USDA 2007).

Alaska as a whole is situated in a unique position compared to the contiguous United States, in that relatively few invasive plant species have so far established themselves in the state. However, 48 non-native invasive plant species have already been detected in Skagway and KLGO, and the park is second only to Glacier Bay National Park and Preserve in number of invasive species that have been documented (Frank 2012). This stresses the point that KLGO is in a vulnerable position due to the amount of foreign traffic and human 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.

The Alaska EPMT has been tasked with monitoring and controlling invasive plant species within Alaska's National Parks. In KLGO, EPMT efforts have been in effect since 2004. Over the past ten years, park EPMT staff has gathered baseline data that catalogs the dispersal and spread of invasive species throughout the park as well as surrounding areas. Staff has conducted annual field surveys for invasive plants, implemented control measures to deal with known infestations, and prepared community awareness and outreach events and activities. The park's strategy has been of early detection & rapid response (EDRR), where species are prioritized based 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 ranking (Carlson *et al.* 2008).

Over the past nine years EPMT members have gathered baseline data for invasive plants in the area, conducted annual monitoring surveys, established community outreach and prevention methods and controlled emerging infestations in and around the park. Specifically, the KLGO EPMT has focused

on early detection and eradication of small, high-priority infestations in and around the park. 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.

In 2014, the KLGO EPMT continued the annual inventory and monitoring plan and collected high-quality data concerning the distribution, abundance and species composition of exotic plants in all three units of the park. Exotic plant monitoring and control activities were focused on the most aggressive species, disjunctive infestations, and populations with a high potential for dispersal that threaten to expand into or within the park. Education and outreach activities targeted park staff and visitors as well as Skagway residents seeking to better inform them of the threats non-native species pose to native ecosystems. The data gathered in 2014 will be used to prioritize future park work and formulate long-term monitoring and control goals. However, this season is the first season that a greater emphasis on partnership development has been in effect to move invasive species control work on lands outside of the park into the hands of the respective owners. The infestations are simply too large to be managed by the Park Service alone, so partnerships will help share the workload.

Methods

EPMT field work for the 2014 season was conducted between the months of June and August. Methods used for all data collection and data management were in compliance with the Alaska EPMT 2013 Field Protocol (Million *et al.* 2014). EPMT staff utilized existing data, recommendations from previous years, this season's phenology, and available labor, to prioritize treatment of infestations and species, select equipment, and choose appropriate control methods.

Defining Work Areas

To better manage prioritization of species infestations, work areas for the 2014 season were divided into six unique locations. Field work was divided between these areas, and therefore results and recommendations are organized in accordance to these six divisions. The six areas are:

1. Nelson Slough Restoration Site
2. The Chilkoot Trail
3. Dyea
4. The Dyea Road
5. Skagway
6. The Klondike Highway



Figure 2. Compliance tool used near cultural resource sites to minimize possible damage to artifacts buried during control work.

Highest priority was given to the control and eradication of infestations within the first three locations, as these areas are contained within KLGO park boundaries. Special accommodation was given to the Chilkoot Trail due to its remote location. However, because it receives high foot traffic and is a primary conduit for seed dispersal, care was given to ensure that appropriate inventory and control methods were allotted. The Nelson Slough restoration site also received special attention due to its high concentration of invasive species. Containment and prevention was the primary objective when dealing with the remaining three locations.

It should be noted that much of the KLGO EPMT work in 2014 was devoted to areas inside of park boundaries. The majority of land surrounding KLGO boundaries are owned by the Skagway Municipality, the State of Alaska, or owned privately. The key to effective progress in controlling invasive infestations is to have the respective owners of all land manage infestations on their own. Invasive plants in these areas have the potential to disperse into federally-owned park property; therefore many were still monitored during the 2014 season.

Prioritization of Species

Prioritization of non-native invasive plant species in Alaska is guided by the Alaska Invasiveness Ranking System outlined by Carlson *et al.* (2008). This index provides a ranking of 0-100 based on four subcategories of invasiveness: ecological impacts, biological characteristics and dispersal ability, distribution, and feasibility of control. This index provided a baseline for species prioritization within KLGO. Within this regional ranking system, species were further prioritized in KLGO based on a system of triage that placed highest priority on species with small infestations and high invasiveness ranking, and lowest priority on species with large infestations and low invasiveness ranking. Still further, prioritization of treatments was given to species present in undeveloped front and backcountry within the park, and later to highly disturbed areas such as roadsides and urban zones.

In 2006, KLGO Natural Resources staff and Alaska Regional EPMT staff established the following list of six high priority species found in or near the park: bird vetch (*Vicia cracca*), common tansy (*Tanacetum vulgare*), white sweetclover (*Melilotus alba*), oxeye daisy (*Leucanthemum vulgare*), yellow toadflax (*Linaria vulgaris*), and narrowleaf hawksbeard (*Crepis tectorum*). For the past eight years the monitoring and eradication of these six species has been the top priority of the KLGO EPMT as these plants are all considered species of greatest concern in Alaska (Carlson *et al.* 2008). Three more species of high priority have since been added to the list: ornamental jewelweed (*Impatiens glandulifera*) first documented in 2007, reed canarygrass (*Phalaris arundinacea*) first documented in 2011 and Canada thistle (*Cirsium arvense*) first documented in 2012. These species were included because of their high invasiveness ranking and relatively small extent, making them targets for eradication. Fortunately, only four of these high priority species have been found in the park and have a very limited extent. Preventing the spread of these nine species into the park through aggressively treating any infestations found in or near the park boundaries is the KLGO EPMT's top priority.

Tools for Identification and Data Collection

The primary field guides used for the identification of invasive plant species were Plants of the Pacific Northwest Coast (Pojar and Mackinnon 1994), the Identification of Non-Native Plants in Alaska (Flagstad and Cortex-Burns 2013) and How to Identify Grasses & Grasslike Plants (Harrington 1977). Most plants that were encountered in the 2014 season were also available in the KLGO herbarium, as well as in the KLGO natural resources exotic pressed plant collection, started in 2010.

Spatial data on the invasive plant infestations were collected using a GPS unit: the Trimble GeoXH6000® datalogger with the Trimble Tornado 4L1® antenna. This unit is set to be accurate within zero to five meters, in compliance with the 2014 Alaska EPMT field protocol (Million *et al.* 2014). Trimble Pathfinder Office 5.40® was used to differentially correct positions using the CORS Skagway, AK base station data and then edit the data.

Collected data were sent to the Alaska EPMT Regional Office for entry into the Alaska EPMT database every two weeks. The regional EPMT staff converted the GPS data to ArcMap® shapefiles for use in KLGO GIS projects and the Alaska Regional invasive plant geodatabase. For mapping and

analysis by KLGO EPMT staff, some data were exported to ArcMap® shapefiles and manipulated using ESRI ArcGIS 10.1®.

Control Methods

The primary control method employed for invasive plant removal was hand pulling, combined with the utilization of hand tools such as trowels. This method allowed for selective control. The greatest concern with this method was that the entire root system must be removed with the plant for the treatment to be effective. Plants with just a single tap root are pulled easily, but those with rhizomatous root systems require special care to remove the entire root system. Many invasive plants can regenerate from root fragments left in the soil when proper hand pulling techniques are not employed. This has been observed in previous years with several species including common tansy, yellow toadflax, and oxeye daisy.

All removed plants were bagged on-site, weighed at the KLGO maintenance building, and transported by KLGO maintenance staff to the Skagway city incinerator to be properly disposed of. This method minimized the potential for seed dispersal while disposing of the exotic species. Care was also taken to ensure bags used in town were not reused outside of Skagway due to the potential for unwanted seed dispersal. The natural resources vehicle was used as the primary transportation method for weed waste in Skagway. Bicycles from the KLGO bicycle fleet were always used for conducting road surveys and for transportation to and from many survey sites.

The discovery of reed canarygrass on the Chilkoot trail in 2011 necessitated the use of different control methods as the infestation was too large to be reasonably controlled by hand-digging. Shade covers, which eliminate plants by depriving them of sunlight, were selected as the most feasible method of control. In 2011, KLGO EPMT covered the reed canarygrass infestations with one layer of 6mm black plastic followed by a layer of black non-woven geotextile.

In 2012, after finding this method deficient at fully controlling reed canarygrass, the shade covers were expanded and fortified with one layer of 10mm opaque plastic followed by one layer of 6mm black plastic topped with black non-woven geotextile. Shade covers were staked down with landscape staples and the margins were weighted down with rocks. Covers were to remain in place for two full growing seasons or until the summer of 2014. The site has been monitored at least once per season to ensure the integrity of the shade covers. Sheep Camp remains the only location where shade covers have been used as a method for controlling exotic plants in 2014.

The Alaska Region Invasive Plant Management Plan contains a protocol for employing the use of chemical control. This plan was utilized this year to treat large, high priority infestations at several parks across Alaska, but not at KLGO. The maintenance staff at KLGO utilized the herbicide Glyphosate to spot treat weeds, primarily common dandelion, in the lawn of the historic Moore House this summer. The Taiya Inlet Watershed Council (TIWC) and Alaska Association of Conservation Districts (AACD) in partnership with the municipality of Skagway have also considered the use of herbicides for high priority infestations outside of the park in the past. In 2014, the Municipality of Skagway reopened discussion on whether or not to use pesticides or other chemical vegetation control measures within the Skagway Borough.



Figure 3. Largest of the 11 shade covers utilized at Sheep Camp to control reed canarygrass as of 2012. Photograph by Peter Frank.

Personnel

The full-time EPMT staff member during the 2014 season was Ramsey Mauldin, a Student Conservation Association intern. Work conducted by this staff member spanned from May 27th to August 12th. A total of 12 people volunteered for the KLGO EPMT this summer, eleven of which volunteered for the Community Weed Pull held at the Skagway Airport

Results

Both work-hours and treated acres were significantly reduced in 2014 compared to previous years. This is due to the lack of SAGA crews that had been previously available to the EPMT at KLGO to help with invasive species control.

Based on 2013 staff recommendations, many low priority infestations were not recorded during the 2014 season. Four years of data already exists for these species, and it can be accepted that these species are ubiquitous along many of the survey sites such as the Dyea Road, Klondike Highway, and much of Dyea and Skagway. These species likely still inhabit their previous ranges and there is no reason to assume that their populations have dwindled. It is more likely that these species have expanded their range and many notable areas of large dense infestations were still mapped. These species are contained in the triage category of lowest priority for control, as their spread is extensive and their invasiveness ranking is low (Carlson *et al.* 2008). These species include: common dandelion (*Taraxacum officinale*), clover (*Trifolium spp.*), common plantain (*Plantago major*), pineapple weed (*Matricaria discoidea*) as well as several additional species. Because these species were generally not surveyed for in 2014, any maps produced by the 2014 EPMT staff utilized distribution data collected in 2014 as well as 2013 and in previous years for representing their extents. Although low priority species were not extensively surveyed for in the four previously cited work areas, they were surveyed in 2014 throughout the Nelson Slough restoration site and the Chilkoot Trail due to their relatively low abundance.

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

Year	Invasive GPS Data* and GPRA Goals - NPS Lands(non-NPS lands)					
	Species Acres Surveyed	Species Acres Infested	Acres Treated		Canopy Acres Controlled	
			Actual	GPRA Goal	Actual	GPRA Goal
2004	43.531 (52.497)	7.838 (6.842)	0.792 (1.505)	-	-	-
2005	3.106 (6.450)	3.099 (2.617)	0.732 (2.436)	-	-	-
2006	63.145 (74.350)	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)	0.5	0.5	0.1
2009	11.931 (83.259)	2.453 (21.645)	0.388 (2.504)	0.5	0.6	0.6
2010	34.638 (245.513)	3.914 (56.212)	0.502 (9.362)	0.5	0.8	0.7
2011	49.720 (98.718)	11.278 (50.695)	3.045 (8.583)	0.5	0.8	0.8
2012	31.430(153.766)	20.987(86.004)	0.911 (5.282)	0.5	0.9	0.9
2013	83.455 (182.7)	5.701 (36.220)	0.771 (2.431)	0.5	0.9	0.9
2014	0.63 (4.27)	0.19 (0.74)	<0.001 (0.09)	-	-	-

Table 2. Summary of the 2014 infested acres in Klondike Gold Rush National Historical Park.

Species		AKEPIC ranking	Chilkoot Trail	Dyea	Dyea Road	Skagway
Latin Name	Common Name					
<i>Bromus inermis</i>	smooth broome	62	-	0.02	0.1182	-
<i>Crepis tectorum</i>	narrowleaf hawksbeard	56	-	-	0.8	0.03
<i>Elymus repens</i>	quackgrass	59	-	-	0.5226	0.03
<i>Euphrasia nemorosa</i>	common eyebright	42	-	0.3708	0.03	-
<i>Leucanthemum vulgare</i>	oxeye daisy	61	-	0.06	0.1974	-
<i>Linaria vulgaris</i>	yellow toadflax	69	-	-	0.01	-
<i>Melilotus alba</i>	white sweetclover	81	-	-	-	0.5668
<i>Phalaris arundinacea</i>	reed canarygrass	83	-	-	-	-
<i>Phleum pratense</i>	common timothy	54	-	-	0.0391	-
<i>Ranunculus acris</i>	tall buttercup	54	0.03	0.0638	0.1007	-
<i>Rumex acetosella</i>	common sheep sorrel	51	0.12	1.7246	0.3949	0.04
<i>Sorbus aucuparia</i>	European mountain ash	59	-	0.04	0.02	-
<i>Taraxacum officinale</i>	common dandelion	58	-	-	0.03	-
<i>Trifolium hybridum</i>	alsike clover	57	0.1029	-	0.6673	0.04
<i>Trifolium pratense</i>	red clover	53	-	-	0.0912	0.03
<i>Trifolium repens</i>	white clover	59	-	0.01	0.0912	0.04

Skagway Airport

The Skagway Airport has remained an area of focus for KLGO EPMT efforts throughout the program's history due to its large and dense invasive plant populations. The high-priority white sweetclover (*Melilotus alba*) and its concentrated presence in the Skagway Airport make this species in particular a focal point for control efforts. For the past several years, EPMT staff and volunteers have removed all white sweetclover at the airport before it has gone to seed. This work has been effective, as populations of white sweetclover at the airport have steadily decreased. EPMT staff spent five hours surveying the Skagway Airport on July 7 in preparation for the Community Weed Pull. EPMT staff coordinated with Missy Tyson of AKDOT for permission and access to perform this survey. Although all but low priority species were thoroughly documented in this survey, EPMT staff took extra care to document the extent of *Melilotus alba*. As in past years, it was concentrated in the runway medians, though the populations were small and patchy. Narrowleaf hawksbeard (*Crepis tectorum*) was abundant throughout the median and small, isolated yellow toadflax (*Linaria vulgaris*) was found mostly along the airport fenceline.

Dyea

Dyea was a focal point of invasive plant management in KLGO. This is the most easily accessible and heavily used area of the park, making it more vulnerable to infestations than other areas. Few high priority species infest park-administered lands, however, several high priority infestations are found just outside of the park boundary. Many of the infestations in Dyea are found at disturbed sites along roadways, trails, and bridges, but recent years have shown increasing numbers of infestations at undisturbed sites such as the Nelson Slough and the Dyea Flats.

Dyea Townsite Road & Trail System

The Dyea Townsite Road begins just north of the Taiya River Bridge and terminates at the Dyea Flats and the Lost Lake trailhead. The entire road was surveyed on foot in early July. The road contains a ubiquitous population of white clover. Most infestations were found towards either end of the road, with several large and spreading infestations within the first mile. The oxeye daisy (*Leucanthemum vulgare*) documented and controlled in 2012, 150 yards from the Dyea Road, has not been found since. The first mile of the Dyea Townsite Road contains mostly tall buttercup (*Ranunculus acris*) and low priority species including white clover (*Trifolium repens*), common dandelion (*Taraxacum officinale*), and common plantain (*Plantago major*). None of the infestations of tall buttercup along the main road margins were controlled this season due to time constraints and lack of personnel.



Figure 4. NPS volunteer, Jade Cook, helps to control tall buttercup throughout a meadow in Dyea.

The Slide Cemetery Road that forks off of the Dyea Townsite Road leads to the Slide Cemetery trailhead and the Lost Lake trailhead. This road remains free of any high priority infestations. However, the low priority white clover infestations are spreading quickly along the road margins. Neither the common timothy found in the Slide Cemetery parking lot nor the creeping buttercups (*Ranunculus repens*) found at the Lost Lake trailhead were located for the second consecutive year. The entirety of the Lost Lake Trail remains free of invasive species.

The Historic town site parking lot located about 0.25 miles south of the Slide Cemetery turnoff still contains infestations of common dandelion, white clover, common plantain and sheep sorrel (*Rumex acetosella*) along its gravel margins. Mouse-ear chickweed (*Cerastium vulgatum*) found and controlled in 2012 has not been observed since, and the creeping buttercup treated in 2011 at the Pullen Barn has not been recorded for the third consecutive year. Other than these

infestations, the half mile section of road between the Slide Cemetery turn off and the Nelson Slough Bridge remains relatively free of invasive species. The Historic Townsite Trail System was surveyed in late July this season. The main trail leading to Vining and Wilkes Warehouse ruins contained only common dandelion and white clover infestations. The False Front Trail survey yielded no tall buttercup on the trail margins for the second consecutive season.

The large, open meadow between the Historic Townsite Trail and the Nelson Slough is host to a thriving native plant community. A population of tall buttercup, first documented in 2008 in this area, has heavily established itself in the meadow over the course of six years, resulting in reduced densities of native plants. In 2012, this infestation was still found to be spreading. After surveying the

meadow again this season, repeated treatment appears to have limited and even reduced the extent of the tall buttercup population in this area. The infestation was manually retreated again this season after having been treated multiple times since the 2008 field season. EPMT staff and one volunteer spent 6.5 hours treating the infestation this season. The yellow toadflax (*Linaria vulgaris*), previously documented at the southern end of this meadow and adjacent to the road, has not been observed since 2012. EPMT staff took great care to remove all of the root systems while treating the yellow toadflax infestation in 2012. The absence of this infestation exemplifies how effective removing the entire root system can be.

Surveys of the fields directly around the Nelson Slough bridge yielded no high priority species this season. The road section south of the bridge leading to the Alaska Excursions parking lot still contains expanding populations of white clover, common dandelion, sheep sorrel and common



Figure 5. Meadow near the Nelson Slough that has shown significant increases in native population after annual control of invasive species.

eyebright (*Euphrasia nemorosa*). The horse trail running from the Alaska Excursions parking lot to the Nelson still houses the most diverse infestations in Dyea consisting of tall buttercup, common dandelion, white clover, alsike clover (*Trifolium hybridum*), pineapple weed (*Matricaria discoidea*), mouse-ear chickweed, sheep sorrel and common eyebright. Only the tall buttercup in this infestation is found to be escaping into a field adjacent to the horse path. One day was spent controlling the tall buttercup in this field starting around the edges of the infestation.

Nelson Slough

In 2006, a wetland restoration project was conducted at the Nelson Slough. Since then, native plants such as Nootka lupine (*Lupinus nootkatensis*), wild-flag iris (*Iris setosa*), northern rice root (*Fritillaria camschatcensis*) and Sitka spruce (*Picea stichensis*), have been thriving in the slough despite the presence of invasive species. Low priority species such as white clover, common dandelion, and common plantain were again located around the edges of the restoration site. However, these infestations seem to be increasingly diminished by the native populations as noted in previous seasons. For this reason, no control work was conducted on low priority species at the restoration site.

The common eyebright patch located south of the bridge behind the interpretive signs has not been observed for the second season. In 2012 it was noted that small surrounding patches had disappeared after repeated control work. The single common timothy (*Phleum pratense*) grass culm found in 2012 was controlled and no others were found in the area in 2013. However, another single culm was

found farther north from where the first infestation was discovered in 2012. The meadow foxtail (*Alopecurus pratensis*), discovered in 2011 growing in the slough a few meters south of the footbridge, has not been documented for the third consecutive season.



Figure 6. The heavily used road margins in the Dyea Flats provide invasive species with ample transportation into the area.

Tall buttercup comprised the majority of the infestations found in the Nelson Slough. Infestations of this species were thoroughly documented again this season. EPMT staff members in previous years have noted the decreasing population of tall buttercup throughout the slough and that trend was observed to continue this season. The high populations of native species in the area are succeeding in crowding out the invasive buttercup, a process which has shown to be substantially expedited by repeated control work. The tall buttercup infestations south of the Nelson Slough restoration site have also been reduced in extent from repeated control

work. These areas were not as heavily controlled this season because of the lack of volunteers and SAGA crews to aid in treatment work. Although the infestations of tall buttercup south of and within the actual restoration site boundary have decreased since 2011, infestations farther north of the site in undisturbed areas were found again this year and appear to be spreading.

Dyea Flats

The road margins throughout the Dyea Flats were surveyed in mid-July and found to be relatively undisturbed by invasive plant populations. The widespread infestation of sheep sorrel documented in 2012 was examined again this season but not documented due to its low density and time constraints. This species is found to be growing amongst native plants, particularly grasses, but does not seem to have much potential to overcrowd native species because of its limited height and growth.

The common eyebright infestations previously located in the southeast portion of the flats was found to have expanded significantly along road margins. EPMT staff members have previously noted that this infestation maintained a stronger association towards the road margins than undisturbed areas; this trend was observed to continue this season. Segments of the infestation found in undisturbed areas do not seem to be persistent, nor do they pose much of a threat to the native vegetation. No control work was conducted on this infestation due to time constraints and lack of personnel. The foxtail barley (*Hordeum jubatum*) was observed but not documented again this season because of its arguably native origins. Its extent on the Dyea Flats has changed since last documented in 2011, but its presence does not appear to pose the threat of overcrowding. Infestations of common dandelion and sheep sorrel were observed to continue northeast of the flats into the field between the Dyea Historic Townsite and the Taiya River, but were not documented due to time constraints. This area contains an infestation of tall buttercup at the northern end of the meadow last controlled in 2012.

That year, the infestation was not observed to have expanded. In 2013, no control work was conducted in this area. This season the tall buttercup infestation in this meadow was documented and observed to have expanded significantly. A combination of new singular plants and small patches were found to be moving southward in the meadow. No control work was conducted for the second consecutive season due to time constraints.

NPS and City Campgrounds

The NPS campground was surveyed in late July this season. Common dandelion, common plantain, sheep sorrel and white clover were found growing around the NPS housing, in the campground parking lot and along the road into the campground. Campsites 1 through 7 all had infestations of common dandelion and white clover specifically around the fire pits. Tall buttercup was also found in some of the campsites, but appeared to be less extensive than observed in 2012. Furthermore, the control work on three European mountain ash (*Sorbus aucuparia*) trees has left the campground free of this species for the second year in a row. The road loops near the back of the campground and the trail system leading from the NPS campground to the Chilkoot Trailhead were found to be free of invasive species.

The City Campground and its adjacent roads were also surveyed in late July. Only small patches of sheep sorrel and white clover were found growing in the margins of the gravel road and near campsites. The nearest meadow to the southwest of the City Campground contains a dense infestation of tall buttercup that is spreading northward up the road margins toward the campground.

Dyea Road

Despite the new decision to reserve EPMT control efforts within park boundaries, the Dyea road continues to be a focal point for monitoring the movement of invasive plants. This is because the road itself provides a conduit for exotic plants found in Skagway or along the Klondike Highway to spread to park lands in Dyea. Heavy traffic and frequent road maintenance facilitates the spread of species along the road. Each side of the Dyea Road was separately surveyed on foot this season over the course of multiple days, starting at the intersection of the Klondike Highway and the Dyea Road (mile 0) and proceeding to the West Creek Bridge (mile 8.3). In total, approximately eight miles of road were surveyed. Note that white clover and common dandelion were found to be almost ubiquitous along the entire length of the Dyea Road. Small infestations of: red clover, alsike clover, pineapple weed, common plantain, sheep sorrel, sticky ragwort (*Senecio viscosus*) and shepherd's purse (*Capsella bursapastoris*) were also documented sporadically along the Dyea Road. Given the frequency and low priority of these infestations they will not be included in the detailed results below, but it will suffice to say that these species were documented in all five segments of the Dyea Road.

Skagway Overlook (Mile 0-2)

Two open fields on either side of the Dyea Road where it meets the Klondike Highway contained infestations of narrowleaf hawksbeard (*Crepis tectorum*), tall buttercup, and quackgrass (*Elymus repens*). The yellow toadflax documented in these fields in 2012 has not been seen since. Dense stands of narrowleaf hawksbeard were found within the first 0.75 miles of the road. These stands are continuing to spread along the gravel road margins in both directions. In 2012, yellow toadflax infestations were located as far as two miles up the Dyea Road. In 2013, the infestations only extended through the first mile. Yellow toadflax infestations were significantly reduced this year due to previous control efforts in the past two years. However, the infestation was not controlled this year. A reed canarygrass (*Phalaris arundinacea*) infestation found in 2009 across from the AB Mountain Trailhead was found not to have expanded significantly since last year. The seed heads were removed from the plant prior to seeding to prevent future spread. Oxeye daisy was observed again in four locations in this section. These infestations have been continuously monitored in the past; however, the infestations occur on private property north of the Skagway scenic overlook as well as just south of it. Outreach to landowners has been attempted in past years but has been met with resistance, so control efforts or further outreach were not attempted. Reed canarygrass, discovered in 2012, was again documented in a small patch just south of the AB Mountain trailhead. This population does not seem to have expanded since previous years. This is the only site outside of the park boundary that EPMT staff conducted control work this year. The seed heads of the grass were clipped to prevent this highly invasive species from expanding farther down the road. European mountain ash was documented again this season on both private property and escaping out into the forest edge. However, no new cases were found.

Nahku Bay (Mile 2-4)

Nahku bay continues to contain some of the largest infestations of quackgrass found along the Dyea Road. The infestations found on the east side of the bay in 2012 were found to be spreading. The extents of the dense concentrations remain the same, but new infestations were found to be moving away from these areas in either direction along the road margins and down slope towards the bay. A small patch of smooth brome (*Bromus inermis*) was located and found not to be spreading since its discovery in 2012. Oxeye daisy was found continuing to spread from private property on this section of the road. Two residences on this section of the road hold the original infestations. One residence at the northern end of Nahku bay contains a smaller infestation that has not spread significantly. Another residence on the western side of the bay holds an infestation that continues to spread onto others property and along the road margins. European mountain ash infestations remain constant as documented in 2012 with no new infestations found. The common timothy grass infestations along this section of road appear to be reduced since previous years. The section of the road where DOT maintenance was conducted last year on the western side of the bay continues to be bare of native and invasive species alike. Currently, the culvert in this area contains low visible organic matter and, more than likely, low nutrient composition. It remains to be seen what species will first inhabit this open space. Lastly, common tansy (*Tanacetum vulgare*), last documented and controlled in 2011 in a pull off at mile 2.7 was not found for the third consecutive year.

Mile 4-6.7 (Taiya River Estuary)

Heavy road construction on this section of the road that began in 2013 continued over the course of the 2014 season. Many of the infestations observed in this section in 2012, particularly common timothy infestations, have been removed along with all native vegetation in these areas leaving the soil bare. No new infestations were documented this season in these areas. The previously documented quackgrass infestations are persistent and found to be spreading as they are all along the Dyea Road. There were 8 different infestations of quackgrass found in this section south of the NPS campground and north of the construction work. Tall buttercup was still noted as being particularly dense on this section of the road north of the areas under construction. Treatment of narrowleaf hawksbeard during the past two seasons has been effective in reducing the population in the area near the NPS campground at mile 6.7. The largest infestation of smooth brome found on the road this season was documented on the west side of the road just north of the rafter's pull out.

Mile 6.7-8.3 (Dyea)

This section of road extends from the NPS campground to the West Creek Bridge. This segment was extensively surveyed twice this season on foot and specific locations were periodically checked throughout the season. Park boundaries encompass much of this section of the road, and therefore it is important for the EPMT to maintain regular observations of this area. The West Creek road was not surveyed again this year because of the negligible number of even low priority species in the area.

On the east side of the Dyea road in front of the Chilkoot Outpost, an infestation of common eyebright was documented for the third year in a row. In 2012, the infestation was documented for the first time since 2008. This common eyebright infestation still appears to be contained to the areas frequently mowed by the private land owner. An infestation of reed canarygrass was first documented in 2011 in a culvert northwest of the Chilkoot Outpost at mile 6.8. This infestation has increased in size and density each year and is now clogging a section of the stream system that it resides within. The infestation is no more than 20 meters away from the KLGO park border, however, this infestation remains relatively confined to its originally observed area. EPMT staff contact with the land owners has been met with resistance in the past and was therefore not attempted this season.

Quackgrass infestations are continuing to spread along the road margins both north and south of the NPS Campground. Both common timothy and tall buttercup continue to spread along the road margins into the KLGO boundary around mile 7 and on both sides of the Taiya River Bridge. Common timothy appears to be spreading more quickly up the road margins north of the Taiya River Bridge. In 2012, a small patch of smooth brome was found and treated in the pull-off on the east side of the road just before the Chilkoot Trailhead entrance. This was the first time that smooth brome was documented in the park. No smooth brome was found in this area last year. However, in the 2014 season, another small patch of smooth brome was found and treated on the north side of the Taiya River Bridge right along the road margin. Continued extensive surveys and quick control work have prevented the establishment of smooth brome in this area.

The patch of oxeye daisy on the east side of the Dyea road north of the Taiya River Bridge was visited again this season. The infestation was not treated last year and was found to have spread significantly since 2012. Common timothy and tall buttercup were observed to remain at low densities between mile 7.1, just north of the Taiya River Bridge, and mile 7.8. These infestations taper off as the road approaches the West Creek Bridge. Infestations comprised of low numbers of plants found on the northern portions of the Dyea Road were controlled by EPMT staff this season. However, the majority of infestations in this segment of road were too extensive to be effectively treated without volunteers or SAGA crew. Narrowleaf hawksbeard was not documented beyond mile 6.7 for the fourth consecutive year in 2014.

The large European mountain ash tree as well as the hedge of Siberian peashrub (*Caragana arborescens*) remain growing in the front yard of the NPS ranger cabin located on the east side of the road at mile 7.7. The removal of these two woody invasive plants has still not occurred because of compliance issues. A brief survey of the surrounding forest edge was conducted because a second European mountain ash sapling was found escaping into the forest edge on the west side of the road in 2012. No saplings were found this season.

Chilkoot Trail

Despite its high influx of human foot traffic, the Chilkoot Trail remains relatively free of invasive plant species establishment. In accordance with the park's strategy of EDRR, however, EPMT staff conducts at least one annual intensive survey along the 16.5 mile section of trail from the Dyea Trailhead to the United States border at the Chilkoot Pass. In 2014, several visual surveys were conducted in early and late June and a thorough GPS survey was conducted in mid-July. The 2014 season marks the fifth consecutive season that the Chilkoot Trail has been included in EPMT efforts. Due to the vast area and shifting ecosystems that this survey covers, this park unit was broken up into four sections.

Dyea Trailhead to Finnegan's Point

No exotic plants were found between the trailhead in Dyea and the base of Saintly Hill despite frequent hiker traffic through this portion of the trail. 17 common dandelion plants were found and controlled in early June by EPMT staff while assisting in an eagle nest survey. EPMT control work on tall buttercup in this section of the trail during the 2012 and 2013 seasons was effective; tall buttercup has not been observed here this season. A survey of the river access trail that forks off at mile 1.6 resulted in no new exotic species found. Common plantain, last documented in 2012 at the end of the second beaver pond boardwalk, was not located this season. Approximately 125 yards south of Finnegan's Point, the trail turnpike contained at least 1 culm of timothy grass that was controlled this season. This is the first documented occurrence of timothy grass on the Chilkoot Trail. The area had been recently mowed by trail maintenance, so it is very possible that the infestation is larger than observed. An extensive survey of Finnegan's Point campground yielded no exotic species, nor the white clover infestation located and controlled in 2012. After noting that infestations found in years prior have commonly been associated with trail maintenance, areas near bridges and other trail maintenance were given extra attention. However, no invasive species were found adjacent to bridges on this section of trail.

Finnegan's Point to Sheep Camp

A single culm of timothy grass was found and controlled 25 yards north of Finnegan's Point. No other exotic species were found between this point and Canyon City. A full survey of the Canyon City campground yielded no exotic species for the fourth year. Surveys performed on the trails to the Canyon City historic site, helicopter pad, and trail crew cabin also revealed no exotic species. The only infestation found between Canyon City and Sheep Camp was a small patch of white clover that was documented and controlled. This infestation was first noted in 2012 and does not seem to have spread due to continued control efforts.



Figure 7. The meadow south of the Sheep Camp Ranger Cabin contains a dense infestation of common dandelion.

Sheep Camp

Sheep Camp continues to contain the largest extent of invasive species found on the Chilkoot Trail as noted since the discovery of the reed canarygrass infestation in 2011. The common dandelion infestation directly southwest of the Sheep Camp Ranger Cabin on the embankment and the meadow surrounding the helicopter pad was documented again this year. In 2012, the infestation was documented as composing around five percent of the vegetation in the meadow. This year, common dandelion made up closer to twenty five and even 50 percent in some sections of the meadow. Despite the increasing density of this infestation, it remains isolated to this area.



Figure 8. Reed canarygrass shade covers at Sheep Camp in 2014.

The 0.25 mile trail from the Sheep Camp Ranger cabin to the Sheep Camp Campground contained no exotic species until approximately 50 yards shy of the campground. There were several small patches of white clover and common dandelion documented here and around the campground, but remained uncontrolled due to time constraints. These infestations become denser farther into the campground and around the old Ranger Cabin and warming shelters. 28 tall buttercup plants were documented and controlled this season compared to two in 2012 and 13 in 2013. A lack of coordination between EPMT and the trail crew resulted in mowing of Sheep Camp a week before the survey this season. This suggests that there were even more tall buttercup plants than documented this season.

The main focus of EPMT work at Sheep Camp is the reed canarygrass infestation discovered in 2011 by the Alaska Natural Heritage Program. A total of 12 shade covers were first applied in 2011 after the discovery of the infestation. In 2012, the infestation was found to be emerging from 10 of the 12 shade covers. EPMT staff responded by removing emerging culms, fortifying damaged shade covers, and increasing the shade cover area by 44%. The 2013 EPMT staff member continued to monitor the site several times throughout the season, replaced worn informational signs, and fortified any exposed edges of the shade covers with rocks harvested from the Taiya River. This season, EPMT staff made two trips to Sheep Camp in early June and mid-July to assess the condition of the reed canarygrass shade cover control efforts. The second trip yielded observation and control of reed canarygrass emerging from the sides of 4 shade covers. Several culms were also found growing up to 5 feet from the edges of the tarps.

Sheep Camp to Chilkoot Pass

Directly outside of the Sheep Camp Campground, the infestation of common dandelion first documented in 2012 was observed lining both sides of the trail. Three tall buttercup plants were controlled amongst the dandelion infestation. However, as stated earlier, this survey occurred after



Figure 9. The rocky alpine ecosystem, where many native species thrive, is often too harsh for most un-adapted invasive plants.

the trail crew had recently mowed and it is likely that more tall buttercup existed than was observed. No more exotic plants were discovered beyond this infestation. The common dandelion infestations documented on Long Hill during the 2004 and 2005 surveys were not found again this summer. The low population of exotic species observed in this section of the trail is most likely due to the change in ecosystems that occurs within this trail section. After Sheep Camp, the trail moves upward into an alpine ecosystem where soils are rocky and shallow, and fewer invasive species can establish themselves.

Outreach & Education

Efforts to educate the park staff, visitors and the general public about the presence and impacts of exotic and invasive plants in Skagway and KLGO were emphasized during the 2014 season. EPMT staff coordinated with multiple community organizations and businesses in order to educate and involve the community in regard to the management of invasive plants. Invasive plant education for park staff was also a priority. Multiple informal educational presentations were held for staff throughout the season. Weekly trail meetings provided an outlet for educating backcountry rangers as well as various other park staff on invasive plant identification. Every survey trip on the Chilkoot Trail provided EPMT staff with an opportunity to educate backcountry rangers and trail maintenance staff on identification techniques and the status of various infestations along the trail.

In 2012, brand new educational material was created for the park. This material was designed to educate people on what exotic and invasive plants are, the impacts associated with invasive plants, and why they should be concerned about invasive plants. Other educational materials were designed to give identification tips as well as ecological and aesthetic attributes of specific exotic plants in order to help the reader recognize them. Signage created in 2012 for education to the public on reed canarygrass and the infestation found at Sheep Camp was replaced with new printouts of the same content. An additional laminated informational sheet was left at the Sheep Camp Ranger Cabin so park staff would have ample information when trying to identify invasive plants in the area. Chilkoot Trail surveys are time intensive and therefore infrequent. Supplying backcountry rangers and trail maintenance staff with invasive plant identification education is crucial to enabling them to help control and report the spread of invasive species along the trail.

An educational display and activity was set up by park staff for Junior Ranger Day on July 24th. The display consisted of informational signs detailing invasive plants common to Skagway and KLGO to help expose children to the problems that invasive species present. The children were then able to pick from an assortment of pre-harvested and pressed invasive plants to assemble and label a bookmark. As a result, the children potentially become familiar with the identification of at least the one species they chose to take home and have at least some knowledge of invasive plants. The activity was successful among the other activities at Junior Ranger Day, receiving many participants.

An article about Skagway invasive plant communities was again published in the Capital City Weekly newspaper during the 2014 season. This provided general information on invasive species to the public, the problems they pose, and an advertisement for the upcoming Skagway Community Weed Pull. The weed pull has been hosted by EPMT staff in coordination with the TIWC and the Skagway Department of Transportation (DOT) for the sixth consecutive season. However, more responsibilities were placed on the TIWC and the DOT this season because of the park's motives to transfer more of the invasive species control efforts to actual land owners. EPMT staff spent a half day documenting the composition of invasive species within the Skagway Airport to have a strong attack plan for the day of the pull. Although only eleven volunteers showed up for this year's Community Weed Pull compared to last year's thirty, a total of 335 pounds of invasive plants were pulled in three hours. As in previous years, volunteers focused on removing infestations of white sweetclover, yellow toadflax, oxeye daisy and narrowleaf hawksbeard in that order of priority. All

present infestations of white sweetclover were removed. Oxeye daisy populations seemed to be reduced from previous years and all plants were also successfully removed this season. Many smaller patches of yellow toadflax and Narrowleaf hawksbeard were controlled on the southeast margin and in the main median of the airport. However, both of these infestations at large are far too extensive to be controlled by hand. After communicating with the DOT, it was decided that the best control method in this area would be intensive mowing. The DOT agreed to mow more frequently to help control invasive species at the airport.

While the 2014 EPMT staff member was conducting surveys for work or hiking recreationally, informal educational talks were often given to other hikers on the trail to educate them on the issues that invasive plants present to the area. These talks were found to be quite effective as it was fairly frequent that a significant percentage of those addressed held little to no knowledge of invasive species prior to the talk.

EPMT staff met informally with several employees of the Municipality of Skagway this season. The future use of herbicides on municipal land was discussed along with methods to help the public understand the benefits of using herbicides in particular situations and the damages caused by particular invasive plant infestations if left untreated. It is hoped that the discussions will help with future efforts to control invasive plant infestations spreading from Skagway.

A plan for a boot brush station, first presented in 2012, was represented this year. The project was stalled after 2012 due to a lack of funding. The boot brush station is a location where hikers can clean off their boots prior to entering the trail. This greatly reduces the chance that invasive seeds will be carried via boots into new areas. The station consists of a sign over the top of a boot brush that sits on a raised bed of gravel. The sign explains what invasive species are, the damage they cause, and how the boot brush can prevent their spread. The boot brush removes dirt that may contain invasive seeds within. The raised gravel bed traps dirt and seeds and prevents their dispersal via wind or runoff after they have been removed from a boot. The sign was not ordered by the end of the 2014 season, but EPMT remained in touch with KLGO administrative staff to ensure the project follows through. After the boot brush station arrives at KLGO it will be set up by maintenance staff at the Chilkoot Trailhead.

Gypsy Moth Monitoring

In accordance with the Alaska EPMT's EDRR strategy, a gypsy moth trapping program has been incorporated into the KLGO EPMT's annual monitoring efforts. The 2014 season was the fourth summer that EPMT staff at KLGO participated in gypsy moth monitoring. The traps lure European and Asian gypsy moths (*Lymantria dispar* & *Lymantria dispar* spp. *japonica*) with synthetic versions of the species' pheromones. Four gypsy moth traps were set out in mid-June. The first two traps were placed in Skagway; one above the boat harbor and one at Yakutania point. The second two traps were placed in Dyea; one at the NPS campground and the other at the municipal campground. All four traps were checked periodically throughout the season and collected in early August. No moths were found in the traps.

Recommendations & Discussion

Recommendations for the 2015 EPMT center on education and partnership development with individuals and organizations operating in and around Skagway and the KLGO park units. In the past, EPMT in KLGO has focused on the prevention and proactive removal of infestations in backcountry and undeveloped front country areas both in and outside of the park. 2014 was the first year that EPMT staff focused work primarily on areas within the KLGO park boundary. Areas outside of the park boundary are encouraged to be managed for invasive species by those who actually own the property. It is up to future EPMT staff to contact land owners and inform them of infestations on their land and urge the control of invasive species, especially in the case that high priority invasive species comprise the infestation.

Location Specific Recommendations

Skagway

Skagway contains the highest number of invasive plants as compared to any park unit. Furthermore, due to its location as a starting point for visitor traffic to other areas around the park, it is a prime location for the process of invasive seed dispersal toward surrounding ecosystems to begin. Many of Skagway's numerous invasive plant species are present in private gardens as ornamentals. However, some species have successfully colonized larger areas in the surrounding region, and have even spread to further extents along the state-owned Dyea Road and Klondike Highway.

Control work in Skagway should continue to focus on eradicating high priority species and preventing the further spread of other invasive plants to areas inside of the park boundary. Survey work in Skagway should continue within and near KLGO park boundaries, along Pullen Creek, and the Skagway Airport. Other areas are now a lower priority as they are outside of the park. Instead of adopting the responsibility of private land management, EPMT staff should contact land owners to discuss high priority infestations on their land in hopes of their cooperation and contribution towards the effort of invasive plant management in and around Skagway and KLGO.

Despite much of the infestation being located off of park lands, white sweetclover remains a priority for control and monitoring in Skagway given its steadily diminishing extent since 2010. EPMT staff and volunteers have annually removed all white sweetclover found in areas in and around the airport since 2009. This practice should continue in 2015 with an emphasis on accurate mapping in order to determine how this infestation changes over time. There are many infestations on municipal lands that have been controlled in the past in part by EPMT staff members, however, these efforts are encouraged to be taken up by volunteers and community members. For example, working with community members Joanne and Andrew Beierly in monitoring and controlling white sweetclover has been very helpful and should be continued in 2015. They should have continued support and encouragement in the future to develop a team of community members working to control invasive plants in Skagway.

EPMT staff in 2015 should also monitor the widespread infestation of tall buttercup on either side of Pullen Creek. If time allows, this infestation should be treated along its borders to impede its expansion. Assisting the TIWC with monitoring and control work at Pullen Creek should continue in 2015. The TIWC has been an essential partner in community outreach and has been very responsive to learning about the exotic plants in Skagway. EPMT staff should coordinate monitoring and control efforts for the infestation of reed canarygrass at Pullen Creek with the TIWC staff. After attempts at manually digging reed canary grass were found to be unfeasible in 2011, herbicides were determined to be the most effective mean of control. Representatives from the TIWC, AACD, USFWS and the Skagway municipality all have expressed an interest in seeing this infestation treated but no actions have been taken because of public resistance. If no treatment efforts are made in 2015 EPMT staff along with the TIWC should once again remove the inflorescences from the infestation to prevent it from spreading its seed. For now, this has been effective at limiting the infestations growth. 2015 EPMT staff is encouraged to contact members of all organizations listed above to readdress herbicide use in the area. Discussions on the use of herbicides in Skagway have reopened at City Council Meetings in 2014 and it would be helpful to convey as much information on invasive species and herbicide use to community members taking part in council meetings in the future.

The seven occurrences of ornamental jewelweed identified in 2012 should be monitored again next year. If the infestations still persist, most of which are on private land, land owners should be contacted by EPMT staff, TIWC, and AACD. Ornamental jewelweed is a major threat to riparian and wetland ecosystems. Therefore, the infestations found closer to Pullen Creek should take precedence over other infestations of ornamental jewelweed.

A plan to control the bird vetch on the corner of Spring and 9th Street should also be a priority for the 2015 KLGO EPMT program. Coordinate with the AACD and TIWC as well as the city to apply herbicide to the infestation. This herbicide treatment has been discussed every year since 2009 but never successfully accomplished. Therefore discussions with all involved parties should start early in the season and establish a plan for treatment. The completion of this small project would be a significant step in the direction of moving control efforts into the hands of the city and other concerned organizations.

Removal of common tansy on the NPS lot located at 5th and Broadway should be a priority in Skagway during the 2015 field season. Given the small extent of this infestation, common tansy is a prime candidate for eradication on NPS land. KLGO management staff members have expressed concern about the public's reaction to this removal project—holding this plan off since 2012. Therefore, to reduce the disturbance associated with this project and expedite the approval process, EPMT staff should present the following plan to KLGO management staff early in the 2015 season: clip the flower heads over the course of the summer to prevent the plant from seeding. Once fall arrives, and the growing season concludes, this infestation should be removed by application of herbicide. In the following spring (2016) the common tansy should be replaced with a native or non-invasive plant species such as Canada goldenrod (*Solidago canadensis*). This will allow the new plants to fill in the areas previously occupied by common tansy during the 2016 summer season—minimizing the aesthetic impacts of this project.

Other work on NPS property should include monitoring and control on the maintenance yard where yellow toadflax, narrowleaf hawksbeard and several other low priority species were found to be abundant. A KLGO staff member is now able to use herbicides on NPS property, and this should be taken into consideration for control work done in the maintenance yard. The control of invasive species in this area will help to prevent the spread from equipment and materials which travel from the maintenance yard to other areas throughout Skagway and Dyea. EPMT staff should again attempt to obtain compliance for the removal and replacement of non-native woody species found on NPS property in Skagway including Siberian peashrub, European mountain ash and rugosa rose. NPS maintenance staff's primary objections to removal was their relative abundance in Skagway and the negative aesthetic impacts that would result. Though both points may be true, the prevalence of an invasive species outside NPS property does not justify it being planted and fostered by NPS employees on NPS property. Just as park employees are required to wear helmets when riding a park owned bicycle to set a good example, the KLGO should not promote the planting and establishment of invasive species. Furthermore, if any of these species escape, as European mountain ash has, the long term economic and environmental implications would nullify any potential short term impacts to the aesthetic quality of an area.

Invasive species observed elsewhere in southeast Alaska, such as Japanese knotweed (*Polygonum cuspidatum*), garlic mustard (*Alliaria petiolata*), Purple Loosestrife (*Lythrum salicaria*) and Orange Hawkweed (*Hieracium aurantiacum*) have not yet reached Skagway and KLGO. Other species found in southeast Alaska including spotted knapweed (*Centaurea biebersteinii*), perennial sowthistle (*Sonchus arvensis*) and large-leaf lupine (*Lupinus polyphyllus*) have previously been documented in Skagway or KLGO and are now considered eradicated. Given the multiple transit systems connecting Skagway to the rest of southeast Alaska it is only a matter of time before these invasive species arrive or are reintroduced. Therefore, EPMT staff should make a point of learning the characteristics of the species listed above to facilitate the early detection of these high priority species.

Dyea Road

The Dyea road should be surveyed at least once during the 2015 season. Surveys can be performed on bicycle or on foot. The 2014 EPMT surveyed the road entirely by foot because this improves the observer's ability to identify plants and thus increased the accuracy and resolution of the data collected. This has been the method recommended by previous EPMT staff members and should be adhered to in the 2015 season. Surveys should be performed in July or August to ensure that exotic grass species will be in flower and identifiable. Mapping of low priority species is not essential as there are now three years of baseline data to support their ubiquitous presence along the Dyea Road. Instead focus should be put on surveying for disjunctive populations of reed canarygrass, white sweetclover, yellow toadflax and oxeye daisy as well as accurately mapping infestations of exotic grasses. While smaller control operations may be continued by EPMT staff during survey routes, heavy control and removal projects on the road should be taken up by the AKDOT. 2015 EPMT staff should contact AKDOT and inform them of the current state of high priority infestations found along the road.

However, EPMT staff should first focus on areas of the Dyea Road that fall inside of the KLGO park boundary. Control work should be carried out on high priority species within the boundary, specifically the smooth brome and oxeye daisy infestations found near the Taiya River bridge. Smooth brome and quackgrass have dense rhizomatous roots, similar to reed canarygrass, and are difficult to successfully dig, while common timothy has relatively shallow fibrous roots that allow for minimal control effort. If possible, 2015 EPMT staff should contact AKDOT for assistance in controlling larger infestations of quackgrass and smooth brome found between the NPS campground and the West Creek bridge.

The reed canarygrass infestation outside of the Chilkoot Outpost poses a large threat to KLGO. This is the highest ranked invasive plant found in KLGO and the infestation is less than 20 meters away from the park boundary. It is in the parks best interest to address this infestation before it has a chance to move into KLGO boundaries. However, outreach to the owners of the Chilkoot Outpost has been met with strong resistance. EPMT staff should discuss potential control methods with the municipality. Given the size and density of the infestation, manual control would not be ideal. If possible, EPMT staff should utilize partnerships with the AACD to coordinate an herbicide treatment. There is another smaller patch of reed canarygrass attempting to establish itself over the past several years. The AKDOT should be reminded of its presence and EPMT staff should suggest possible control efforts. An infestation of narrowleaf hawksbeard previously found south of the NPS campground was significantly reduced in 2014 due to mowing. 2015 EPMT staff should monitor this site early in the season to get a better idea of the actual extent of the infestation. The yellow toadflax infestation found beyond the first mile of the Dyea Road closest to Skagway should also be extensively monitored as it was found to be largely reduced in 2014, and eradication may soon be a possibility.

Dyea

The yellow toadflax and oxeye daisy found in Dyea in 2012 appear to be under control after searching for the infestations on several different occasions throughout the 2013 and 2014 seasons. Two different infestations of creeping buttercup previously located at the Lost Lake Trailhead and the NPS campground have not been observed since 2012. Future EPMT staff should continue to conduct biweekly surveys of these infestations.

Control work on tall buttercup throughout Dyea takes second priority to treating the species listed above. Due to the size of infestations as well as the ease of identification and removal, tall buttercup is the ideal candidate for treatment with volunteers or volunteer groups. However, there will likely be no SAGA crews to assist EPMT staff at KLGO in 2015 just as there weren't in 2014. Any control work in Dyea in 2015 should again focus on the Nelson Slough and adjoining meadows, starting at the northernmost infestation and working south toward the flats. EPMT staff should also control all tall buttercup found in the large field located north of the Dyea Flats. This infestation is spread out at low densities over a very large area, so control work is best suited for a small volunteer group. The 2014 EPMT staff had one other Natural Resource employee and two other volunteers to aid with control work. A small team is sufficient to conduct effective treatment on these areas. Final priority

should be given to controlling tall buttercup along the road system in Dyea Townsite road and trail system. The majority of occurrences are small isolated populations and should be controlled during routine survey work.

Control efforts for common eyebright should be focused on the Nelson Slough Restoration Site. The common eyebright infestations south of the foot bridge and near the Nelson Slough Bridge in 2012 have not been seen since. These sites should be heavily monitored again in 2015 to ensure their eradication. The large infestations of common eyebright on the Dyea Flats had expanded significantly in 2014. These infestations require considerable time for hand-pulling and are low priority. Past SAGA crews have controlled these infestations, but tall buttercup and other exotic grasses in Dyea are a much higher priority.

Both European mountain ash and Siberian peashrub were documented at the Ranger Cabin in Dyea in 2012. These species were both found to be growing outside of cultivation, and none have been removed because of compliance issues. European mountain ash has been documented growing in several locations in Dyea, most likely offspring of the large tree found at the Ranger Cabin. Future EPMT staff should work with the park compliance staff to approve removal of the European mountain ash and Siberian peashrub. The hedge of Siberian peashrub could easily be removed with hand tools but the European mountain ash tree is more than 8 meters tall and would require a chainsaw. EPMT staff should partner with the KLGO maintenance staff and the regional liaison to develop a plan to remove and replace these two woody exotics before they spread. Both species would require herbicide applications for the most effective control.

Chilkoot Trail

Managing the exotic plants found in backcountry areas on the Chilkoot Trail is time-consuming and logistically complicated. When hiking the trail, make sure that the GPS unit, invasive plant bags, and camera are always on hand for on-the-spot surveys and control work. Consolidate the number of trips needed by integrating multiple tasks into a single trip to save time and effort, and bring other NPS employee volunteers when possible or necessary. 2015 EPMT staff should continue to maintain partnerships with the Chilkoot Trail backcountry rangers and trail maintenance staff. They are on the trail more than any other KLGO employees and can help monitor infestations and survey areas not readily accessible to EPMT staff. Surveying the Chilkoot Trail should now be done annually, given the discovery and subsequent treatments of reed canarygrass at Sheep Camp during the 2011 and 2012 field seasons. At least three trips should be made to Sheep Camp in 2015. Note that the timing of these three trips is dependent on the duration of EPMT staff's stay, so plan accordingly.

The first trip should occur in the early spring, preferably in June, during which EPMT staff will check the status of the shade covers, remove any newly emerging reed canarygrass from the perimeters and patch any holes which may have developed over the winter. Intensive surveys should not be performed during this initial trip as most invasive species will not have emerged and grasses may be particularly difficult to identify at this point.

The second trip should occur near midseason when reed canarygrass is in bloom and easily identifiable but has not yet gone to seed. To determine the appropriate time for this survey, EPMT

staff can utilize the readily accessible infestations along Pullen Creek to estimate the phenology of reed canarygrass at Sheep Camp. Infestations in Skagway were found to be approximately one to two weeks ahead of those at Sheep Camp. An intensive exotic plant survey of the entire Chilkoot Trail should be incorporated into the second trip to Sheep Camp as all exotic species should have emerged and become readily identifiable at this point in the summer. The shade covers at Sheep Camp were expected to be removed by 2014. However, multiple reed canarygrass culms were found. EPMT, Regional, and KLGO administrative staff collectively decided that the shade covers should remain and that the use of herbicides should be considered for the 2015 season. Between the 2014 and 2015 summer seasons, EPMT Liaison, Chris Overbaugh, will be determining which herbicide will be most appropriate to use at Sheep Camp in the summer of 2015. EPMT staff is advised to contact him early in the season to further discuss herbicide application. During the second trip, EPMT staff should thoroughly survey the Sheep Camp Campground again to ensure that no new infestations of reed canarygrass have emerged. Any newly recorded small patches of reed canarygrass should be removed of their inflorescences and flagged for herbicide treatment provided compliance for this work has passed. Backcountry rangers and trail maintenance staff should be well informed of the actions to be completed by EPMT staff if reed canarygrass is again found in 2015. Note that it is very likely that reed canarygrass will be found again during the 2015 season. The culms in 2014 were found both on the edges touching the footpaths through the camp and the edges covered by native vegetation.

The final trip should occur later in the summer after herbicide application has occurred, during which EPMT staff and as many volunteers as are available will remove the shade covers and begin the initial steps toward revegetation. EPMT staff and KLGO administrative staff discussed applying grass mix seed after raking the first several inches of soil under the shade covers after their removal. It may also be possible to transplant shrubs local to Sheep Camp into the treated areas. These processes should be discussed early on in the season to develop a plan as soon as possible.

Limiting the spread of invasive plants along the Chilkoot Trail will be a far more effective means of management than any treatment options. Therefore prevention must be a key component in the invasive plant management strategy on the Chilkoot Trail. Installing a boot brush station at the Chilkoot Trailhead will promote the active involvement and education of park staff and visitors while preventing the introduction and spread of invasive species. However, hiker traffic is not the only vector for invasive plants on the Chilkoot trail. The NPS regularly uses helicopters to transport supplies into the backcountry, and there are large infestations around the helicopter pad at Sheep Camp. Therefore EPMT crew members should coordinate with maintenance and law enforcement staff to perform inspections of all gear potentially contaminated with exotic plant material before it is flown out. This would include any tools used for vegetation management or earth work such as shovels, pick axes, weed cutters and motorized weed eaters, any unwashed tent footprints or tarps, or any larger items that may have been stored in the maintenance lot as it contains several highly invasive species. EPMT staff should check for and remove any dirt, debris or plant material found on the item which could harbor invasive plant seeds. Ideally, these inspections should occur before the 2015 field season, which means reaching out to maintenance and law enforcement should be one of the first priorities of the new EPMT manager at Klondike.

Klondike Highway and White Pass Unit

The White Pass unit of the park was lower on the priority list than previously because of lower invasive species populations than the other park units. EPMT surveys should only be done if time allows after higher priority work has been accomplished. The Klondike Highway should be surveyed in 2015, but its priority is placed below that of the Dyea Road's. EPMT staff should conduct a survey via bicycle with heavy vigilance on Canada thistle, reed canarygrass, and white sweetclover. EPMT should assess the size and scale of infestations prioritized for control to formulate a plan for treatment that includes personnel and equipment requirements. Unless high priority infestations are found to be spreading significantly since their last documentations and a viable amount of volunteers are available, control work should not be conducted on the highway unless treatments are manageable with limited personnel and resources. Instead, AKDOT should be contacted and informed of the current status of infestations on their highway and encouraged to control infestations.

Survey Work

Surveys are a vital component of invasive plant management. Early detection of species will help control infestations before they become more serious threats. For example, timothy grass found during the Chilkoot Trail survey this year initiated a rapid plan for control work, addressing the issue before the infestation could spread further along the trail. The reed canarygrass infestation discovered three years ago at Sheep Camp had ample amounts of time to spread before discovered; if extensive survey work had occurred sooner in the area, the effort required to remedy the infestation would be significantly reduced.

Volunteers

Volunteers are an essential part of the KLGO EPMT's control strategy. The efficiency and effectiveness of manual control efforts is often directly correlated to the number of personnel working on the project. Many targeted infestations in KLGO cannot be efficiently controlled by a single staff member. The 2011 KLGO EPMT had two full weeks with two eight-person SAGA crews during which more than 520 volunteer hours were logged. Since then, SAGA crew time spent with KLGO EPMT has been significantly reduced or eliminated. Not surprisingly, there has been a significant decline in the acres treated over the years beginning in 2011. If the objective of the KLGO EPMT is to effectively control and prevent the spread of invasive species in the park then volunteer groups must once again be an integral part of that effort or the EPMT must look to less resource-intensive control methods such as herbicides.

Outreach & Education

Outreach and education should remain the high priority focus for future seasons as oppose to heavy emphasis on treatment work as long as the EPMT at KLGO has no youth crews to assist in control efforts. Regional and KLGO park staff have decided to urge the responsibility of invasive plant management onto the respective owners of areas located outside of the park boundary. However, because the EPMT staff at KLGO have access to high grade equipment for monitoring infestations, it should remain a priority to monitor areas outside the park boundary. The benefits gained from outreach and education efforts far outweigh the amount of time devoted to them, as they may be the most useful tools in preventing the spread and colonization of invasive species. In the 2014 season,

past partnerships were sustained with the TIWC, DOT, as well as other local businesses and organizations. These partnerships proved to be successful in advancing the goals of KLGO EPMT and should therefore be continued in the 2015 season.

The 2014 Community Weed Pull was a large success again this year. This is a good example of outreach and education efforts having an effect far greater than what could be supplied by the same effort being placed into individual control work. The event was coordinated by KLGO EPMT, AKDOT, and members of TIWC. Extensive advertisement for this event, including posting flyers on bulletin boards across town, an announcement in the local newspaper, and announcements via multiple local email lists helped to get people out for the event. Volunteers successfully removed all white sweetclover from the airport premises. This species should continue to be the focus in 2015, as it is now a candidate for eradication in this location. Collaboration with Missy Tyson of the AKDOT was vital to the success of this event.

In the past, an invasive plant informational display was set up in the library's display case near the beginning of the season at the Skagway Library. Although this display was not setup this season, it should be continued in the future. In 2013, the library was found to be a successful outlet for such a display, reaching a large number of people with a low amount of labor. EPMT staff received comments from library staff and community members alike several times throughout the season. This is a great way to keep the concept of invasive plants alive in the community in order to help cultivate a movement against them in the city. This season, the invasive plant bookmark station was again set up at Junior Ranger Day. Deb Boettcher, a NPS employee at KLGO helped to run the invasive plant booth this season. This has remained a success and is a great way to bring children's awareness to invasive species in the community and should be continued in the 2015 season.

Invasive plant education should also be provided to park staff in 2015. Brief and informal identification talks, delivered at trail meetings in to park staff, backcountry rangers, and members of trail maintenance, are the best way to keep NPS employees knowledgeable of exotic and invasive plants. These talks have been successful and are one way to incorporate the park's EDRR strategy, and therefore should be continued in 2015. EPMT staff should take care to provide these identification briefings in layman's terms in order to ensure the highest level of comprehension. The 2015 EPMT staff should also hold a presentation at The Alaska Geographic Guide Series. This has been a success in the past and is a great opportunity to reach out to an audience beyond the park service. Many local citizens, especially guides, attend these presentations and they can be an excellent opportunity to educate active community members.

Boot brush stations have been discussed with both park and regional EPMT staff over the years and all necessary compliance has been established. In 2015, this project should continue to be a high priority, as it will be an excellent outreach opportunity and certainly coincides with the EPMT's goals of preventative weed management. Detailed plans for the construction of the boot brush stations can be found outlined by in the appendices of the 2012 KLGO EPMT annual report (Frank 2012). The final edit of the boot brush sign can be found as a JPG file in the 2014 KLGO EPMT files within outreach documents. This file has passed compliance and will be ready to print as funding becomes available.

There is an app known as EDDMapS developed by The University of Georgia. This app is a web-based mapping system for documenting the spread and distribution of invasive species that falls right in line with the EDRR methodology of the EPMT. This would be an excellent tool that community members could use while hiking or even just in town to help map the spread of invasive species in and around Skagway and KLGO. The existence of this app should be mentioned at trail meetings, resource meetings, and community events such as the weed pull or the guide series program.

Restoration

Restoration is a key element in combating and preventing the future establishment and spread of invasive species. When invasive plants are cleared on a large-scale, there is almost always significant disturbance to the control site, leaving increased opportunity for new opportunist invasive plant species to establish. Because of this, it is very important that these anthropogenic disturbances be revegetated to prevent the future establishment of invasive plants.

The Sheep Camp reed canarygrass project has caused much disturbance to the natural ecosystem found at Sheep Camp. Therefore, active restoration methods are necessary to prevent further infestation. After the shade covers are removed, approximately 251 square meters of bare soil will be exposed. The high number of dandelion, tall buttercup, and white clover in the area would surely colonize the bare soil if no restoration methods were conducted. This season, reed canarygrass culms were discovered around the shade cover margins, and it was decided that the covers should remain for at least another year. Discussions of possible herbicide use in the area occurred between EPMT staff and NPS Regional staff. Notes on physical attributes, characteristics, and resource composition were taken at Sheep Camp this season to determine what herbicide would perform most effectively and safely in the area. Therefore, 2015 EPMT staff should continue in this direction and seek guidance from KLGO Chief of Resources, NPS Regional staff, and AACD staff.

Checking the shade covers early in the season, although identification of reed canarygrass may be difficult at this time, will be helpful in understanding the extent of the infestation next season. Flagging should be placed at all observable reed canarygrass culms. This way, if the use of herbicides follows through compliance, the applicator can easily identify and treat infested areas. The application of a native grass mixture to the bare soil underneath the shade covers seems to be the most embedded plan for revegetation. However, 2015 EPMT staff should also consider transplanting some of the native shrubs local to Sheep Camp. This method must go through cultural resource compliance before carried out and should be planned accordingly.

Wind Dispersal Considerations

The strong southerly winds that rush from the cold Pacific into the warm continental interior during the summer months have a strong effect on the dispersal of seed for many plants growing in the Skagway area. Many exotic plant species found in the Skagway area, such as narrowleaf hawksbeard, common dandelion, and tall buttercup are regularly dispersed by wind. The strong south wind in open areas such as the Skagway airport and the Dyea flats can also move larger, less mobile seeds, such as those of white sweetclover, considerable distances. Known introduction points, or high density areas, followed by decreasing densities of a species to the north are often evidence of wind dispersal.

It is recommended that when hand pulling 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

Due to the historical significance of many areas in KLGO, a meeting concerning proper cultural resource field methods should occur annually. Additionally, any time control work is conducted in the Dyea Townsite or other areas of historical significance, all workers should be briefed on the how to respond if a cultural artifact is found. Possible 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

Pressed plants are the best level of proof that certain species exists in the area, and also aid in species identification for other park staff. The KLGO Natural Resources Exotic Plant Collection was started in 2010 with a few samples collected. The following species, which have been documented around the Skagway area, need to be added to the collection:

Anthemis arvensis, *Bromus inermis*, *Capsella bursa-pastoris*, *Cerastium fontanum*, *Chenopodium album*, *Collomia linearis*, *Elymus repens*, *Erysimum cheiranthoides*, *Euphrasia nemorosa*, *Galeopsis tetrahit*, *Galeopsis bifida*, *Hordeum jubatum*, *Lepidium densiflorum*, *Medicago lupulina*, *Papaver nudicaule*, *Phalaris arundinacea*, *Phleum pretense*, *Plantago major*, *Poa pratensis*, *Polygonum aviculare*, *Polygonum convolvulus*, *Potentilla gracilis*, *Ranunculus acris*, *Rumex acetosella*, *Rumex crispus*, *Senecio vulgaris*, *Silene cucubalus*, *Stellaria media*, *Tanacetum vulgare*, *Viola tricolor*, *Thlaspi arvense*, *Trifolium repens*, *Tripleurospermum inodorum*, *Vicia cracca*.

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