Exotic Plant Management
Klondike Gold Rush
National Historical Park

Lupinus polyphyllus

Summer 2008

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ABSTRACT

The 2008 season followed the exotic plant management plan developed in 2006 at the Klondike Gold Rush National Historical Park. Over 550 hours were devoted to exotic plant management, approximately 370 of which were spent manually removing exotics, with the majority of time spent in Skagway on the white sweet-clover. There was a dramatic increase in the total number of exotic species recorded this year due primarily to more expansive surveys and the assistance of a visiting exotic plant expert. Notable discoveries included several infestations of reed canary grass (*Phalaris arundinacea*), two previously undocumented large-leaf lupine (*Lupinus polyphyllus*) occurrences, and an infestation of hemp nettle (*Galeopsis bifida*) in Liarsville. The success in previous years' control work was turned on its head with a slew of new common eyebright (*Euphrasia nemorosa)* infestations and rediscovered occurrences of oxeye daisy (*Leucanthemum vulgare*) in Dyea. More time will need to be allocated to control work in 2009 in order to keep a handle on these newly discovered infestations.

KEY WORDS

Exotic plants, Klondike Gold Rush National Historical Park, Survey, Control, Alaska

INTRODUCTION

Overview

The idea of controlling exotic plant species in Alaska as a natural resource management strategy is relatively new. With Alaska's pristine environment, relatively cold climate, and lack of human presence, land managers have been fortunate enough to avoid the headache that their counterparts in the lower 48 states have had to endure. Things are changing though. With the ever increasing use of land due to population growth, coupled with a warming climate, Alaska is beginning to show more of the effects that exotic plants can have on the environment.

Lower 48 headache of yellow toadflax

Land managers in Alaska's national parks have initiated the first stages of exotic plant management. This involves an accurate inventory, a regular monitoring plan, and a fast-acting treatment plan with long-term goals.

The Threat of Non-Native Plants to KLGO and the Surrounding Area

Most of the non-native plant invasions have occurred in disturbed areas (e.g., road ditches and fill material). There are, however, locations where non-native plants now spreading into well-established native vegetation from disturbed sites. This is the case at Nelson slough where the common eyebright has established itself and is growing up through the moss and around native plants in undisturbed areas. In general, exotic plants have a difficult time gaining a foothold in undisturbed areas in Alaska. The lack of disturbance, coupled with limited human presence and a cold climate, has kept Alaska relatively safe from non-native plants. However, this is changing as land is increasingly developed for a growing population inevitably, bringing more ecological stress and disturbance on the surrounding ecosystems. Add to this a warming climate, and you have a recipe for an outbreak of exotic plants in Alaska. This is becoming evident in the Dyea and Skagway valleys. A continued vigilance is needed to contain and eliminate existing occurrences of exotics and prevent the establishment of new ones.

Focus

The emphasis of Klondike Gold Rush National Historical Park's (KLGO's) exotic plant management plan in 2008 was the continued control of known exotic plant populations, especially in those areas of greatest concern in 2007. Several days were dedicated to searching Dyea and White Pass for new infestations, and a surprising number of new exotic species were recorded. Infestations monitored in locations where control was difficult, or in sites that didn't include priority species.

The majority of this year's work took place in Dyea where several new occurrences of common eyebright (*Euphrasia nemorosa)* were discovered and controlled, as well as two adjacent infestations of large-leaf lupine (*Lupinus polyphyllus*). The Nelson Slough restoration site was continuously monitored for 14 previously inventoried exotic species, only nine of which were located this season. Once again, the control work in the restoration area centered around common eyebright, but efforts were made this year to begin the elimination of tall buttercup (*Ranunculus acris*) from the site. As in previous years, significant effort was put forth in Skagway to reduce the abundance of white sweet-clover (*Melilotus alba*) and yellow toadflax (*Linaria vulgaris*) in and around the airport as well as in the railroad yard, enhanced this season by a productive SAGA crew. The Chilkoot Trail was not surveyed for exotics this year, but the White Pass region of the park through which the Klondike Highway passes was carefully surveyed on foot. Whitney Rapp, regional EPMT data manager and Invasive Species Program Coordinator at Glacier Bay National Park and Preserve, led a survey of invasive grasses in KLGO, which until now had not been performed with any thoroughness in the park.

METHODS AND MATERIALS

Identification

For plant identification, the primary field guides referenced were Flora of the Pacific Northwest (Hitchcock and Cronquest 1987) and Plants of the Pacific Northwest Coast (Pojar and Mackinnon 1994). In the office, Flora of Alaska and Neighboring Territories (Hulten 1968) was used to confirm identification. An online database, E-Flora BC (http://www.eflora.bc.ca), was used as an additional reference at the suggestion of Whitney Rapp. Most of the plants encountered were also available at the KLGO herbarium.

Data Collection

To collect the spatial location of each infestation, the Juniper Systems Archer, Trimble Recon®, Trimble Ranger®, and Trimble ProXT® GPS units were used. Each of these units is accurate when strict data collection techniques and standards are followed. However, problems with the CORS Gustavus base station and poor satellite coverage were prevalent through much of the season, resulting in data with lower accuracy than last season. A Trimble Hurricane L1® antenna was used in most cases to enhance GPS accuracy, but even that did not entirely mitigate the satellite reception problems.

Data collection was again made simple by the AKEPMT's data dictionary and protocol (Heys and Rapp 2008), which was given to all National Parks in Alaska to use when collecting exotic plant information. This ensured that every member of the AKEPMT was collecting data in an identical format, and that the data could be brought together to analyze the exotic plant distribution on a regional scale.

The collected data was downloaded into Trimble Pathfinder Office 4.0® software where it underwent spatial corrections and editing. In early September, this data was then sent to Jeff Heys and Whitney Rapp who entered all the relative information into the National Park Service's Alien Plant Control and Management (APCAM) database. It was also converted to ArcMap® shapefiles for use in KLGO GIS projects.

A time log of work was maintained to track the total hours spent working on each aspect of exotic plant management (see Table 1), as well as a phenology log of the flowering and seeding dates for each exotic species in the park, and a rover file log documenting the status of all GPS files.

Finally, efforts were made to take digital photographs of major infestations and those of greater concern, which will be linked to GPS positions for a more comprehensive set of data on each high priority occurrence.

Control Methods

The primary control method employed for exotics removal was hand-pulling, allowing for the most selective and low impact control possible. The greatest concern with this method was that the entire root system be removed with the plant. Plants with just a single tap root pulled easily, but those with rhizomal root systems needed special care to remove the entire root system. Most of these plants can grow back from just a small portion of root left in the soil. This has been observed in previous years with common tansy (*Tanacetum vulgare*) and oxeye daisy (*Leucanthemum vulgare*), and this year was an important consideration in the removal of large-leaf lupine (*Lupinus polyphyllus*).

A visiting SAGA crew had larger tools available, such as picks and shovels, which were used in the first large-scale attempt at removing the creeping buttercup (*Ranunculus repens*) along the Dyea townsite road. The displaced material was then raked to separate the vegetative material from excess soil.

All removed plants were bagged on site, deposited and disposed of in nearby NPS garbage cans for the effect of double bagging, and then burned in the Skagway incinerator, which helped to ensure that any seeds collected with the exotic plants were not dispersed to other locations.

The use of chemicals for control is not employed by the National Park Service in Alaska at this time. However, a proposal for the application of herbicides to an isolated patch of bird vetch (*Vicia cracca*) on city land is currently pending.

RESULTS

Defined Work Areas

In this report, six work areas are defined as follows:
1) Dyea, which is all the area in Dyea except the Chilkoot trail and the Nelson slough restoration site (Appendix B);
2) the Nelson slough restoration site (Appendix C);
3) the Chilkoot trail;
4) the Dyea road from Skagway to the pavement in Dyea (Appendix D);
5) the town of Skagway (Appendix E); and
6) the Klondike Highway from Liarsville to the summit of White Pass, including the White Pass sector of the park (Appendix F).

Species of Concern and Priority

Deliberation between KLGO Natural Resources staff and Alaska Regional EPMT staff in 2006 resulted in a list of the following six high priority species: Narrowleaf hawksbeard (*Crepis tectorum*), oxeye daisy, yellow toadflax, white sweet-clover, common tansy, and bird vetch. These plants are all considered species of greatest concern in Alaska (Carlson et al, 2004). Along with the species of greatest concern, common eyebright was recognized as a species of priority, due in large part to its limited distribution and recent appearance just outside of NPS owned land. Large-leaf lupine was considered a high priority this season, as it is also currently limited in its extent and has proven to be very difficult to control once expanded to a larger area.

Dyea

The Dyea area continues to be the focal point of exotic plant management in the KLGO. It is the most heavily used and accessible natural site in the park. Except for dandelion (*Taraxacum officinale*) and one or two species of lesser concern, the exotic plant populations lie in disturbed sites adjacent to roads. The major species of concern in Dyea this year were large-leaf lupine and common eyebright. A single stem of oxeye daisy was rediscovered at the head of the townsite road, but more demanding of attention was a sizable new patch within the forested townsite south of Nelson Slough. Narrowleaf hawksbeard was less of a concern this year, though it still exists along the Dyea Road between the Chilkoot Trail Outpost Lodge and the end of the pavement.

Large leaf lupine

Large-leaf lupine was collected from the Nelson Slough vehicle bridge in 2002, but it does not appear to have documented as an exotic species in the EPMT records until this year. Two more specimens were collected and a full scale effort made to eliminate this infestation and an adjacent one, those being

the only two occurrences known in and around the park. With the help of the SAGA crew, the first round of control went swiftly. Every stem in sight was removed and many of the rhizomes were tracked through the soil for more than a half meter and removed. Unfortunately, the rhizomes break easily when pulled and often run for nearly a full meter, making it very difficult to extract any more than half of them. Both sites were monitored and controlled through the end of the season, including more diligent removal of the rhizomes as new growths appeared from those previously left in the ground. No plants went to seed.

Common eyebright

Last season, a great amount of time and effort went towards mapping, removing, and experimenting with control methods on common eyebright. Infestations remained in the three locations where it was found in Dyea in 2007 and six more occurrences were relocated from previous years or discovered: one along the main road in the tidal flats; one just north of the footbridge to the dog camp; one along the road between the townsite parking and the Nelson Slough vehicle bridge; one on the footpath in the townsite east of the warehouse; one in the meadow east of the forested townsite; and one at the west side of the parking area for the Dyea campground. All except the large patch near the Taiya River and the equally sizable patch near the dog camp bridge were carefully removed by hand, then monitored and retreated as needed through the end of the season. The larger patch near the Taiya River on the eastern edge of the flats was mapped very carefully and is sure to be expanding, but it remains too expansive for full manual treatment with the limited persons available for control. In 2007, a series of experimental plots were established to explore the possibility of hoeing as a means of controlling this infestation. The evaluation of this experiment is treated separately under Discussion. Interestingly, the native arctic eyebright (*Euphrasia mollis*) was found along the newly graveled city road through the townsite.

The creeping buttercup along the northern segment of the road to Dyea flats, first sighted in 2006, finally underwent control work this season. The SAGA crew helped to remove the top six inches of soil spanning over a foot back from the edge of both sides of the road where the buttercup had been identified. The displaced soil was then raked to shed excess material from the vegetation that was being bagged. Even so, the total bagged weight was upwards of 1000 pounds! A visit to the site two weeks later showed the creeping buttercup back in its original numbers, possibly even worse than before controlling took place. It appears that mechanical treatment only aggravates the problem and that either hand-pulling or the use of plastic sheets should be considered in the future. Herbicides could be considered if authorized for use in the park.

Creeping buttercup

The successful eradication of oxeye daisy from the Taiya River bridge to the head of the Dyea flats road in 2006 was nearly confirmed for the second year in a row, with only a single plant found in 2008. However, an infestation in the townsite south of Nelson Slough, last recorded in 2005, is still present in considerable numbers. The majority of plants were small rosettes when control work took place, but over 200 were pulled and there are sure to be many that were overlooked. Considering the proximity to the population of native arctic daisies (*Leucanthemum arcticus*) in the tidal flats and a few that were found this season near the Nelson Slough restoration area, it was possible that this infestation was in fact the native arctic daisy, but the plants were identified in the field with confidence as oxeye daisy by Whitney Rapp during her visit to the park. It is presently unknown whether oxeye daisy hybridizes with arctic daisy. The patch in the Dyea campground parking area, last mapped in 2004, was present and underwent late control work in mid-September when they were well in seed. None were observed near Matthew's Cabin, the Chilkoot Trail Outpost Lodge, or the raft pullout area where they had previously been documented.

Oxeye daisy

Narrowleaf hawksbeard

The most intensive surveys of the paved segment of the Dyea Road took place early in the season when narrowleaf hawksbeard had probably only begun to flower. Therefore, it is difficult to compare their extent this year against that of last year. Narrowleaf hawksbeard was only opportunistically controlled this season as it reappeared sporadically in small numbers in the road right-of-way in front of the Chilkoot Trail Outpost Lodge and near the entrance to the Dyea campground road. This is a dramatic decrease in the control effort for this species from the last two seasons. Locating and controlling the plants became difficult when the lodge owners cut the grass in the right of way. This helped to control the exotics in the short term but ultimately created newly disturbed sites for the establishment of new exotic populations, namely more narrowleaf hawksbeard that was mapped in September. It appears that the DOT did not use their road grader to control the growth in the ditches this year.

Whitney Rapp led a day-long survey of exotic grasses in Dyea, which was the first time that this had been done. Many new exotic species were added to the KLGO list including quackgrass (*Agropyron repens*), smooth brome (*Bromus inermis*), *Poa spp*., common timothy (*Phleum pretense*), and foxtail barley (*Hordium jabetum*). Hopefully this knowledge will encourage a new effort to better identify and map exotic grasses in the park in future years.

A knotweed species was found in large numbers in the tidal flats and is likely to be prostrate knotweed (*Polygonum aviculare*). There was not enough time to map this infestation as a polygon, so more attention should be paid to this species next season.

In general, all of the road side ditches have a few common species of exotic plants. They include dandelions (*Taraxacum officinale*), sheep sorrel (*Rumex acetosella*), plantain (*Plantago major*), common groundsel (*Senecio vulgaris*), tall buttercup (*Ranunculus acris*), clover (*Trifolium spp.*), and pineapple weed (*Matricaria discoidea*). These species have been given low priority status because of their widespread distribution and/or their inability to encroach into undisturbed native Alaskan plant communities. Sheep sorrel was present in much of the unforested region of the Dyea flats and pineapple weed was present along virtually every roadway in Dyea. Tall buttercup existed in large numbers in certain open sites within the forested region of the flats, and this year an effort was made to control the largest infestation in a meadow south of Nelson Slough with the help of the SAGA crew. A considerable impact was made after a full day's work, but it will take several more follow-up efforts if it is to be eliminated from that site.

Nelson Slough Wetland Restoration Site

The Nelson Slough restoration area continues to be heavily monitored with control work taking place at a minimum of once per week. After the seeding and transplants that took place in 2006, the site is now filled with flourishing wild-flag (*Iris setosa*), Nootka lupine (*Lupinus nootkatensis*), northern rice root (*Fritillaria camschatcensis*), sweet gale (*Myrica gale*) and Sitka spruce (*Picea stichensis*) seedlings. It is also thick with yellow rattlebox (*Rhinanthus minor*) and many shoots of Sitka alder. There continues to be a number of exotic species of lesser concern including plantain, sheep sorrel, tall buttercup, and most notably the white and red clover, which are populating the areas between previous years' transplants. Earlier reports expound the continued transplanting of native vegetation onto the site with the hope that the native plants would then out-compete and overtop the non-native vegetation, eventually propagating throughout the site. As in 2007, there were no new transplants to the main restoration area. However, a number of Sitka spruce seedlings were planted in the meadow northeast of the footbridge with the hope of speeding succession to the state of the surrounding Sitka spruce/Sitka alder/cottonwood communities that predominate in the upper slough.

Common eyebright continues to be the one threatening species in the site, and control work was performed on it throughout the season in 2008. Heeding last year's lesson in phenology, control work began later in the season as the plants began to flower and removal was more efficient. The site underwent weekly treatments, which became increasingly time-consuming as the size of flowering plants dwindled to merely a centimeter in height by mid August. Control work continued into September when new plants were still being discovered almost daily as they went to seed. Whether they were not mapped as thoroughly last year, or whether they have truly increased in density, common eyebright appears to be more numerous in the site than in previous seasons, growing beneath even the thickest mats of lupine and grasses.

A note to future exotic plant management staff: the native marsh peavine (*Lathyrus palustris*) occurs in the restoration area and might resemble an exotic pea when it flowers late in the season and climbs to head height over Sitka spruce and other vegetation. Be careful not to mistakenly remove it! Also, a few native arctic daisies were found on the northeast corner of the path by the footbridge, but be aware that oxeye daisies previously existed in the restoration site.

Chilkoot Trail

There were no surveys done on the Chilkoot Trail this year for logistical reasons. The site was only opportunistically surveyed in 2007, finding dandelion along a limited stretch of the trail. The extent of tall buttercup, sheep sorrel, dandelion, and clover found in 2006 should be reassessed in 2009.

No effort was made to continue the removal of the sheep sorrel at the Canyon city trail crew cabin that first took place in 2006. However, it is believed that in the next few years, with diligently repeated treatments, it could be removed from its Canyon city site.

Dyea Road

As in previous years, there was no formal survey conducted on Dyea Road, but the author frequently observed the roadsides while driving to and from Dyea. None of the common tansy was found when inspecting the locations described in 2006, but an unidentified mustard was very common along much of the road and it is possible that this is the wormseed mustard (*Erysimum cheiranthoides*) described in 2006. There is still a small group of yellow toadflax on the first ascent after turning onto Dyea road from Main Street, as well as several locations of narrowleaf hawksbeard on private drives. The oxeye daisy continues to thrive and spread from a single location on private property, and another planted occurrence was found along the paved section of the road closer to Skagway. Many other exotic species such as plantain, dandelion, and sheep sorrel were found along the road in numerous locations. Due to greater exotic threats in Dyea, there wasn't time to survey common exotics along a road outside the park boundary.

Common tansy

The one major discovery on the Dyea Road was a small group of reed canary grass (*Phalaris arundinacea*) near the AB Mountain trailhead, made by Whitney Rapp on her visit from GLBA. It is very important that this occurrence be monitored as this is a species of great concern in the Alaska Region. Manual treatment is not known to be

Reed canary grass

effective with this species, but small quantities of herbicide applied carefully have been effective in other locations.

Skagway

Skagway is known as the garden city, and with gardening can come many exotic plants with the potential to escape and grow where they are not wanted. This is currently the case in Skagway where exotics have become an overwhelming problem. With so many established infestations, the goal now is to stop the spread of these plants outside of the Skagway area and keep the problem locally contained. The infestations are so broad that they cannot be managed without assistance, so it will be critical to recruit volunteers and raise awareness in the community in order to make progress in the future.

SAGA crew pulling white sweet-clover

Skagway contains five of the species of concern identified in 2006, including narrowleaf hawksbeard, yellow toadflax, oxeye daisy, bird vetch, and the most troubling, white sweet-clover. White sweet-clover persists in considerable numbers on the south half of the airport, on both sides of the fencing, and all around the terminal and parking lot. With the help of the SAGA volunteer group, an effort was made to pull the white sweet-clover and yellow toadflax from around the airport runway and terminal, similar to the efforts in the past two years. After three days of work, most of the white sweet-clover stems were removed from this area, but many of the root systems remain due to the difficulty of excavation. This species has spread through much of the west side of Skagway, thriving both in gravel lots like those south of 1st Street, and in unkempt lawns like those around the corner of 15th and Alaska Street. A new linear infestation was found on the quarry service road on the west side of the base of the Klondike Highway, and another was reported on private property on the east side of the Klondike Highway just north of the Dyea Road intersection.

White sweet-clover growing through concrete.

Yellow toadflax is still prevalent throughout the airport medians, along the bank of the Skagway River adjacent to the runway, and in many other locations near the airport along the entire west side of town. Some time was dedicated to the removal of this plant in the airport medians with the help of the SAGA crew, but it was so abundant that little impact could be made with the time available.

Narrowleaf hawksbeard continues to thrive throughout the airport, especially on the northernmost section of gravel, and

throughout Skagway on lawns and road ditches up to the Klondike Highway.

A new location of oxeye daisy was found on the south side of Otter Street, primarily within fenced off private property, but including two small patches in the right of way that were controlled. Without access to the private property they are likely to continue to spread from within the fenced area, so the perimeter should be monitored for new growth.

Bird vetch

The bird vetch found in 2005 at the corner of Spring Street and 9th Street is still contained in the same location. Manual treatment was not performed this year after the limited results from last year's efforts. The fact that bird vetch has a long-running weak root system makes it difficult to remove the whole plant to prevent it from re-sprouting. The plant generally breaks off and sprouts from the remaining root left in the soil. The only effective way to control this plant will be with the spot use of herbicide, which has been proposed to the city and is awaiting consent. The grass clippings being dumped in and around the population of bird vetch last year were not seen this season.

The railroad yard east of the tracks was surveyed and controlled once again. White sweet-clover is still present in small amounts and yellow toadflax remains in great abundance in the gravel directly adjacent to the rails. A very small group of oxeye daisies was found and removed again. There is typically at least one pile of gravel in this area that has an odd assortment of plants not otherwise seen in the immediate vicinity, and this year there was a single poppy species growing on it that was removed. Most of the pile was thick with chickweed.

The Liarsville road was surveyed fairly extensively, turning up several new exotic species additions to the park list. A single perennial sowthistle (*Sonchus arvensis*) plant was removed from the intersection of the Liarsville road and the Klondike Highway. A large patch of splitlip hempnettle (*Galeopsis bifida*) was mapped on the north end of the gravel pit on the east fork of the road, along with nightflowering silene (*Silene noctiflora*), yellow toadflax, prostrate knotweed, shepard's purse (*Capsella bursa-pastoris*), common chickweed (*Stellaria media*), and common groundsel (*Senecio vulgaris*), as well as a number of more common exotics.

The Taiya Inlet Watershed Council (TIWC) installed a new meander in Pullen Creek from the 1st Street culvert to Pullen Pond, in order to rehabilitate stream flow to better meet the needs of returning salmon. This involved a great deal of soil fill around the creek, in addition to the rock and gravel used in the creek bed. When checked in September, virtually every plant growing in the fill was an exotic, though most were of very low priority. The most notable find is a *Silene sp.*, but several non-native flowers were also hand-planted, including a daisy species that is not oxeye daisy.

KLGO has been working closely with the TIWC on the white sweet-clover and the bird vetch issues in Skagway in previous years. Because of multi-ownership issues, the desire is to have the TIWC continue to take the lead in the exotic plant management role in Skagway.

Klondike Highway

The shoulder of the Klondike Highway that falls within the White Pass section of the park boundary was surveyed on foot with the help of Whitney Rapp. A driving survey of the Klondike Highway from Skagway to the summit of White Pass was also conducted, with occasional stops for plant identification and mapping. Several infestations of reed canary grass were located and mapped, and each should be monitored with care in conjunction with the occurrence on Dyea Road in the future. Other species of concern included several occurrences of narrowleaf hawksbeard, a single patch of oxeye daisy, field pennycress (*Thlaspi arvense*), common chickweed, mouse-ear chickweed (*Cerastium fontanum*), shepherd's purse, common groundsel, foxtail barley, and quackgrass. There was also the usual assortment of lesser exotics.

The railroad tracks were not formally surveyed this year, but Whitney Rapp recorded her sightings during a train ride to and from the Laughton Glacier trail:

> At the Laughton Glacier trailhead/train stop were common timothy (*Phleum pretense*), white clover, mouse-ear chickweed, common dandelion, and European mountain-ash* (*Sorbus aucuparia*). From the trailhead to the cabin were common timothy and European mountain-ash*. From the cabin to the glacier were common timothy and common dandelion (discrete patch in open area relatively close to glacier). Elsewhere along the train tracks I saw timothy, quackgrass, European mountain-ash (or western?), and yellow toadflax.
>
> *There was definitely Sitka mountain-ash (*Sorbus sitchensis*) on the trail. What I am calling European mountain-ash could possibly be western mountain-ash. Most of the plants were still relatively small growing in understory/edge habitats. There were generally 13 sharp-pointed leaflets (which is the overlapping number for both species), and the plants were past flower, but the fruit were not yet ripe. I also did not have winter buds to compare. There is a lot of European mountain-ash in downtown Skagway, but because this area has more interior plants than I'm familiar with and I've never seen western mountain-ash, I'm uncertain about the determination.

Log of Work

The total amount of time spent on exotic plant management in 2008 was nearly 600 hours. This is considerably less than the 900 hours in 2007, which can be attributed primarily to fewer volunteer groups and fewer natural resources staff being consistently involved. The work hours can be broken into three categories: (1) Control work, which consists of all removal work, including time donated by volunteers; (2) GIS and GPS work, which includes mapping infestations, uploading and editing rover files, and

managing GPS units, as well any survey time or follow-up visits that did not involve control work; and (3) Office and administrative tasks, which includes data management, research, report writing, planning, training, and travel.

Work Category	Hours
Control	370
GIS/GPS, Inventory, Monitor	125
Other (Administration, training, etc.)	89
Season Total	584

Table 1. Exotic plant management work hours by category.

SAGA Crew

During the first week in July, a SAGA crew arrived in Skagway to help the park with exotic plant management, among other tasks they were assisting the community in. They had already helped with exotic plant management in Sitka National Historical Park before their stint in Skagway. Having seen the extra productivity that can be achieved with volunteer groups in 2007, the park was eager for their help with large-scale control work like that of the white sweet-clover removal in Skagway.

SAGA crew asserting dominance over a field of tall buttercup.

The crew spent the first two days in Skagway concentrating on the control of white sweet-clover in and around the airport. It should be noted that, in 2006, the locations where the plants were pulled had fewer plants remaining than in places where the white sweet-clover was cut. So, while brush-cutting has been reported as an effective method of control if done consistently for many years, it is beneficial to hand-pull as many plants as possible when energetic volunteer groups like SAGA are available. The only effective manual treatment of white sweet-clover is to pull the plant completely, root and all. While there is an overwhelming amount of white sweet-clover

in Skagway, the SAGA crew made a large impact in the areas where control work was concentrated.

The next two days were spent on an experimental removal of creeping buttercup on the Dyea townsite road, large-leaf lupine by the vehicle bridge, and a large meadow of tall buttercup. The crew maintained a laudable productivity level despite the peaking mosquito populations and intense sun. They capped the week off by resuming control work on white sweet-clover near the airport.

The park is very grateful for the enthusiastic effort and cooperation of the SAGA crew.

DISCUSSION

Exotic Plant Management: 2008 vs. 2007

The 2008 season saw an addition of many new exotic species to the park's EPMT list. This was due primarily to more widespread surveying in areas not thoroughly covered in previous years, and Whitney Rapp's contributions were significant, adding at least five species of exotic grasses to the park EPMT list in addition to other plant identification that would have otherwise been overlooked.

Despite the expanded surveys, the emphasis was still on control work and remapping known infestations. The size of persisting infestations was discouraging, namely the continued spread of white sweet-clover through Skagway onto private property, the expanding infestation of common eyebright in the tidal flats as well as four new occurrences in Dyea, and the creeping buttercup that did not respond favorably to control work. It is difficult to say whether there is still progress being made on the white sweet-clover at the airport. The plant has not been eradicated from any one location and it seems to appear in new places each season. While the oxeye daisy occurrence at the head of the Dyea townsite road still appears to be well controlled, a worrisomely large occurrence of rosettes was found further south in the townsite. More time will need to be spent on control work in 2009 to keep a handle on the new species and infestations discovered this year.

Common Eyebright Taxonomy

Euphrasia nemorosa is the most oft used latin name ascribed to common eyebright. However, ITIS recognizes the following as synonyms:

E. americana
E. arctica ssp. Borealis
E. borealis
E. canadensis
E. curta
E. officinalis
E. pectinata
E. tatarica

Polar eyebright (*Euphrasia disjuncta*) was collected in White Pass in 2002, and subalpine eyebright (*Euphrasia mollis*) was collected from Nelson's Slough in 2000. Both of these are native varieties of *Euphrasia arctica*. Having found *E. mollis* in Dyea this year, care should be taken not to confuse the native species for *E. nemorosa*, which is distinguished by its larger corolla, generally larger size, and glabrous calyx and leaves.

Common Eyebright (*Euphrasia nemorosa*) Control Experiment

In 2007, three sites were selected for experimentation within the large occurrence of *E. nemorosa* located on the eastern edge of the Dyea flats (**Figure 1**). Each site contains three plots that are one square meter in size: a hoed plot, a hand-picked plot, and an unmanipulated plot for control. Each treated plot underwent a complete removal of all *E. nemorosa*, while the control was left undisturbed. The depth of hoeing was not specified in 2007, but was approximated at 3 cm in 2008.

The percent coverage by *E. nemorosa* in each plot was recorded (**Table 2**) before the treatments were conducted on July 17 and 23, then reassessed twice on July 18 and August 14 in 2008. In August of 2007, it was already apparent that hand-picking was only marginally effective, as many new flowering plants had regrown in all three hand-picked plots. Alternatively, hoeing was clearly a time efficient and effective method of removing all existing *E. nemorosa*, but with the severe disadvantage of removing the entire existing flora and upper organic layer along with it. In August of 2007, only a handful of grass had sprouted in the hoed plots where moss had often represented the greatest percent coverage prior to manipulation.

From the percent coverages in Table 2, it is clear that hoeing is an effective means of reducing the number of *E. nemorosa* plants, if only temporarily. It is also clear that *E. nemorosa* is one of the first plants to repopulate the hoed area, along with the invasive *Rumex acetosella*. Based on the rapidity of repopulation by invasives, the current seedbank of *E. nemorosa*, the relatively large size of the infestation, and the questionable

impact of *E. nemorosa* on native vegetation, I cannot recommend hoeing as a means of control at this site. However, it might be a viable method of control at other sites where the infestation is less than a few square meters in extent. It is unclear yet whether hoeing has the potential to eliminate the *E. nemorosa* seeds in the seedbank.

Due to the size of the infestation, I also cannot recommend hand-picking as a means of removal, even if it is effective in small areas. It is overly time consuming and very difficult to achieve the level of thoroughness needed to prevent further expansion. However, it is probably worth the effort to remove flowering plants on and directly adjacent to the dirt roads in order to prevent unnecessary dispersal, as bikers use the paths daily for tours and vehicles pass through infrequently toward the city campground sites. These travelers might easily transport the seeds throughout Dyea and even along the Dyea road to Skagway, given enough time.

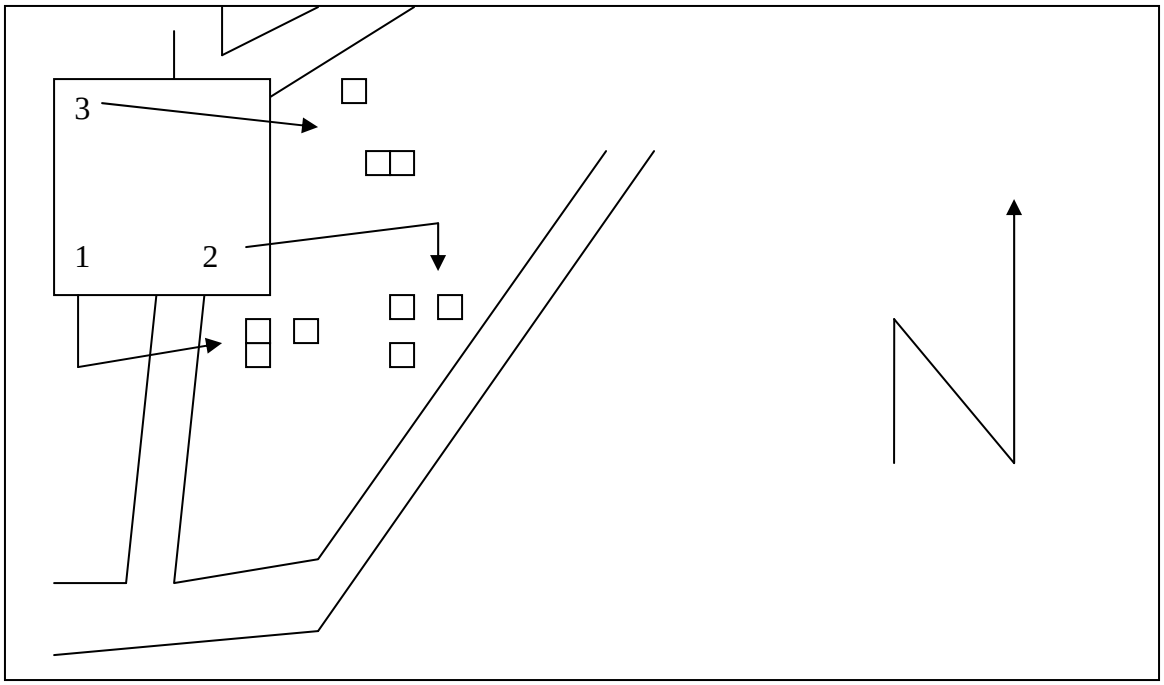

Figure 1. *Euphrasia nemorosa* experimental plots.

Plot	Treatment Method	Date Treated	%Eyebright 2007	%Eyebright 2008 Avg	Eyebright %Change	%Grasses	%Mosses	%Rattlebox	%Unalaska Paintbrush	%Sitka Spruce	%Beach Pea	%Yarrow	%Sheep Sorrel
1a	Picked	7/17/2008	40	34	-7	40	15	3	0	0	0	2	2
1b	**Hoed**	7/17/2008	**35**	10	**-25**	**8**	**2**	**<1**	**<1**	**0**	**0**	**3**	**2**
1c	None	7/17/2008	30	35	5	30	25	2	0	0	0	1	1
2a	Picked	7/23/2008	40	23	-20	25	30	3	2	0	0	4	2
2b	**Hoed**	7/23/2008	**40**	8	**-32**	**15**	**1**	**<1**	**0**	**0**	**0**	**<1**	**<1**
2c	None	7/23/2008	43	14	-30	30	40	1	0	0	0	0	1
3a	Picked	7/23/2008	30	14	-22	10	60	<1	1	0	0	3	1
3b	**Hoed**	7/23/2008	**47**	4	**-42**	**7**	**8**	**1**	**0**	**0**	**0**	**8**	**2**
3c	None	7/23/2008	45	34	-12	30	50	0	0	4	4	5	2
	Picked	Average	37	24	-16	25	35	3	1	0	0	3	2
	Hoed	Average	**41**	**7**	**-33**	**10**	**4**	**1**	**0**	**0**	**0**	**6**	**2**
	None	Average	39	28	-12	30	38	1	0	1	1	2	1

Table 2. *Euphrasia nemorosa* coverage by plot.

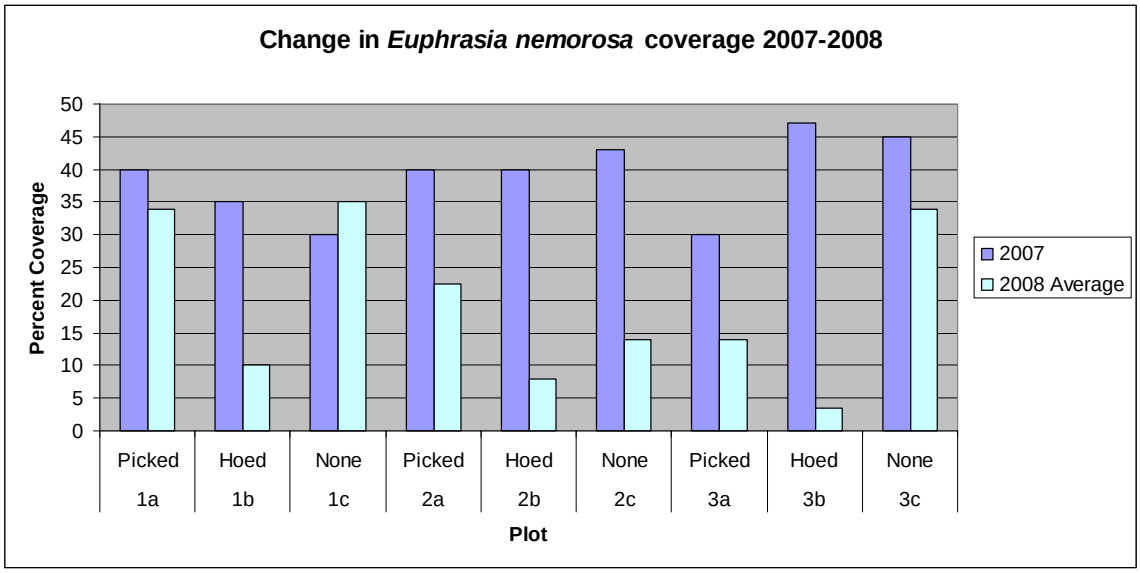

Figure 2. Change in *Euphrasia nemorosa* coverage from 2007 to 2008.

GPS

As we are currently unable to use real-time differential correction in Skagway, all GPS data from this and previous seasons underwent post-processing. This season, there were problems with many of the CORS stations, including the Gustavus location, which serves as our primary source for differential correction base data. Therefore, the majority of this season's data was post-processed using the SOPAC station in Whitehorse, Yukon Territory, providing less-than-desired 2-5 m accuracy and often worse.

Additional problems were encountered when the Hurricane antenna appeared to stop functioning due to a broken cable, and the productivy-precision settings on the GPS unit had to be set to 100% productivity in order to obtain enough satellites to collect points. This may have been compounded by several days of lower than usual satellite coverage. Switching to the Archer PDA seemed to relieve most of the satellite problems for the remainder of the season.

RECOMMENDATIONS AND PLANS FOR THE COMING YEAR

Dyea

The highest priority in Dyea should be given to the two infestations of large-leaf lupine. They are still manageably small in extent and a great deal of effort was given to eliminating them in 2008. It is probably most efficient to wait until they are flowering in June so that the extent of the infestation can be easily mapped. Care should be taken to track down and remove as much of the rhizomes as possible. The site will require a few follow-up treatments toward the end of the season to remove the new, smaller plants that will have grown from the remaining rhizomes.

The second priority should be to monitor the previous oxeye daisy locations where they were thought to be eliminated, but efforts should be focused on the occurrence in the townsite south of Nelson Slough. Because oxeye daisy is rhizomal, care is needed to remove the entire root mass to prevent it from re-sprouting. The search of all roadsides and disturbed areas should continue to determine if these plants are extending their range.

Once flowering starts near the end of May, conduct weekly pulling treatments of the narrowleaf hawksbeard and any common tansy occurrences that may reappear. The narrowleaf hawksbeard pulls very easily – if grasped at the base of the flowering stalk the complete root will come out most of the time.

Continue to remove common eyebright from its various locations with priority going to complete eradication of the small, scattered patches, especially those in high traffic areas. The optimal time for control would be in mid July and early August once they have grown to a manageable size and begin to flower. Hoeing should be considered as a method of removal for small infestations. Manual control of the large patch on the eastern edge of the flats is not a good use of time at this point, but it should be mapped carefully in order to assess its rate of expansion. The same goes for the infestation near the bridge to the dog camp. In general, common eyebright control should be given lower priority until removal is more efficient, or it becomes more clearly detrimental to surrounding vegetation.

The knotweed species in the tidal flats should be concretely identified and mapped more accurately in the case that it is prostrate knotweed.

If there is time available for lower priority species, the tall buttercup in the meadow on the east side of the slough should be retreated in hopes of gradually reducing the extent of this species in Dyea.

Nelson Slough

The Nelson Slough wetland restoration site poses some interesting dilemmas. Removing exotics from in-between transplants only opens up the space for the seed bank to germinate and for the encroachment of other exotics. Currently the most established exotics are the red and white clovers (*Trifolium pretense* and *T. repens*). In 2006, the clover encroached into the spaces between the transplants and covered approximately 30% of the restored area with a thick mat of vegetation. Additional native plant transplants are needed to break up some of the clover. Manual treatment of the clover should follow, and seeding of the area with native plant seeds collected in 2006 would help the restoration move along. The manual treatment of clover will be very time consuming so, if another crew similar to the TCCC can be obtained, this would be an ideal place to start.

Most of the exotics imported in the original fill have been eliminated, such as the prostrate knotweed and mouse-ear chickweed, and the lupine and iris have populated the area very successfully. The northwest section could receive some more transplants, as it currently has more bare dirt than should exist there, providing easy real estate for exotics to move in.

White clover between transplants

Previous years' reports recommended that all the spruce planted within the restoration site be removed because they do not represent the plant communities within the adjacent meadows (Phillips 2002). The Division of Natural Resources Program Manager in 2008 opposed this decision and called for additional spruce plantings. Currently all meadows in the restoration area contain spruce seedlings and saplings, and it is now recommended that they remain in order to speed succession to the surrounding Sitka spruce / Cottonwood / Sitka alder community in the upper slough.

Control work should continue on the common eyebright that exists on both sides of the pond. It is well established on the north side and is very time consuming to remove even late in the season. As on Dyea flats, it is ideal to pull the common eyebright in mid July or early August when it has grown to a height that is easily seen, and when it has begun to flower so that it stands out among the other plants.

Minimal effort was put towards removing red clover and tall buttercup in 2008, and it should not take much more to eliminate these two species from the restoration site. With

weekly treatments beginning in June, it should be easy to keep any plants from going to seed.

Chilkoot Trail

While no survey was conducted on the Chilkoot Trail this year, those non-native species that were previously located are low on the priority list. Continued mapping of the trail should be done on a yearly basis to see if the plants are extending their range, and to continue monitoring for any new species that might appear. The tall buttercup is limited enough it its distribution that it might be worth a control effort to remove it. Also, even though the sheep sorrel is low on the priority list of species, the occurrence at the Canyon City trail crew cabin should be treated any time crews are in the vicinity, since it is isolated and easy to access.

To begin control of the dandelions on the trail, those that surround the helipad at Sheep Camp should be the first to be removed. Help from the trail crew and trail rangers in clipping the flower heads as they appear would enable this process to be effective over the span of a few years. With their help, a biannual removal of dandelions might be effective in the long term.

The alpine dandelions close to The Scales are thought to be the native horned dandelions. A few voucher specimens should be taken to verify this tentative identification.

Dyea Road

The Dyea Road is a prime spot for new infestations. With a large seed source in Skagway and the first few miles of the road, these plants have the potential to extend their range along the road and into Dyea. The exotic plant control work here has been centered on land that is not adjacent to residential property. Many people have planted exotics on their property (i.e., oxeye daisy) and are not interested in having them removed. Care is needed here not to overstep the park's jurisdiction. Even if there is no control work taking place, all infestations of high priority species along the road right-of-way should be mapped to document new and expanding occurrences. This currently includes several patches of oxeye daisies, yellow toadflax, and most importantly, the newly discovered reed canary grass. The roadside should continue to be monitored throughout the coming years, and certainly anytime park biologists drive to Dyea, they should be keeping an eye open for new exotic occurrences.

Skagway

Skagway is home to just about all the exotic species known in the area. Preventing the spread of these plants outside of Skagway should be the focus of exotic plant management here. The two species of concern in Skagway that have been managed heavily are white sweet-clover and bird vetch. It should be possible to prevent the white sweet-clover from moving out of Skagway, but it will depend on a concerted effort

between the park, DOT, and the Skagway community. Concentrated work on the white sweet-clover around the airport is necessary to prevent seeds from attaching themselves to planes, people, and luggage headed to other Southeast Alaskan communities. This continues to be an ideal job for groups like the SAGA crew and any other powerful volunteers. Also, eyes should be kept open for this plant along the roadways and railways going out of Skagway to help prevent its spread.

The bird vetch could be eliminated with the use of an herbicide. Manual methods can prevent the plant from going to seed and from growing out of control but will not result in eradication. Authorization for the use of the herbicide Clopyralid is pending an M.O.U. from the Municipality of Skagway and an Environmental Assessment statement.

Common eyebright was documented on the Haines airport by Whitney Rapp, and others have reported seeing it in different locations around Haines. With the frequent air traffic between Skagway and Haines, this plant has probably arrived on our airstrip and has gone unnoticed so far. The entire Skagway airport should be surveyed for both this species and others that are likely to occur but have not yet been documented.

It is highly recommended that the railroad yard continue to be surveyed for new exotics in addition to the continued removal of any white sweet-clover and oxeye daisy that appear there. The piles of gravel are a source of frequent oddballs like the poppy found this year and an unidentified geranium-like plant in 2007. It may be that people are tossing old plant materials here.

The new meander above Pullen Pond should be monitored carefully. Based on the number of exotics seen already growing in the fall of 2008, there is great potential for a threatening species to appear in the coming year. This is an area of very high foot traffic, and the railroad tracks and paved road intersect each other nearby, making it very easy for any unwanted plants to spread in all directions.

It will be essential to work with the TIWC on the exotic plant issues in Skagway. They have spearheaded the work in the past and they are an essential ally when working in residential areas. On top of collaborating with the TIWC and volunteer groups, it would be a great step to educate the community about exotic plants in town, focusing on the white sweet-clover and yellow toadflax. This might begin with a powerpoint presentation on exotic plants in Alaska held at the visitor center. A “Reclaim Your Yard” day could be advertised through the mail with a brochure sent to all boxholders following the presentation, encouraging everyone in town to eliminate unwanted exotics from their yards on a specified day. Even more, a day could be dedicated to controlling white sweet-clover when a group of community volunteers could gather at a single location and be assigned to a particular infestation. This event would concur with the SAGA crew’s exotic plant detail, anticipating their return to assist the park in 2009.

White Pass

Following two years of sparse data collection, White Pass saw more attention this year with a full walking survey of the section of the Klondike Highway contained by the park, as well as a driving survey to the summit of White Pass. With the help of Whitney Rapp, this was a very productive trip that should be repeated at least once each year, focusing on the park land. It is heavily travelled through the summer and there are species of concern in Canada that might make it to Skagway on commercial buses, trucks, or personal vehicles frequenting Whitehorse.

The importance of monitoring the existing reed canary grass infestations needs to be stressed. Secondarily, there are several species of concern that should be kept in check with any available time. Monitoring of the White Pass railroad line should be conducted again in 2009 to assess any new growth that is bound to have happened since the 2004 survey. Most importantly, anytime someone rides on the train they should look for white sweet-clover along the tracks. It would be a shame to see a population established along the railroad tracks and then move its way down to the river where the worst effects of white sweet-clover would manifest themselves.

Notes on GPS

In 2008, there were many times when satellite availability was limited and geometry was poor. Skagway's location, sitting low between deep valleys and high mountains, is anything but ideal for collecting GPS data. Most satellites lie on the southern horizon, so achieving a clear view of the south sky is crucial for data collection. It became necessary this season to use an antenna with the ProXT receiver in order to obtain one meter accuracy, although the Archer PDA was used with increasing frequency and success at the end of the year.

With respect to the seasonal report, it is useful to collect a point feature to accompany each small polygon feature so that the infestation is easily displayed at any scale on a map. An example from this year is the bird vetch in Skagway, which is at most 15 meters wide and is hardly visible as a polygon at the city-wide scale.

ACKNOWLEDGEMENTS

I would like to thank Dave Schirokauer for providing guidance, Whitney Rapp for her continued assistance in every aspect of the program and for her tutorial on grass identification, Jeff Heys for his regional support, and the SAGA crew for their hard work and upbeat attitude. I would also like to thank those whose dedicated efforts in the past have resulted in the tremendous progress seen today in KLGO exotics management.

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Appendix A

KLGO Exotic Species List

Scientific Name	Common Names	Chilkoot Trail[1]	Nelson Slough	Dyea	White Pass[2]	Dyea Road[3]	Klondike Highway
Bromus inermis	smooth brome				!		!
Capsella bursa-pastoris	shepherd's purse		* * *			* *	!
Cerastium fontanum	mouse-ear chickweed		* *				!
Chenopodium album	lambsquarters		* *			* *	!
Crepis tectorum	narrowleaf hawksbeard			* * * * !	!	* * * !	!
Elymus repens	quackgrass			!		!	!
Erysimum cheiranthoides	wormseed mustard		* * *			* *	
Euphrasia nemorosa	common eye-bright		* * * * !	* *			
Galeopsis tetrahit	bristlestem hempnettle		* * *				
Galeopsis bifida	splitlip hempnettle	Found only in Skagway					
Hordeum jubatum	foxtail barley			!	!	!	!
Impatiens glandulifera	ornamental jewelweed	Found only in Skagway					
Leucanthemum vulgare	oxeye daisy			* * * !		* * * !	!
Linaria vulgaris	yellow toadflax		* * *		*	* * * !	
Matricaria discoidea	pineapple weed		* * * * !	* * * * !	* !	* * * !	!
Melilotus alba	white sweet-clover	Found only in Skagway					
Phalaris arundinacea	reed canary grass				!	!	!
Phleum pretense	timothy grass						!
Plantago major	plantain		* * * * !	* * * * !	* !	* * * !	!
Poa pratensis	Kentucky bluegrass	* * *		* *	*		
Polygonum aviculare	prostrate knotweed		* * *	!	!	* *	!
Potentilla gracilis	slender cinquefoil			!			
Ranunculus acris	tall buttercup	* * *	* * !	* * * !	* !	* * * !	!
Ranunculus repens	creeping buttercup			* * !			
Rumex acetosella	sheep sorrel	* * *	* * * * !	* * * !	* !	* * * !	!
Rumex crispus	curled dock		* * *			* *	
Senecio viscosus	sticky ragwort			* *		* *	
Senecio vulgaris	common groundsel		*	!	!	!	!
Silene cucubalus	bladder campion		* *			* *	
Silene noctiflora	nightflowering silene	Found only in Skagway					
Sonchus arvensis	perennial sowthistle	Found only in Skagway					
Sorbus aucuparia	European mountain-ash	Found only in Skagway					
Stellaria media	common chickweed		* * *	!	!	* * !	!
Tanacetum vulgare	common tansy					* *	
Taraxacum officinale	dandelion	* * * *	* * * * !	* * * * !	* !	* * * !	!
Thlaspi arvense	field pennycress		*				!

Trifolium hybridum	Alsike clover					* !	* !
Trifolium pretense	red clover		* !	* !		* !	* !
Trifolium repens	white clover	* * *	* * * * !	* * * * !	* !	* * * !	!
Vicia cracca	bird vetch	Found only in Skagway					
Viola tricolor	johnny-jump-up violet		*				
* 2004 survey results							
* 2005 survey results							
* 2006 survey results							
* 2007 survey results							
! 2008 survey results	Previously undocumented						
[1]not surveyed in 2008							
[2]not surveyed in ’05 ’06 ‘07							
[3]not surveyed in 2004							