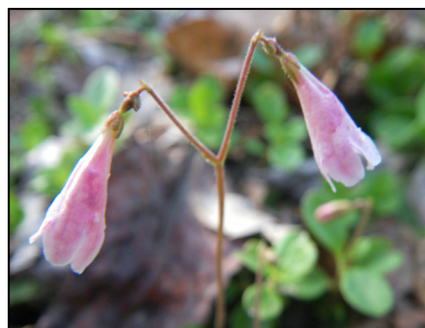
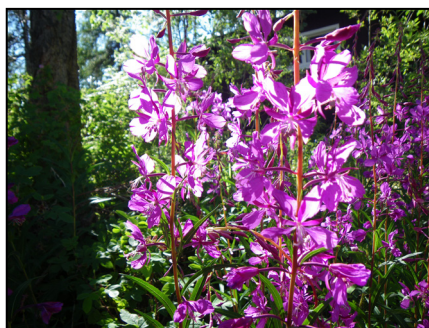
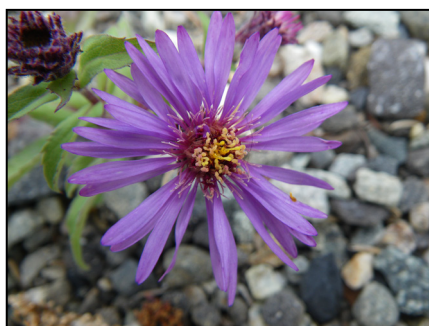




Invasive and Exotic Species Management for Denali National Park & Preserve

2010 Summary Report

Natural Resource Data Series NPS/DENA/NRDS—2010/106



ON THE COVER

Nine of the numerous native wildflowers of Denali National Park that the Alaska Exotic Plant Management Team is working to preserve. From left to right, top to bottom: Siberian aster, prickly rose, alpine forget-me-not, fireweed, frigid arnica, twinflower, bluebells, narcissus-flowered anemone and pale corydalis.

Photographs by: Patricia A. Knapick

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U.S. Department of the Interior
National Park Service
Natural Resource Program Center
Fort Collins, Colorado

The National Park Service, Natural Resource Program Center publishes a range of reports that address natural resource topics of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

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

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available from the Alaska Region Exotic Plant Management Team Reports website (<http://www.nps.gov/akso/NatRes/EPMT/reports.html>) and the Natural Resource Publications Management website (<http://www.nature.nps.gov/publications/NRPM>).

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Abbreviations

AKEPIC	Alaska Exotic Plant Information Clearinghouse
AKNHP	Alaska Natural Heritage Program
AKPMC	Alaska Plant Material Center
ARRA	American Recovery and Reinvestment Act
DENA	Denali National Park and Preserve
EPMT	Exotic Plant Management Team
GPS	Global Positioning System
INR	McKinley National Park Airport
MSLC	Murie Science and Learning Center
SAGA	Southeast Alaska Guidance Association
SCA	Student Conservation Association

Abstract

This report describes the work performed by the Alaska Exotic Plant Management Team at Denali National Park & Preserve during the 2010 field season. The Exotic Plant Management Team staff at Denali National Park & Preserve was comprised of two American Recovery and Reinvestment Act funded Student Conservation Association interns and one seasonal National Park Service employee. For the seventh consecutive year, invasive plant inventory and control occurred within the park focusing on the entrance area including the Denali Park Road, Visitor Center, railroad station, and campground. Invasive plant infestations were mapped using a Trimble 2003 GeoXT and manual weeding was performed with the help of three Southeast Alaska Guidance Association crews. Data was edited and analyzed using Pathfinder Office and ArcGIS. Total canopy acres controlled in 2010 (16.711) were slightly larger than in 2009 (11.687). A total of 159.037 acres of the park and 35.254 acres of non-park lands were surveyed in 2010.

Introduction

The 2010 season is the tenth year in which invasive plants have been inventoried and the seventh year in which the Alaska Exotic Plant Management Team (EPMT) has conducted eradication efforts of invasive plants in Denali National Park and Preserve (DENA). Through documentation made via Global Positioning System (GPS) mapping, manual removal, educational outreach, and native seed collection for re-vegetation projects, the DENA EPMT continues to monitor, inventory, and eliminate invasive weeds and promote the preservation of native species within the park.

The constant arrival of visitors and goods into the park provides continued opportunities for the introduction of new invasive species into DENA. Invasive plant seeds enter the park on vectors that may include vehicles, shoes, clothing and pets. In 2010, multiple construction projects in the park required heavy construction equipment that was delivered from the cities of Fairbanks and Anchorage. The arrival of these vehicles provided an additional opportunity for invasive plants to be introduced into the park. With this in mind, areas of human disturbance remain the focus of the efforts of the DENA EPMT.

The DENA EPMT prioritizes invasive plant control efforts in the park based upon a number of factors. One such factor is the overall ability of the DENA EPMT to effectively control a given population before the population has a chance to spread. The DENA EPMT emphasizes prevention and early detection for this reason. Areas most likely to have new invasives are repeatedly surveyed throughout the growing season. These areas are primarily within the area of the park between the George Parks Highway park entrance and the Denali Visitor Center (fig. 1). When detected early, hand pulling a new isolated infestation is more likely to prevent the spread and establishment of an invasive species. A larger, well established population is much more difficult to manage.

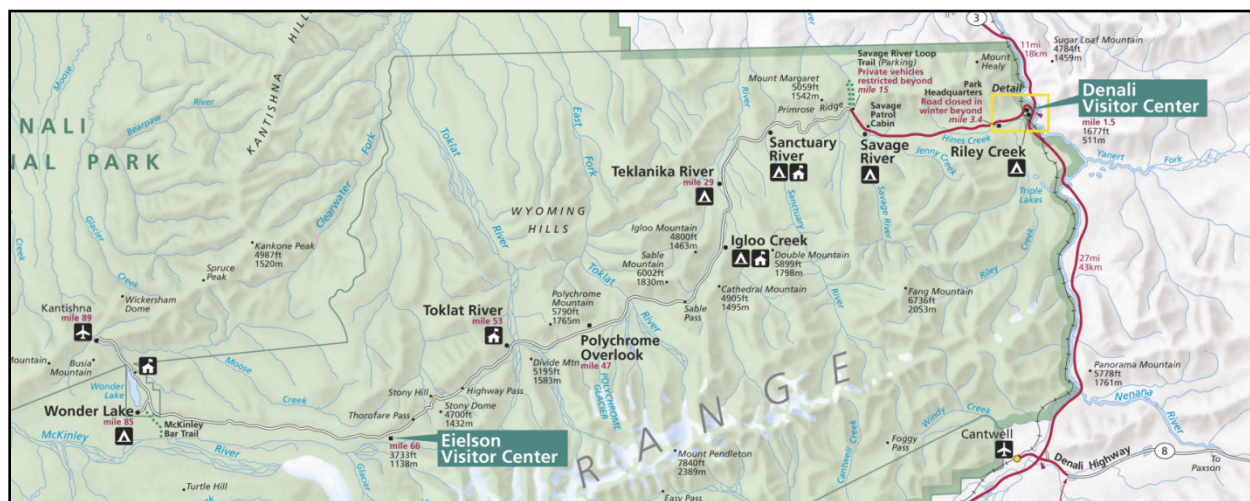


Figure 1. Map of the entrance area of Denali National Park.

Another factor that is considered when prioritizing control of invasive plants in DENA is the Alaska invasiveness ranking. The Alaska Natural Heritage Program (AKNHP) provides a ranked list of many invasive plants found in Alaska. Several factors are considered, and a

numerical value is assigned to create a relative ranking for each invasive plant considered. The species rankings range from 1 to 100, with 1 denoting the lowest potential impact and 100 indicating the highest potential impact on Alaska ecosystems.

Highlights of the 2010 Season

- Herbicide was applied to the area directly outside the fenced park sewage treatment lagoon to control a dense growth of narrowleaf hawksbeard (*Crepis tectorum*). At the beginning of the season scattered infestations of narrowleaf hawksbeard were hand pulled along the perimeter of the sewage lagoon and a former burn pile site.
- Control of narrowleaf hawksbeard was maintained throughout the summer with frequent “*Crepis* sweeps” to hand pull plants found along the Denali Park Road between the George Parks Highway and the railroad tracks. The two new infestations found (one in the bus concessionaire’s staff parking lot and the second in the adjacent bus parking lot) were mapped with GPS, monitored and treated frequently throughout the summer.
- Common dandelions (*Taraxacum officinale ssp. officinale*) were mapped with GPS and removed along the Denali Park Road between the park entrance and the Kantishna Airstrip.
- Inventory, monitoring, and control of yellow toadflax (*Linaria vulgaris*), sweetclover (*Melilotus spp.*), bird vetch (*Vicia cracca*), foxtail barley (*Hordeum jubatum*), scentless false mayweed (*Tripleurospermum perforata*), and other invasive weeds were performed throughout the front country of the park.
- Seeds of wheatgrass (*Agropyron spp.*), Eskimo potato (*Hedysarum alpinum*), downy ryegrass (*Elymus innovatus*) and locoweed (*Oxytropis campestris*) were collected for revegetation projects within the park. The seed sources were mapped with GPS.
- Several revegetation projects were completed at the end of the season including: the Teklanika Rest Area, the west side of the Denali Park Road at mile 4, several areas near the Denali Visitor Center, and the completed portion of the sewage lagoon project on the east side of the George Parks Highway at mile 237.25. Areas of revegetation were mapped with GPS.

Methods

Manual control of invasive plants is achieved with hand tools such as dandelion diggers or shovels or simply by hand-pulling. These methods can be as easy as a tug on the stem of a narrowleaf hawksbeard or as tedious and time consuming as when digging up the intricate root system of bird vetch. Invasive plants are placed in green plastic bags after removal. After the bags are weighed, the date, species and location pulled are recorded. Finally, the bags are then sealed and destroyed by burning. The primary disadvantage to the use of manual control is the amount of time and effort required to achieve results.

The 2010 field season saw an increase in Alaska EPMT funding through the American Recovery and Reinvestment Act (ARRA). This resulted in an increase in staffing at DENA and allowed the DENA EPMT to work on more projects than in previous years. Two Student Conservation Association (SCA) interns were stationed at the park throughout the 2010 summer and three Southeast Alaska Guidance Association (SAGA) crews worked in the park for a total of eight weeks.

A state certified pesticide applicator used a backpack sprayer to apply the herbicide Milestone® VM around the sewage lagoon. Permission to apply this herbicide was obtained from the Regional Integrated Pest Management Coordinator. The use of Tyvek® suits, nylon gloves, and safety eyewear were employed while the product was being applied. DENA EPMT staff, certified by the state, applied the herbicide at the manufacturer's recommended rate of five fluid ounces per acre. Warning signs were posted in the area of treatment prior to application and remained posted for a period of 48 hours after application (fig. 2).



Figure 2. DENA EPMT staff member Canyon Evans in front of a chemical application warning sign.

Seeds from downy ryegrass, wheatgrass, locoweed, and Eskimo potato were collected in 2010. Seeds from these species were collected by hand and placed in species-specific paper bags. Larger seeds were then placed on metal screens to dry at ambient room temperature and humidity. A layer of muslin was placed between smaller seeds and drying screens to prevent small seeds from being lost. Once dry, the seeds were placed in plastic freezer bags. Bags were labeled with the species name, the date collected and the location collected. It is necessary to record the collection area of the seeds as DENA revegetation policy specifies that seeds cannot be planted more than 20 miles from their point of collection to maintain the genetic integrity of the plants. Finally, bags of dry seeds were added to the seed bank inventory in long-term cold storage. All seed collections, except Eskimo potato, required cleaning and processing at the Alaska Plant Materials Center (AKPMC) in Palmer, Alaska. Due to the high cost of seed

treatment at AKPMC, DENA EPMT staff cleaned many of the seeds collected this year with the help of a SAGA crew. Stored seeds will be used for future revegetation projects within DENA.

The DENA EPMT hosted three separate SAGA AmeriCorps groups from in 2010. The first SAGA crew assisted the DENA EPMT with the removal of 2,437 pounds of invasive plants (fig. 3). Later in the summer season, the second SAGA crew assisted the DENA EPMT by collecting seeds of native grasses and wildflowers for the DENA EPMT restoration seed bank. A total of 79 pounds of seeds were collected for future revegetation projects. The third SAGA crew helped the DENA EPMT by planting native seeds in several areas that were disturbed by construction equipment. The DENA EPMT is grateful for the assistance of the SAGA crews.



Figure 3. The DENA EPMT and a SAGA crew at Reflection Pond during the Wonder Lake Dandelion-DeVeg Week.

Results

Overview

During the 2010 season, DENA EPMT staff surveyed over 194 species acres for invasive plants. 174 species acres were free of invasives. 19.382 species acres were infested with invasive plants. Of those 19.382 acres, 16.711 species acres were treated. Most invasive plants are located along Denali Park Road or in the developed areas.

Table 1. Summary of Denali National Park & Preserve Exotic Plant Management.

Year	EPMT Personnel		Work Crews		Total Person Field Hours	Invasive GPS Data NPS Lands(non-NPS lands)		
	# pers.	Field Hours	# pers.	Field hours		Species Acres Surveyed	Species Acres Infested*	Acres Treated
2004	1	39	1	25	64	2.553 (6.557)	0.934 (6.557)	0.450 (0.035)
2005	1	224	8	544	768	16.713 (2.321)	12.877 (1.531)	3.261 (0.186)
2006	1	454	8	679	1,133	750.313 ¹ (2.958)	16.866 (0.349)	10.211 (0.121)
2007	2 ²	743	16	1,173	1,916	805.951 ¹ (7.826)	11.329 (0.301)	8.368 (0.289)
2008	2 ²	626	10	454	1,080	741.687 ¹ (11.982)	12.750 (7.968)	11.051 (0.649)
2009	2 ²	571	5	385	956	749.459 ¹ (4.210)	20.437 (0.317)	11.370 (0.317)
2010	3 ³	1,893	16	2,560	4,453	159.034 (35.245)	16.766 (2.616)	14.125 (2.586)

* Acres infested is calculated by acres mapped multiplied by the percent cover in areas greater than 0.5 acres. If under 0.5 acres, acreage mapped is counted as 100% cover.

1-This acreage includes the actual road surface of the Denali Park Road.

2-Includes one SCA intern

3-Includes two SCA interns

Narrowleaf hawksbeard (*Crepis tectorum*)

Narrowleaf hawksbeard is an annual plant that is distinguished by a basal rosette, narrow leaves on a thin stem, and small yellow flowers that are similar to those produced by dandelions (AKEPIC 2005). A single plant is capable of producing over 49,000 seeds (Royer and Dickinson 1999). The invasiveness ranking for narrowleaf hawksbeard is 54 although this ranking is being revisited in the next round of Alaska ranking due to numerous requests from around the state (Carlson et al. 2008). The species is easily hand-pulled because of its shallow roots. Frequent monitoring is necessary to retreat the new sprouts.



Figure 4. Narrowleaf hawksbeard infestation at the sewage lagoon.

The main infestation of narrowleaf hawksbeard in DENA is growing in and around the park's sewage lagoon (fig. 4). This infestation was first mapped in 2004 (Bauder 2004). Annual hand pulling treatments were conducted for five years with little impact on the overall size or density of the infestation. In 2009, the DENA EPMT applied the herbicide Milestone® VM within the fenced area of the facility. On May 27, 2010, DENA EPMT staff spot sprayed outside the fenced area with the same herbicide (fig. 5). On that date, there were no narrowleaf hawksbeard plants found within the fenced area. Product instructions direct that spraying should be conducted two

weeks before disturbing treated soils. The wastewater treatment facility and collection system was scheduled for rehabilitation to conform to Alaska U.S. Environmental Protection Agency wastewater disposal regulations. The herbicide application was performed two weeks prior to the scheduled beginning of the 2010 construction project.

On August 6, 2010, a follow up survey of the sewage lagoon construction site was completed. This survey located narrowleaf hawksbeard inside the fenced area. This infestation was hand pulled with the assistance of a SAGA crew. DENA EPMT staff and a SAGA crew spent 9.5 hours retreating the area.

Infestations of narrowleaf hawksbeard that had been previously mapped were revisited and hand pulled in numerous areas around the park entrance. Weekly monitoring was conducted to pull the more easily detected flowering plants. Two new infestations were found in 2010 in the bus driver parking area and adjacent bus parking lot.



Figure 5. Herbicide application in DENA.

Narrowleaf hawkweed (*Hieracium umbellatum*)



Figure 6. Narrowleaf hawkweed.

Narrowleaf hawkweed is similar in name and look to narrowleaf hawksbeard (fig. 6). Narrowleaf hawkweed can be distinguished from narrowleaf hawksbeard by the lack of a basal rosette, the presence of a thick woody stem and a tendency to produce larger yellow flowers (AKEPIC 2005). The invasiveness ranking is 46 (Carlson et al. 2008). This species is noticeably harder to pull than narrowleaf hawksbeard and may require the use of a digging tool to remove. Narrowleaf hawkweed was mapped in 2009 on mile 231.75 of the Parks Highway and was retreated this year.

Foxtail barley (*Hordeum jubatum*)

Foxtail barley is a grass that is easily distinguished by pale green to reddish wispy spikes (fig. 7). The sharp awns surrounding the seeds can irritate the gums, throat and digestive tract and may be a possible cause of infection when ingested by wildlife and domestic animals (AKEPIC 2005). Foxtail barley is easily hand-pulled because the plant has shallow roots. The DENA EPMT has consulted with both former EPMT liaison Jeff Heys and DENA plant biologist Carl Roland regarding the noticeable spread of this species within DENA. Foxtail barley was targeted for treatment this year because it is rapidly spreading in the front country of the park. SAGA crews assisted the DENA EPMT by pulling 1,275 pounds of the species in 2010.



Figure 7. Foxtail barley.

Yellow toadflax (*Linaria vulgaris*)



Figure 8. Yellow toadflax.

Yellow toadflax can be distinguished by the clusters of yellow and orange snapdragon-like flowers and narrow pale green leaves (fig. 8). The invasiveness ranking of this species is 69 (Carlson et al. 2008). A hand tool is required to remove the root structure as the species has an extensive system of creeping rhizomes that is difficult to remove. In 2010, only a single infestation of toadflax was documented within the park on the railroad tracks north of the Alaska Railroad Depot. This infestation was retreated and remapped with GPS. A former infestation located where the Triple Lakes Trail crosses the railroad tracks was revisited in 2010 and no toadflax was found.

White & yellow sweetclover (*Melilotus alba*, *M. officinalis*)

White and yellow sweetclover are tall biennial forbs with a distinctive three-leaved leaf pattern and many tall showy floral spikes. White sweetclover has white flowers; yellow sweetclover yellow flowers (fig. 9). The invasiveness rankings of white and yellow sweetclovers are 81 and 65 respectively (Carlson et al. 2008). Each white sweetclover plant can produce up to 350,000 seeds; these seeds have been found to remain viable in the soil for up to 81 years (Klemow and Raynal 1981, Royer and Dickinson 1999). Smaller sweetclover plants are easily hand-pulled, while larger plants may require hand tools to remove. Sweetclover was primarily observed around the DENA Alaska Railroad Depot, along the George Parks Highway, and in Glitter Gulch. Several isolated infestations were found by the Rock Creek Bridge, on the C-Camp propane field, and along the Denali Park Road between the Alaska Railroad Depot and the Wilderness Access Center. A new infestation of yellow sweetclover was discovered in the bus driver parking lot in 2010.



Figure 9. White and yellow sweetclover.

Common dandelion (*Taraxacum officinale* ssp. *officinale*)



Figure 10. Common dandelion.

Common dandelion has deeply toothed, light green leaves and bracts that fold downward toward the soil unlike the native rock dandelion (*T. ceratophorum*), which has more deeply divided and darker green leaves and upright bracts. The invasiveness ranking of common dandelion is 58 (Carlson et al. 2008). Hand-pulling is most effective for this species if all the plant's root is removed (fig. 10). DENA EPMT staff and a SAGA crew removed 570 pounds of dandelions in 2010; this was an increase of 345 pounds over the 2009 season. The majority of dandelions were removed from the park entrance area, mainly along the sides of the road on the first two miles of the Denali Park Road. Additionally, DENA EPMT staff and a SAGA crew spent three days in June, at Wonder Lake Campground, targeting the

invasive dandelions at the Kantishna Airstrip and between miles 85 and 92 of the Denali Park Road. DENA EPMT staff refer to this annual task as the west end Dandelion DeVeg project, a week targeting the removal of the invasive dandelion.

Invasive clovers (*Trifolium repens*, *T. hybridum*, *T. pratense*)

All three of these species have palmately compound leaves with three leaflets. Alsike and red clovers (*Trifolium hybridum* and *T. pratense*) have white to red-colored flowers that are supported on erect stems that do not root at the nodes. White clover (*Trifolium repens*) has a creeping habit and roots at the nodes (fig. 11) (AKEPIC 2005). The Alaska invasiveness ranking of these three species range from between 53 and 59 (Carlson et al. 2008). White clover and alsike clover are abundant in the park headquarters and Alaska Railroad Depot areas. Only one patch of clover was removed in 2010, an infestation of white clover located on the Denali Park Road at the entrance to the bus barn.

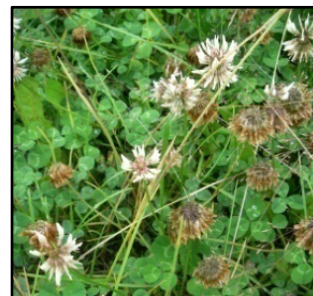


Figure 11. White clover.

Scentless false mayweed (*Tripleurospermum perforata*)



Figure 12. Scentless false mayweed.

Scentless false mayweed has distinctive narrow, branched, threadlike leaves that are alternately arranged on the stem (AKEPIC 2005). The plant also produces a daisy-like floral head (fig. 12). The invasiveness rank of this plant is 54 (Carlson et al. 2008). A scentless false mayweed seed may remain viable in the soil for 15 years (Alberta Agriculture and Food 2007). Scentless false mayweed was found at one location along the railroad tracks south of the Alaska Railroad Depot. DENA EPMT staff removed a total of 5 pounds of this plant in 2010. This is a change from 20 pounds pulled in 2009.

Bird vetch (*Vicia cracca*)

Bird vetch is a weak-stemmed vine with climbing tendencies. It uses tendrils to coil and grasp onto other structures such as other plants for support (AKEPIC 2005). The plant's bluish-purple flowers appear on a one-sided floral spike (fig. 13). The invasiveness ranking of bird vetch is 73 (Carlson et al. 2008). It is time consuming and tedious to dig up bird vetch and untangle the rhizomatous root system using a hand tool. DENA EPMT staff revisited numerous sites this season to inventory and retreat bird vetch, resulting in the removal of nineteen pounds of the invasive plant. Sites that had received control efforts in previous years were revisited and controlled including infestations adjacent to the power plant, on the Denali Park Road between the Wilderness Access Center and the railroad tracks, at the northeast end of the McKinley National Park Airstrip (INR) near the park entrance, at the McKinley Chalet entrance, at mile 231.75 of the George



Figure 13. Bird vetch.



Figure 14. Bird vetch infestation sites in the DENA entrance area.

Parks Highway, and across from the Riley Creek Mercantile bus stop. No plants were found at four formerly infested sites located at the Alaska Railroad Depot on the northwest side of the tracks, along the south side of the Denali Park Road west of the Wilderness Access Center, on the McKinley Chalet grounds and, for a second year in a row, at the C-Camp propane field. These sites were mapped accordingly. Three new infestations of bird vetch were discovered and hand pulled in the park entrance area: on a mound of dirt behind the McKinley Village office building, at the corner of the field across from the power house, and at a second location at the INR. Figure 14 illustrates the locations of the bird vetch infestations in DENA.

Several other invasive plant species were monitored and controlled in DENA in 2010. These efforts are summarized below in Table 2.

Table 2. 2010 invasive plant monitoring and control efforts.

Species		AKEPIC Rank	Location*	Invasive GPS Data	
Latin Name	Common Name			Acres Infested ¹	Acres Treated
<i>Crepis tectorum</i>	Narrowleaf hawksbeard	54	F, PH, PK, TD	5.685	5.501
<i>Hieracium umbellatum</i>	Narrowleaf hawkweed	51	PH	0.089	0.089
<i>Hordeum jubatum</i>	Foxtail barley	63	F, PH, PK, TD	4.076	3.508
<i>Lappula squarrosa</i>	Bluebur, sticky sox	44	F	0.001	0.001
<i>Linaria vulgaris</i>	Yellow toadflax	69	TD	0.044	0.044
<i>Matricaria discoidea</i>	Pineapple weed	32	F	0.003	0.003
<i>Melilotus alba</i>	White sweetclover	81	F, PH, PK, TD	2.868	2.830
<i>Melilotus officinalis</i>	Yellow sweetclover	69	F, PH	0.002	0.002
<i>Plantago major</i>	Common plantain	44	F	0.252	0
<i>Taraxacum officinale ssp. officinale</i>	Common dandelion	58	F, PH, PK, TD	5.892	4.562
<i>Trifolium spp.</i>	Alsike, red and white clover	57/53/59	F	0.293	0.001
<i>Tripleurospermum perforata</i>	Scentless false mayweed	48	PH, TD	0.015	0.015
<i>Vicia cracca</i>	Bird vetch	73	F, PK, PH	0.079	0.076

* F = front country, PH = George Parks Highway (AK Route 3), PK = park road, and TD = train depot.

¹ Acres infested is calculated by acres mapped multiplied by the percent cover in areas greater than 0.5 acres. If under 0.5 acres, acreage mapped is counted as 100% cover.

Discussion

Annual hand pulling treatments of narrowleaf hawksbeard in the park sewage lagoon area have been conducted annually since 2004 with little impact on the overall size or density of the infestation (Bauder 2004, Acosta 2005, Wilson 2006, Aguirre 2007, Weidman 2008, Byrne 2009). In 2009, the DENA EPMT received approval to apply the herbicide Milestone VM within the fenced area of the facility (Byrne 2009). In May 2010, DENA EPMT staff spot sprayed outside the fenced area with the same herbicide. The area that was sprayed in 2009 had much less narrowleaf hawksbeard and was retreated in early August of this year by manual hand pulling in 9.5 person-hours. Although the herbicide treatment was effective, DENA EPMT staff must continue to monitor the sewage lagoon area. The wastewater treatment facility rehabilitation project was not completed this season as expected but will continue in 2011. The DENA EPMT will continue to survey the chemically treated soil that was then disturbed by construction. The goal of the repeated spot spraying was to prevent further seed dispersal during and after the construction process. The DENA EPMT will consider applying herbicides again if control of this infestation of narrowleaf hawksbeard cannot be maintained by manually treating any resprouts.

Major construction projects inside the park in 2010 included the Teklanika Rest Area improvements, the construction of a new emergency services and law enforcement building adjacent to the park seasonal housing complex, and the wastewater treatment facility rehabilitation. Per contract specifications, all work within the park involving the use of heavy equipment from outside the park boundaries is required to undergo vehicle inspections. Construction companies bringing heavy equipment vehicles within the park boundaries were required to have all vehicles pressure washed and inspected to limit the spread of invasive plants. As requested, DENA EPMT staff performed these inspections.

DENA EPMT was also asked to inspect four gravel pits for the presence of invasive weeds in the town of Healy, ten miles north of DENA. The purpose of these inspections was to avoid bringing mineral materials into the park that could have been contaminated with invasive species seeds or propagules. Two of the gravel pits failed inspection because of the presence of white sweetclover and narrowleaf hawksbeard infestations in or on the edge of the gravel pits. The gravel pit owners were asked to pull these invasive weeds and allow these sites to be re-inspected prior to the movement of fill materials from these locations into DENA. DENA EPMT staff will need to continue these inspections next year, as several of the construction projects will continue into 2011. See Appendix 1 for the DENA Invasive Plant Policy and more information on the park inspection program.

Because an individual sweetclover plant may produce hundreds of thousands of seeds that can remain viable in the soil for decades (Klemow and Raynal 1981, Royer and Dickinson 1999), it is important that the DENA EPMT remain vigilant to prevent the spread of this plant into the park, as prevention is more efficient than trying to eliminate this species once it has become established. There are several isolated infestations of sweetclover within the first three miles of the Denali Park Road. The majority of the sweetclover infestations near DENA are located outside the park entrance on the George Parks Highway, north of Glitter Gulch (mile 239) to 5 miles south of McKinley Village (mile 226).

Education & Outreach

The Murie Science and Learning Center (MSLC) offers year-round educational exhibits, speakers, seminars, and classes for the public. The MSLC includes a display where park visitors can find information about invasive plants and weed issues including the booklet, “Selected Invasive Plants of Alaska, 2007,” that highlights some of Alaska’s urgent problem species and the “Weeds Gone Wild” and “What the heck is an invasive plant?” brochures.

The bus drivers of the park are an essential part of the early detection of invasive plants along the Denali Park Road. Observant drivers have emailed and called DENA EPMT staff with information about invasive species in the park. This season, the DENA EPMT staff designed and posted a flyer in the bus dispatch building informing the bus drivers about the presence of narrowleaf hawksbeard in the driver’s parking lot. This outreach paid off when the DENA EPMT staff were informed of several new infestations of narrowleaf hawksbeard discovered by bus drivers. When DENA EPMT staff members were observed pulling dandelions on the side of the Denali Park Road during the Dandelion DeVeg Week many drivers chose to tell passengers about invasive plant control efforts in DENA. The Dandelion DeVeg is an annual project. DENA EPMT and volunteers or a SAGA crew target the removal of the invasive dandelion from the park. One week is spent at the east end of the park and a second at the west end of the Denali Park Road.

DENA EPMT staff members wear orange and yellow safety vests while performing control work on or near the park’s roads. The bright vests attract curious visitors who often inquire about what staff members are doing. This allows an excellent opportunity to educate park visitors about invasive plants in DENA. When discussing invasive plants with park visitors DENA EPMT staff members found it useful to ask the visitors about invasive plants from their home areas to better communicate the invasive species issues facing Alaska.

These outreach and education methods were used together to connect with a broad range of park visitors. By providing these learning opportunities, meaningful connections were made with those contacted, hopefully paving the way for a new awareness about invasive species in DENA.

Issues

During the 2010 season, staff from the DENA EPMT and the head of the DENA engineering department inspected heavy construction equipment that was contracted from the neighboring communities of Fairbanks, Healy and Anchorage. The goal of these inspections was to prevent the introduction and reduce the spread of invasive plants into and within the park.

The DENA EPMT suggests that the existing program of vehicle inspections be expanded to the concessionaire businesses operating inside the park, the Alaska Railroad, visitors with special permits, vehicles traveling to the Teklanika campground and to bicycles entering the park. This could begin as a voluntary program and would at least increase awareness of the issues of invasive plants in DENA and Alaska.

Future Goals

- Continue to inventory and control narrowleaf hawksbeard and other invasive plants in the sewage lagoon area until the wastewater treatment facility and collection system rehabilitation project is completed.
- Plant and label displays of native plants in the Teklanika Rest Area flower boxes.
- Continue to monitor and control the infestations of foxtail barley, common dandelion, narrowleaf hawksbeard, sweetclover, bird vetch, and other invasive species in the front country of the park.
- Continue to collect seeds for future revegetation projects.
- Continue to manage areas of disturbance and high human traffic for possible new invasive populations.
- Revegetate disturbed areas created by current construction activities when the construction is complete. These areas include the emergency services and law enforcement building, C-Camp utility upgrades and the wastewater treatment facility upgrades.

Literature Cited

- Acosta, L. L. 2005. Exotic plant management at Denali National Park and Preserve summer 2005 field season report. National Park Service Unpublished Report, Anchorage, Alaska.
- Aguirre, R., and W. Mahovlic. 2007. Exotic plant management Denali National Park and Preserve 2007 field season report. National Park Service Unpublished Report, Anchorage, Alaska.
- Alaska Exotic Plant Information Clearinghouse (AKEPIC). 2005. Invasive Plants of Alaska. Alaska Association of Conservation Districts Publication. Anchorage, Alaska.
- Alberta Agriculture and Food. 2007. Scentless chamomile: Biology and control. Agri-facts: practical information for Alberta's agriculture industry. AGDEX 640-6. Available from [http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/agdex871/\\$file/640-6.pdf?OpenElement](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex871/$file/640-6.pdf?OpenElement) (accessed 4 October 2010).
- Bauder, P. 2004. Denali National Park and Preserve 2004 exotic plant report. National Park Service Unpublished Report, Anchorage, Alaska.
- Byrne, J., and W. Mahovlic. 2009. Exotic Plant Management Team Denali National Park and Preserve 2009 season report. National Park Service Unpublished Report, Anchorage, Alaska.
- Carlson, M. L., I. V. Lapina, M. Shephard, J. S. Conn, R. Densmore, P. Spencer, J. Heys, J. Riley, and J. Nielsen. 2008. Invasiveness Ranking System for Non-Native Plants of Alaska. USDA Forest Service, R10, R10-TP-143. 220 pp.
- Klemow, K.M. and D. J. Raynal. 1981. Population ecology of *Melilotus alba* in a limestone quarry. *Journal of Ecology* 76: 383-392.
- Royer, F. and R. Dickinson. 1999. Weeds of the Northern U.S. and Canada. The University of Alberta Press, Edmonton, AB, Canada.
- Weidman, K., and W. Mahovlic. 2008. Exotic plant management report Denali National Park summer 2008. National Park Service Unpublished Report, Anchorage, Alaska.
- Wilson, N. J., and W. Mahovlic. 2006. Denali National Park and Preserve exotic plant management 2006 report. National Park Service Unpublished Report, Anchorage, Alaska.

Appendix 1 - Invasive Plant Policy of Denali National Park

September 2008

TOPSOIL TRANSPORTATION

- Top priority – no invasive plants or seeds contained within the topsoil.
- Can transport topsoil from the west end of the park to the east end of the park as most invasives are at the east end. Not recommended to transport topsoil from the east end to the west end. There are exceptions to this as there are some invasive plants at the west end. An example is the horse corral in Kantishna. There are several invasive plants in that area that are not seen anywhere else in the park.
- No mileage limitation.
- Important to make sure that the surrounding area where the topsoil is taken from is free of invasive plants and seeds.
- Saving topsoil from the disturbed site to put back when the project needs it is a good policy – if feasible.

REVEGETATION OF DISTURBED LAND

- Disturbed land in the park must be revegetated with native species from within a 20 mile radius of where the disturbance is.
- Revegetation may occur with native tundra mats, native transplants, native seedlings, native cuttings, bioengineering techniques with native plants, and native seeds.
- Instructions on how to revegetate using the materials above are found in the “Native Plant Revegetation Manual for Denali National Park and Preserve” by Roseann V. Densmore.
- Revegetation with native species must occur to keep the ecosystem intact.
- One of the most important procedures before using any of the revegetation methods is scarifying the soil. Soil compaction is the cause for most of the unsuccessful revegetation projects (luckily, there aren’t many of those!!!!).
- Fertilizer is not used in the Front Country front country projects as it makes the invasives grow as much or more than the native plants or seeds.
- Fertilizer was used at the Primrose turn-around (mile 17) with no detrimental effects.
- After the native tundra mats or native plants are planted it is ESSENTIAL to water, water, water – especially if it is a dry summer.

- Saving tundra mats and transplants before the site is disturbed is good policy if they are free of invasive plants – if feasible. The tundra mats at Eielson were saved for three years on pallets and are doing marvelously after being transplanted in May and June of 2008.

SEED COLLECTION AND RANGE OF USE

- Collection of native plant seeds for revegetation concerns may occur within a 20 mile radius of the disturbed area - inside and outside of the park. This is to protect the genetic integrity of the plants.
- Seeds are collected, cleaned, and planted by hand thereby making them very precious.
- Seed needs for a project can take up to several seasons to collect, so prompt communication with the revegetation technician about any maintenance projects that need seeds is vital to the success of native seed planting. Joe D. informed the revegetation technician six years before the new Denali Visitor Center needed seeding. That was a sufficient amount of time to be able to collect all the seeds needed for such a large project.
- When planting the native seeds, annual rye is used in the mix. This provides almost instant greening of an area and helps diminish the possibilities of invasives taking hold. Native seeds can take up to three or four seasons to become established and invasives can invade in one season. Annual rye is also used to stabilize slopes.

EQUIPMENT INSPECTION FOR USE WITHIN THE PARK

- Construction companies that are going to be using their equipment within the park boundaries need to have it pressure washed and inspected before bringing it in the park. Hopefully, this will diminish the spread of invasive plants within the park. This includes species that have already taken hold in parts of the park (common dandelion) and others that have not arrived here but are in Anchorage and Fairbanks or the lower 48.
- When inspecting equipment, one looks in all the nooks and crannies of the rig, looking for clumps of dirt, mud, or gravel that might be harboring invasive seeds which range in size from smaller than a pinhead to several inches. Inspecting the tires or treads is also very important as seeds can “hitch-hike” on the rubber or metal as well as the axils. The parts of the equipment that are closest to the ground are most likely the areas that will transport the invasive seeds, but the entire piece of equipment needs to be inspected.
- If the equipment does not meet the standards of the inspector, the piece must be taken to be pressure washed again and re-inspected.

GRAVEL AND BORROW PIT INSPECTIONS

- Any pit that is outside the park and is used to store or extract soil, gravel, or any other material to or from the park needs to be inspected. This is to insure that the equipment going to/from the pit stays invasive free (as it has already been inspected) and the material in the pit that is coming to the park is invasive free.
- When inspecting a pit, one looks for invasives not only in the pit, but on the road entering the pit and all areas surrounding it. If any invasives exist, it depends on the species of invasive as to what happens next. If the invasive is of the variety in which the seeds can stay viable for up to 80 years (such as *Melilotus alba* or *M. officinalis*), then the pit will fail inspection. If the seeds are not that variety, the invasives can be pulled by the inspector (if there are not that many) or the owner of the pit should pull them and the pit can be inspected again.