



Invasive and Exotic Plant Management in Denali National Park and Preserve

2012 Summary Report

Natural Resource Data Series NPS/DENA/NRDS—2013/426



ON THE COVER

A volunteer crew pulls dandelions by the Denali Power Plant
Photograph by: Henry Ring

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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.

This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data.

Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Abstract

We report the efforts of the Exotic Plant Management Team (EPMT) in Denali National Park and Preserve for the 2012 field season. There were no new invasive species discovered within the park boundaries in 2012, and the size of previously documented infestations was declining year-to-year, possibly due to extensive hand-pulling of these species during the last several years. The primary focus of our efforts this season was continuing treatment of exotic plant infestations near the Railroad Depot, along the length of the Park Road, the Kantishna airstrip, the McKinley Park airstrip, the Kantishna Horse Corral, near the Sewage Lagoon, and mile 231 – 239 Parks Highway. In addition, the Wilderness Access Center (WAC) and the Backcountry Information center (BIC) were surveyed for invasive plants and treated for the first time since their construction. This year, the EPMT staff and volunteer crews pulled 2075 pounds of invasive plants, accrued 1390 volunteer hours, treated 10.7 acres of the park for invasive species, and revegetated 1.95 acres of the park by planting native seeds. A single National Park Service (NPS) employee and a Student Conservation Association (SCA) intern comprised the Denali's field team in 2012, although two Southeast Alaska Guidance Association crews (SAGA), a Boy Scouts of America volunteer group and other individual volunteers did assist in revegetation and invasive species control efforts. While manual treatment was the primary method of control, this season saw the first use of herbicide treatment for bird vetch (*Vicia cracca*), and the first use of herbicide treatment outside of the sewage lagoon area. All revegetation and invasive species control areas were mapped using Trimble GeoXT 2008 units, for data correction and editing, we used Pathfinder Office and ArcGIS.

Introduction

We have controlled invasive plant populations in Denali National Park and Preserve (henceforth Denali) for 13 consecutive years, and this work has been done in coordination with the Exotic Plant Management team from the Regional Office for 9 years. While the park's six million acres remain largely pristine due to its isolated location and harsh climate, there are 28 invasive plant species within park boundaries and there are many more species in neighboring areas and transportation corridors that could, in time, make their way into one of America's most scenic and iconic parks.

The relatively pristine and intact environment that defines Denali's backcountry areas (re: the majority of the park's acreage) make it particularly difficult for invasive species to establish themselves in these difficult-to-access locations. Currently, the only known exotic plant infestations within the park occur in the frontcountry, generally in recently disturbed or other areas highly impacted by human activities where the native vegetation cover and/or soil layer has been removed.

Over the last decade, there has been a continuing rotation of construction and revegetation projects near the Denali Visitor's Center, the George Parks Highway Entrance, C-Camp seasonal housing, Park Headquarters and in general the entire frontcountry area on the east end of the park. In 2008, Denali EPMT staff attempted to mitigate the impact of these continuing construction projects by enacting soil and gravel inspections and construction vehicle cleaning standards. While those protocols have likely been effective in reducing invasive species entering the park, the already infested construction sites on the east end continue to be population centers for exotic plant species within the Park. Similarly, the Park Road corridor, the Railroad Depot, and the McKinley Park and Kantishna air strips merit monitoring and control efforts, as these sites are primary entry and travel points for park visitors. Keeping populations of exotic plants in these areas under control is crucial for reducing the establishment of new species in the park via human vectors.

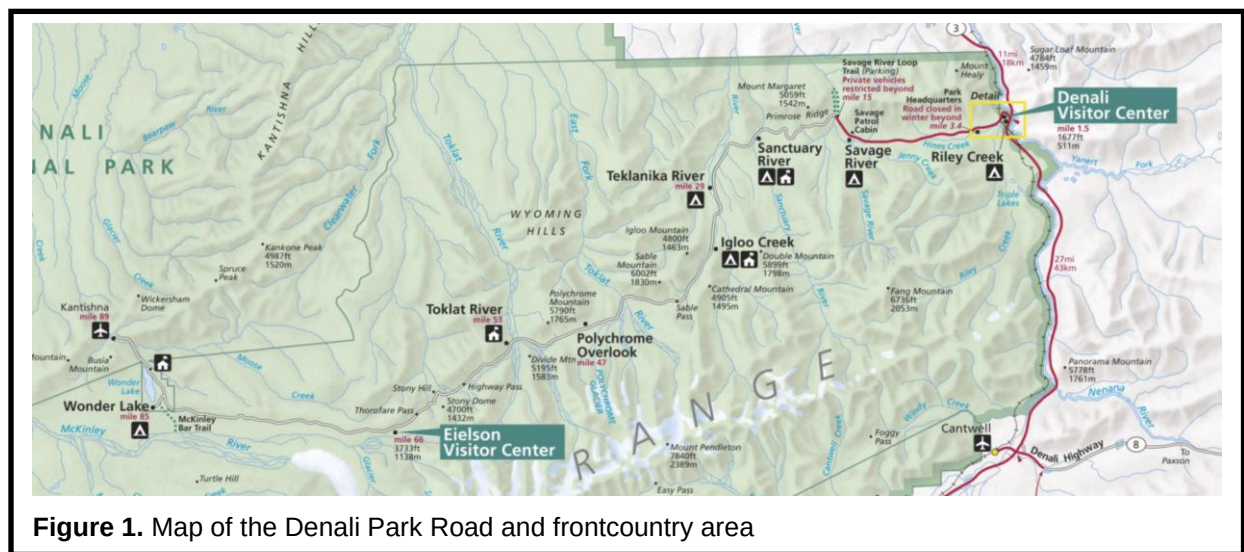


Figure 1. Map of the Denali Park Road and frontcountry area

Denali's revegetation technician and EPMT SCA intern have focused their efforts on control action against exotic species, including projects like the annual Dandelion Devegetation program and the Crepis Sweeps which maintain aggressive control of narrowleaf hawksbeard (*Crepis tectorum*) near the sewage lagoon.

The Denali EPMT also is responsible for assisting revegetation of disturbed sites, usually through the use of tundra mats and reseeding sites whose native vegetation has been removed, both of which have been vital in reclaiming disturbed areas with native vegetation before invasive species can establish themselves. On the east end of the Park the EPMT focused on the disturbed areas near the Kennels, continuing a major revegetation project from 2011. The Shaffer Building, newly constructed in 2011, the Concession Land Assessment (CLA) building which is still under construction, and the recently finished sewage pump station near the Murie Science and Learning Center were also of primary concern. The mile 80 – 84 Department of Transportation road widening project which was completed in 2011 is what the EPMT revegetated with native seeds on the west end of the Park.

Methods

Site Selection

Denali EPMT members carefully inventory, monitor, and treat infestations of exotic plant species within the park. The team follows the principle of Early Detection, Rapid Response in order to guide its use of volunteers and park resources to treat invasive plants in the most efficient manner possible. By monitoring past infestations and constantly mapping newly disturbed areas, the team's goal is to detect particularly aggressive invasive species when they first appear in the park and to treat them immediately before the plants can establish a self-perpetuating population, which makes eradication much more difficult. For larger established infestations of invasive plants that exhibit a less vigorous growth pattern the team concentrates on containment, rather than eradication. The EPMT staff has assigned the common dandelion (*Taraxacum officinale*) infestation in the Park to this containment status, because eradicating it completely would likely be impossible at this point in time due to its large range and population size.

The Early Detection, Rapid Response strategy is useful because of the small size of the EPMT staff in Denali's 6.2 million acres. Further, Denali has a relatively low number of exotic plant species and the population sizes of these species is also relatively low as compared to other parks in the National Park System, particularly in the continental U.S.. The Denali EPMT staff relies on the Alaska Natural Heritage Program's (AKNHP) invasiveness ranking scale to determine which invasive species deserve the highest priority in treatment plans. AKNHP's online database, the Alaska Exotic Plant Information Clearinghouse (AKEPIC) is our primary source of information for prioritizing infestations. AKNHP's scale, which varies from 1-100, rates invasive plants on their potential for impact on the Alaska ecosystem (Carlson et al 2008). This ranking system allows the EPMT staff to allocate our time efficiently, treating the worst infestations first and most vigorously and treating the less aggressive species as an important, but secondary concern. The Early Detection, Rapid Response strategy is also, in part, guided by the annual goals set by the Government Performance and Results Act (GPRA) as it applies to the National Park Service, promoting ever-greater efficiency in managing invasive plants.

Once a treatment plan is established for a season, the EPMT staff moves forward by inventorying and mapping all hotspot areas, which in this season included these frontcountry areas: the Power Plant, the Railroad Depot, the Park Road Corridor from the George Parks Highway entrance to Kantishna, the Wilderness Access Center and Backcountry Information Center campus, the Kennel Road, the Aramark Employee and Bus parking lots, the Jonesville Trail, and the Denali Visitors Center campus. Also included were these campgrounds and rest stops: the Sanctuary, Igloo, Teklanika, and Wonder Lake campgrounds; Toklat and Teklanika rest stops. Locations further West on the Park Road included: East Fork Cabin, Fannie Quigley's Cabin, Friday Creek Cabins, the West End Ranger Station, DalleMolleville, and the Kantishna Horse Corral. Historical exotic infestations along Mile 230 – 239 George Parks Highway were also inventoried, mapped and controlled. These areas were all previously infested, with the exception of the Wilderness Access Center and Backcountry Information Center, which had never before been surveyed, even though they are high-traffic frontcountry areas.

Mapping and Inventorying

We completed GPS mapping of infestations in 2012 by using the Trimble Geo XT 2008 model, with differential correction and data editing done through Pathfinder Office. All data files were gathered, edited and stored according to the Alaska EPMT Field 2012 Protocol (Million and Rapp, 2012).

In some cases, large infestations of weeds were inventoried without treatment as they were ranked lower on the AKNHP invasiveness scale and would require too many work hours to fully treat. Dandelions and invasive clovers (*Trifolium repens*, *T. pratense*, *T. hybridum*) were the weeds that were most commonly excluded from treatment for this reason.

Manual Treatment

Once the infestations were mapped, Denali EPMT staff manually treated them by hand-pulling weeds or using trowels, spades, or dandelion digger tools. Manual treatment tends to be the most effective method for treating invasive plants within the park, as it allows for the removal of taproots, rhizomatous root structures, and flowering plants from an area, severely limiting treated plants' capacity to return in following years. Pulled weeds were collected in clearly-marked reinforced plastic bags and set aside to be burned this winter by fire crews. Control teams varied in size depending on available volunteers, including two different sets of eight-person SAGA volunteers and a Boy Scouts of America volunteer crew of six.



Figure 2. A SAGA crew manually treats dandelions along the Park Road

The main control efforts for this season were focused on two large-scale projects. The largest project that the Denali EPMT crew tackled was the annual Dandelion Devegetation program, focused on eliminating dandelions from the unpaved portion of the Park Road between the Savage River Box and Kantishna. This 77 mile stretch of dirt road is largely clear of dandelions, except along miles 15-17, campgrounds along the road, and the larger Wonder Lake area at the west end of the road. The other major Denali EPMT project this season has been the growing narrowleaf hawksbeard infestation that has escaped the

sewage lagoon and is working its way up both sides of the Park Road towards the Denali Visitor Center campus. When this plant began blooming in late June, the park's EPMT crew began weekly sweeps along this stretch of road, pulling all visible weeds with each sweep. These sweeps continued throughout the summer.

Chemical Treatment

While manual treatment is the preferred method of treatment in Denali due to its low impact on the environment and small footprint, manual treatment is also labor intensive, and occasionally ineffective against more vigorous species. To that end, the revegetation technician began the first round of chemical treatment outside the Sewage Lagoon area this year. In 2009, Denali EPMT

and the revegetation technician sprayed herbicide on the narrowleaf hawksbeard population inside the fence at the Sewage Lagoon as it wasn't responding to 5 years of hand-pulling manual treatment (Byrne and Mahovlic, 2009). The proper permission was granted in 2010 to spray herbicide outside of the Sewage Lagoon fence for the remaining narrowleaf hawksbeard population before the start of the Waste Water Treatment Plant construction project.

Before the start of the 2012 field season, in order to proceed with chemical treatment according to policy and guidelines in place within the Alaska Region of the N.P.S., the revegetation technician obtained state pesticide certification and approval from the Regional Integrated Pest Management Coordinator, the Park Supervisor and the Park Superintendent for specific treatment of, five small infestations of bird vetch (*V. cracca*) in the frontcountry. The technician used Milestone® VM herbicide, following the manufacturer's recommended application rate of five ounces per acre and wearing all necessary Personal Protective Equipment. The actual total area treated was approximately 0.1 acre, and warning signs were posted in treatment areas 24 hours prior to application and remained posted for 48 hours afterwards. In addition to the bird vetch, the technician also treated a small patch of invasive clover (*Trifolium repens*) near the Power Plant as a general test to determine if chemical treatment of larger patches might be effective in the following season.

Results

Overview

In the 2012 season, the Denali EPMT staff inventoried 61.872 acres of the park. 19.108 acres were infested with invasive species and of those infested acres, 10.5 species acres were treated (Table 1). The majority of Denali's infestations occur in the frontcountry.

Year	EPMT Personnel		Volunteer 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)
2011	3 ⁴	764	3	143	907	290.592 (23.395)	29.348 (7.228)	10.290 (2.010)
2012	2 ²	478	35	912	1390	61.872 (6.397)	19.108 (2.366)	10.519

* 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

4-Includes one SCA intern and one international SCA intern

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

Dandelion Devegetation

The common dandelion, *Taraxacum officinale* is probably the parks most widespread and abundant exotic plant species, with populations spread across much of Denali's frontcountry (Park Road mile 0-15). The common dandelion is easily recognizable to visitors, and because of its taproot, requires a dandelion digger or other hand tool and a fair amount of time and energy to remove each individual plant. While the proliferation of dandelions along the paved portion of the Park Road is monumental and beyond the EPMT staff's ability to effectively treat at this point, the gravel portion of the Park Road (beginning at mile 15) is still relatively clear from dandelions. Controlling and reclaiming this gravel portion of the Park Road is the main aim of the Dandelion Devegetation project (Dandelion Deveg), which began in 1999.

The Dandelion Deveg is an on-going annual control project broken into two week-long control efforts, one centered around the east end of the park from the Savage River Entry Box to the East Fork Cabin (mile 15-44), and the other centered around the Wonder Lake area, ranging from the west end of the Park Road to the beginning of the Eielson Bluffs (mile 76-91). Between these two more aggressively infested stretches of road, dandelion cover on the side of the road is almost nonexistent and is spot-treated as crew members drive the road.

The mainstays of the Dandelion Deveg project are the volunteers that assist the EPMT staff during these control efforts. For each end of the control effort, dozens of miles of the Park Road are walked and mapped, and all dandelions are manually treated using spades, trowels, and dandelion diggers. This is a labor-intensive effort that would be impossible for the EPMT staff to handle alone especially over so large an area. Luckily, for the east end Dandelion Deveg effort from June 11th to 15th, an eight person SAGA crew contributed nearly 320 person-hours of labor and pulled 420 pounds of dandelions. On the west end, a single very dedicated volunteer was able to assist the SCA intern and the revegetation technician, contributing 40 work-person hours from June 18th to 22nd. The west end group pulled a total of 120 pounds of dandelions.



Figure 3. The SAGA crew pulling weeds for the east end Dandelion Deveg

The Dandelion Deveg project is a worthwhile effort for two primary reasons: 1) it is important for controlling the common dandelion and reducing the probability that this species spreads further within the Park; and 2) it allows for a careful inventory along the length of the Park Road corridor for other invasive species.

Crepis sweeps

Narrowleaf hawksbeard presents a unique challenge for manual treatment, as the plant's stalk is quite thin and difficult to see until it flowers. As such, it is often necessary to revisit an infestation multiple times within a season to catch the plants as they flower, treating the entirety of the infestation. This year treatment began on June 26th.

In 2006 the Denali EPMT staff began their first annual control effort for narrowleaf hawksbeard along the Park Road near the Sewage Lagoon, revisiting the site once a week from when the first flowering plants were spotted until the end of the season. This project, continuing through this year, is known informally as the Crepis Sweep and covers both sides of the Park Road from the Sewage Lagoon to the Wilderness Access Center, including the first few hundred yards of the Bike Path and the large field between the Park Road and the Riley Creek Campground road. Unfortunately, over the years, as the narrowleaf hawksbeard has spread outwards, the Aramark Bus and Employee Parking Lots and the Power Station Dirt Mound have also been added to this sweep, as well as more sporadic visits to the Railroad Depot.

Unlike the common dandelion, narrowleaf hawksbeard has a very small root system, is easy to hand-pull without tools, and is still at a relatively manageable size in the frontcountry. The weekly Crepis Sweep project is important to keeping this invasive at bay and out of the backcountry, and should be adjusted to include all new construction sites within the park.

Species Specific Accomplishments

This season, the Denali EPMT staff treated 15 species in the park. Table 2, below, provides a brief overview of each species, its invasiveness ranking and location, the acres inventoried, and acres treated.

Latin Name	Common Name	AKEPIC Rank	Location*	Acres Infested	Acres Treated
<i>Chenopodium album</i>	Lambsquarters	37	F,HC,PH,PK,TD	0.528	0.416
<i>Crepis tectorum</i>	Narrowleaf hawksbeard	56	F, HC, PH, PK, TD	5.367	4.513
<i>Galeopsis bifida</i>	Splitlip hempnettle	50	HC	0.0008	0.0008
<i>Hieracium umbellatum</i>	Narrowleaf hawkweed	51	PH	0.136	0.136
<i>Hordeum jubatum</i>	Foxtail barley	63	F, PH, PK, TD	2.49	2.425
<i>Linaria vulgaris</i>	Yellow toadflax	69	TD	0.012	0.012
<i>Matricaria discoidea</i>	Pineappleweed	32	F,HC,PH,P,K,TD	0.007	0.007
<i>Melilotus alba</i>	White sweetclover	81	F, PH, TD	0.239	0.239
<i>Melilotus officinalis</i>	Yellow sweetclover	69	PK	0.0002	0.0002
<i>Plantago major</i>	Common plantain	44	F, FQ, HC PK, PH, TD	1.321	0.002
<i>Silene noctiflora</i>	Night flowering silene	42	HC	0.0002	0.0002
<i>Taraxacum officinale ssp. Officinale</i>	Common dandelion	58	F, FQ, HC, PH, PK, TD	9.782	4.824
<i>Trifolium spp.</i>	Alsike, red and white clover	57, 53, 59	F,HC, PH, PK	0.623	0.07
<i>Tripleurospermum inodorum</i>	Scentless false mayweed	48	TD	0.017	0.017
<i>Vicia cracca</i>	Bird vetch	73	F, FQ, PH, PK, TD	0.016	0.013

* F = front country, FQ=Fannie Quigley's Cabin, HC=Kantishna horse corral, 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.

Table 2. Species specific monitoring and treatment throughout the season

Narrowleaf hawksbeard (Crepis tectorum)

Narrowleaf hawksbeard is a high priority exotic species for control and management in Denali. Narrowleaf hawksbeard is spreading out from its point of origination in the park, the sewage lagoon. We believe that the plant came into the park during a construction project in that area, when a load of infested gravel was introduced to the disturbed soil near the construction site. The infestation was first mapped in 2004 (Bauder, 2004) and increased slowly in size and density, responding minimally to manual treatment. This situation highlights the crucial importance of

ensuring that all gravel and topsoil used for construction in the park is weed-free. In this regard, an ounce of prevention is literally worth a ton of cure!



Figure 4. Narrowleaf hawksbeard

In 2009, the revegetation technician treated the sewage lagoon area with herbicide, and in 2010, the technician treated the area directly outside the fence bordering the sewage lagoon (Evans, 2010; Walter and Mahovlic, 2011). The infestation was greatly

diminished by chemical treatment. Late in the 2011 season, the sewage lagoon was subject to another large-scale construction project and, for this season, the only narrowleaf hawksbeard detected in the sewage lagoon area was relegated to an older section that had not been previously treated with herbicide. The revegetation technician advised that this area should be treated with herbicide next season. This infestation was the main reason that the gravel quarry and construction vehicle inspection policy was implemented in 2008. This policy in full appears in the Appendix section of this report.

Narrowleaf hawksbeard has also begun to edge up both sides of the Park Road, coating the area between the sewage lagoon, the Wilderness Access Center, and the Riley Creek Mercantile. The infestation continues to push up the Park Road towards the Denali Visitor Center campus, occupying approximately mile 0.4-0.8 of the Park Road and pushing westwards. Infestations have also been established on two different earthen mounds near the Power Plant, Railroad Depot, and in the Aramark Bus Parking Lot and Employee Parking Lot. Narrowleaf hawksbeard has also been seen in the Kantishna Horse Corral area. Additionally, a new small narrowleaf hawksbeard infestation has been spotted and treated in the Kennel Road revegetation area. To combat these infestations, the Denali EPMT staff has continued the weekly *Crepis* Sweeps mentioned above, mainly focusing on the Park Road areas.

At mile 237.25 on the west and east sides of the George Parks Highway, the revegetation technician discovered a new population of narrowleaf hawksbeard and hand-pulled this infestation. This infestation is along the outflow pipe on the edge of a large construction site that was completed in 2011 as an expansion of the leaching field for the park's waste water treatment plant. The narrowleaf hawksbeard removed from this site were particularly robust, reaching a height of approximately 1 meter.

This year, volunteers and the Denali EPMT team pulled 117 pounds of narrowleaf hawksbeard in the park. This number is up from the 40 pounds pulled last year, and while the infestation along the Park Road continues to spread at a slow pace, it should be noted that the larger infestation within the sewage lagoon seems to be mostly eradicated thanks to prior chemical treatments. Further chemical treatment of the remainder of this old infestation is strongly advised by the park's revegetation technician. Also, monitoring all new construction sites for this invasive is vital.



Figure 5. Splitlip hempnettle

Splitlip hempnettle (Galeopsis bifida)

Ranked 50 on the invasiveness scale by AKNHP, this species is a very low priority for the park. While detected last year by EPMT staff in the Kantishna Horse Corral, locals from Kantishna attest that this species has been growing in the corral area for many years. This species is easy to pull and occurs only in a small 1 meter square area shared with another newly detected species, night-flowering silene (*Silene noctiflora*). This infestation should continue to be a part of the yearly horse corral sweeps, but merits little additional attention.

Narrowleaf hawkweed (Hieracium umbellatum)

Narrowleaf hawkweed was not found within park boundaries this season. A small infestation from previous years was found at mile 231.75 of the George Parks Highway near the McKinley Village and was manually treated by the revegetation technician, removing 5 pounds of plant material. Currently, narrowleaf hawkweed is ranked 51 on the invasiveness scale by AKNHP and is considered a very low priority for the park.



Figure 6. Narrowleaf hawkweed

Foxtail barley (Hordeum jubatum)

Foxtail barley is generally considered to be native to western North America and to have been present in eastern Alaska prior to European contact. However, this species is thought to have spread dramatically in the last several decades, possibly due to the increasing footprint of human disturbance. Due to its rapid expansion, this species has been of increasing concern and AKNHP has issued it an invasive species ranking of 63. Foxtail barley is considered a nuisance weed, due to the sharp awns surrounding its seedpods, which, when dry, can easily damage the eyes, mouths and skins of animals, and the plant itself has also been known to be a host for several viruses (AKEPIC 2012). While Denali's native species appear to be in no immediate danger, the park's kennel staff continued their efforts to pull and control foxtail barley near the kennels to prevent injury to the sled dog teams.

The park revegetation technician lead a SAGA crew of eight to treat foxtail barley infestations at a variety of locations in and around the park frontcountry the week of July 23rd to 27th. At the Power Plant, on the same dirt mound where a small infestation of narrowleaf hawksbeard can be

found, the foxtail barley infestation is slowly being turned back, responding to years of manual treatment. On the east side of the Maintenance Yard near the lumber storage area, the control crew treated a never before controlled infestation. Staff treated the Park Road in the Crepis Sweep area (mile 0.4-0.8); the majority of the infestation there is on the south side of the road. A new infestation appeared behind the Auto Shop this year and bears continued treatment and monitoring.



Figure 7. Foxtail barley

Outside of the park, the SAGA/EPMT control group manually treated an infestation at mile 237.5 (state pull-out) of the George Parks Highway. The EPMT staff assigns a lower priority to areas outside the park partially due to national goal-setting and partially to limit potential private/public property disputes. This particular site on the George Parks Highway is heavily infested, but hopefully by treating this infestation where it currently occurs so close to the Park Entrance at mile 237, the team can prevent the infestation from spreading towards the park. A new infestation of foxtail barley was discovered and treated at mile 237.25

(Waste Water Treatment Plant Outflow Pipe corridor – east and west of Parks Highway).

Currently, given the time and work-hour restraints on the EPMT team and foxtail barley's large infestation areas and somewhat debated status as invasive, this is a lower-priority invasive for the park. The park plant ecologist, Carl Roland, suggested that foxtail barley should be treated, but generally given a lower priority than other invasive plants in the park. Monitoring and control efforts should continue in the frontcountry areas, but for the next year particular attention should be paid to the new construction areas near the Shaffer Building and Kennels. Some intermittent patches of foxtail barley have also been spotted further in along the Park Road at the Primrose area, Hogan Creek, near Sable Pass and Igloo Campground but were not formally inventoried. For this season, 549 lbs. of foxtail barley were treated and removed from the park.

Yellow toadflax (Linaria vulgaris)

Yellow toadflax is easily identifiable by its yellow, spurred flowers, which are unique in shape and coloration in Alaska. Currently, yellow toadflax is considered a noxious weed in Alaska and has an AKNHP invasiveness ranking of 69. In Denali, yellow toadflax is only present in one relatively small infestation on the railroad tracks north of the Alaska Railroad Depot. While safety constraints and the particularly



Figure 8. Yellow Toadflax along the railroad tracks

stony soil in this area makes this infestation difficult to treat, the revegetation technician and a SAGA crew managed to pull 2 pounds of yellow toadflax this season on July 26th, down from the 4 pounds pulled in the same area last season. This infestation bears continued monitoring, as yellow toadflax can reproduce by seeds or by creeping rhizomes. Given the difficulty of removing the entirety of the root structure in the rocky soil conditions at the Railroad Depot, it is likely that this small pocket of yellow toadflax will reemerge next year, meriting another brief bout of manual control to keep the infestation at its current highly manageable size.

White and yellow sweetclover (*Melilotus alba* and *M. officinalis*)



Figure 9. White and yellow sweetclover

White and yellow sweetclover (ranked 81 and 69, respectively, by AKNHP) are high-priority species for treatment within the park. Luckily, the few infestations in and around the park have been decreasing in size over the course of years of manual treatment, and given that white sweetclover alone can produce 350,000 seeds per plant (AKEPIC 8/6/12), and each of those can remain viable for up to 81 years, eradication must be a priority.

Outside the park, a SAGA group of eight lead by the revegetation technician treated the largest infestation near Denali under the Kingfisher Creek sign on the George Parks Highway (mile 237.75). While white sweetclover has infested vast swaths of the George Parks Highway between Denali and Fairbanks, this site represents the closest and largest arm of any infestation along this road corridor. Another large infestation near mile 232.25 on the George Parks Highway was inventoried this year, but the control team found nothing to treat in this area. Over the course of the past year, a minor Department of Transportation construction project was completed, and it seems as though the soil at this site was either heavily turned or covered, burying the infestation. Given that individual seeds can last up to 81 years, this site should be monitored carefully in following years.

Inside the park, white sweetclover seems to be responding well to manual treatment. The park's densest infestation along the tracks at the Railroad Depot has been reduced to small patches scattered along the length of the station. The infestations on the east side of the Rock Creek bridge abutment and at Riley Creek Campgrounds appear to be eradicated, as no white sweetclover was found in either location this year. As is the case for all previously infested locales, however, these areas should be inventoried and reevaluated in following seasons.

The park's revegetation technician discovered a new infestation at Park Headquarters near the Barn building. Given that many government vehicles are parked in other areas of this same parking lot, this small infestation should be given especially aggressive treatment. For this season, the control teams pulled a total of 60 pounds of white and yellow sweetclover from the park.

Night flowering silene (*Silene noctiflora*)

With an invasiveness ranking of 42 and only one small infestation within the park at the Kantishna Horse Corral, this invasive species poses little threat of expansion. This species was mapped by the EPMT staff in 2011, as the staff reconfirmed a previous sighting of night flowering silene in the horse corral (Walter and Mahovlic, 2011). This small infestation shares territory with the park's only splitlip hempnettle infestation. Treatment and monitoring of the entirety of the horse corral area should continue as other exotic invasive plants may also be growing unmonitored there.

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

Despite its relatively low invasiveness ranking of 58, the common dandelion occupied a large chunk of the EPMT's control efforts. While there is only a small chance that the common dandelion could survive in the harsh conditions of the backcountry, the high level of attention it received was merited both by the large size of the infestation within the park and the ease of recognition visitors have in identifying the dandelion as a problem plant. An additional problem is the dandelion's taproot, which necessitates the use of hand tools to fully remove each plant, adding extra treatment time to fully eradicate each plant. The dandelion infestation within the park is large-scale, recurring and very time-consuming to treat, and thus Denali's small EPMT team generally treats this plant in a manner more consistent with containment than eradication.



Figure 10. Night flowering Silene



Figure 2. Common dandelions near Park HQ

the Park Road), future EPMT crews may be able to push the dandelion infestations back along the road corridor and away from the backcountry.

The EPMT staff based their dandelion control efforts in the park this season largely around another iteration of the annual Dandelion Deveg program, in which teams of volunteers lead by EPMT staffers manually treat dandelion infestations along the gravel portion of the Park Road from the Savage River Entry Box to Kantishna (miles 15-92). Generally speaking, the infestations of dandelions in the frontcountry areas (miles 0-15) are far too dense and widespread for any reasonable treatment to be attempted. By working out towards the park entrance from the furthest infested point (at the far end of

The Dandelion Deveg program is usually broken into two sections to tackle the 77 miles of Park Road over two distinct pushes. This year, for the duration of the week-long east end program from June 11th to 15th, the SCA intern and the revegetation technician lead an eight-person SAGA crew. The group treated infestations along both sides of the Park Road from the East Fork Cabin to the Savage River Entry Box (miles 44-15), including infestations at the Teklanika rest

stop and Sanctuary, Igloo, and Teklanika campgrounds. It should be noted that, while there are sporadic infestations along the whole length of the Park Road, the densest patches in this stretch occurred between miles 15-17 and in the Sanctuary Campground.

The week-long west end Dandelion Deveg project took place from June 18th to 22nd and proceeded on a much smaller scale, necessitating only the SCA intern, the revegetation technician and a single volunteer, returning from previous years. This group treated dandelions in all areas westward from the Toklat Ranger Cabin, with the majority of the infestations occurring from mile 76 and westwards, becoming particularly dense at the Kantishna Horse Corral, Fannie Quigley's Cabin, the West End Ranger Station and DalleMolleville. While the small team approach proved largely effective, there wasn't enough time to fully treat all of the infestations near the Kantishna Airstrip, Friday Creek, Friday Creek Cabins, and Fannie Quigley's Cabin, meaning that the infestations in these areas could increase in size and density next year.

Outside of the Dandelion Deveg project, dandelions in the frontcountry are left largely untreated, instead simply being inventoried as more threatening species like narrowleaf hawkbeard are treated instead. An exception to this was one very eager National Park Service employee who, through landscaping, removed an unprecedented 528 pounds of dandelions from the Park Headquarters campus. Unfortunately, even this heroic effort made little difference in the proliferation of dandelions around Park Headquarters, reconfirming the EPMT staff's decision to treat more manageable infestations along the Park Road, effectively eradicating the new plants as efficiently as possible.

The single employee's 528 pound addition marks a drastic increase in the total poundage of dandelions annually treated, for a total of 1138 pounds of dandelions treated this season. In recent years, the next-largest amount removed was 570 pounds in the 2010 field season. For future years, the Dandelion Deveg project will continue to be vital to containing the worst of the dandelion infestation in the frontcountry. Additional monitoring and control efforts at the Wilderness Access Center and Backcountry Information Center campus should also be made a priority, as the infestation there seems very manageable and all buses and hikers headed into the backcountry pass through the campus and could easily carry seeds along with them.



Figure 12. Alsike clover

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

The park's invasive clovers are generally left untreated due to their lower invasiveness ranking (59, 57, and 53, respectively) and the extreme difficulty of manual treatment. These clovers have a dense rhizomatous root structure and can usually only be manually treated by digging up the entirety of the plant with a shovel. These clovers have relatively well-established infestations at the Railroad Depot, Park Headquarters, the Visitor's Center campus and along certain stretches of

the paved portion of the Park Road. This year, a small infestation at the Kantishna Horse Corral was treated with 40 pounds of clover removed, down from 2011's 50 pounds in the same area. It should be noted that these weights do not accurately reflect the amount of weeds treated, as a good deal of soil weight is included in each weighed bag due to the treatment method of digging up the entire plant.

While these clovers are generally a lower priority for the Denali EPMT staff, the revegetation technician has expressed increasing concern over the clovers' slow spread up the Park Road. This year, during the application of Milestone VM® to the bird vetch populations near the Power Plant, the revegetation technician also applied the herbicide to a small and particularly dense patch of clover near the Power Plant entrance as a potential test for next season. If the plant doesn't return, perhaps Milestone VM® could be used to treat the largest, densest patches along the Park Road next season.

Scentless false mayweed (Tripleurospermum inodorum)

Scentless false mayweed (ranked 48 by AKNHP) is a success story for Denali. New to the park in 2005 (Acosta 2005), this weed has been contained successfully to the Railroad Depot for the past seven years, and while this infestation grew drastically to 20 pounds of treatable plants in 2009 (Byrne and Mahovlic, 2009), years of treatment have reduced this season's infestation to only three plants. A sweep for this infestation should be maintained as part of the Railroad Depot treatment plan, although hopefully this species will be eradicated in Denali as of next season.



Figure 3. Scentless false mayweed



Figure 4. Bird vetch

Bird vetch (Vicia cracca)

Currently assigned an invasiveness ranking of 73 by AKNHP, bird vetch is one of Denali's highest-priority invasive plants. Given its aggressive growth habits and thin rhizomatous root structure, this plant takes a great deal of effort to fully treat through manual means, often necessitating the use of a shovel to remove large amounts of soil with each plant in order to fully remove the root structure from rocky frontcountry areas.

Given the difficulty of manual treatment for this plant, the revegetation technician decided to chemically treat several of the recurring infestations in the frontcountry with Milestone VM® herbicide. The areas treated were two small infestations near the Power Plant, an infestation at the northern edge of the McKinley Park Airstrip, one infestation along the Park Road near the Wilderness Access Center and an infestation on the shoulder of the

road between Riley Creek Mercantile and the Post Office. All herbicide treatments were consistent with park and state guidelines, as detailed in the Methods section of this report.

Bird vetch seems to be responding well to previous treatments and two infestations in the frontcountry were inventoried and not detected this season. The infestation in C-Camp in and near the propane field was reduced to a single plant last year and not detected at all this year (Walter and Mahovlic, 2011). Another infestation along the Park Road near the WAC, but further west along the road than the chemically treated infestation remained undetected as well. These sites should continue to be monitored carefully in coming years, but it is encouraging that some progress is being made on frontcountry infestations.

Finally, a number of infestations were hand-pulled, due to concerns with spraying herbicides in areas outside the park's frontcountry. A small infestation near Fannie Quigley's cabin was manually treated and only a few plants needed to be removed. Outside the park, the McKinley Chalet entrance area also sported a small recurring infestation and the landscaper at the Chalet treated it. Mile 231.75 Parks Highway found the same *Vicia cracca* infestation that has been occurring there since 2010. The Revegetation technician and the SAGA crew treated this site by hand-pulling plants.

This season marked the EPMT staff's first attempt to treat the *Vicia cracca* population with herbicide within Denali. All treated sites should be carefully inventoried next season to survey the effectiveness of treatment. These sites where this species has occurred merit further monitoring, and Fannie Quigley's Cabin and out-of-park locations require more manual control. If the herbicide treatment program in the park's frontcountry is a success, serious consideration should be given to attempting to pursue herbicide treatment at all current bird vetch sites, pending proper authorization and approval of this activity.

Revegetation

Revegetation is one of the best ways to prevent the establishment of exotic plant populations. By reestablishing native species in disturbed soil before exotic species have a chance to take root, even small revegetation projects can provide a strong buffer against the establishment of weed populations in the Park.

This year, the majority of the EPMT revegetation efforts centered on the Kennels Road and Shaffer Building areas. A small area near the new Lift Station at the Murie Science and Learning Center was also scarified and seeded but at the time the Lift Station was malfunctioning and the area in the site may have been disturbed again as the pump was fixed. The blend of seeds included: wheatgrass (*Elymus sp.*), milk vetch (*Oxytropis campestris*), Eskimo potato (*Hedysarum alpinum*) and the non-native plant annual rye (*Lolium multiflorum*).

The Kennels Road area was completed at the end of the 2010 season and revegetation efforts began in 2011. Construction crews under the direction of the revegetation technician



Figure 5. Boy Scout volunteer crew and the revegetation technician working the Shaffer Building revegetation area

installed tundra mats along critical areas and the EPMT SCA intern and the revegetation technician seeded the remaining areas of exposed soil with annual rye in July, 2011 to reestablish ground cover and prevent erosion. This year on June 5th, the EPMT SCA and the revegetation technician scarified all exposed soil along the shoulders of the Kennel Road with rock rakes and planted a largely native seed mixture put together using mostly local seeds from the park's annual Need For Seed project. The blend of seeds was comprised of the following species: wheatgrass (*Elymus sp.*), milk vetch (*Oxytropis campestris*), Eskimo potato (*Hedysarum alpinum*) and the non-native plant annual rye (*Lolium multiflorum*). While the seedlings of these plants have already sprouted in some places, a few particularly robust narrowleaf hawksbeard specimens also sprouted in this area late in the season and were treated.

The Shaffer Building, completed late in 2011, has already had some revegetation efforts centered around it. The contractor responsible for the building installed tundra mats on the north end of the C-Camp parking lot and the EPMT SCA intern and the revegetation technician scarified and seeded a number of areas near the Shaffer Building, including the Fuel Pump area in the summer of 2011. This year on June 6th, a Boy Scout volunteer group of six, the EPMT SCA intern and the revegetation technician scarified and seeded soil in the remaining untreated areas around the Shaffer Building complex and the C-Camp parking lot. The team used Pulaski entrenchment tools and rock rakes to prepare the soil for the seed mix, which was comprised largely of seeds gathered in the Need For Seed project in previous years. The mix included: wheatgrass (*Elymus sp.*), alpine bluegrass (*Poa alpina*), milk vetch (*Oxytropis campestris*), arctic lupine (*Lupinus arcticus*), Eskimo potato (*Hedysarum alpinum*), goldenrod (*Solidago multiradiata*), and the non-native plant annual rye (*Lolium multiflorum*).

As the season drew to a close, it was difficult to ignore the culvert project along the paved portion of the Park Road (mile 0-15). While the instillation of the 150 culverts is still underway, the installation areas are also major sites for disturbed soil along the Park Road and should be considered a top priority for reseeding in the coming year.

In the summer of 2012, 1.95 acres was revegetated by planting native seeds.

Need For Seed

The Need for Seed is an annual volunteer effort in which native seeds are collected for future revegetation purposes. This year, the east end effort was from August 13 – August 16 and the west end session was August 20 – August 25 which are a week later than other seasons due to the native seeds in 2011 not being ripe. This strategy proved effective in that all the seeds were ripe and ready for collecting. A total of 13 lbs. of uncleaned native seeds were collected and 6 volunteers spent 240 hours collecting seeds in the two volunteer sessions.

The east end collection areas were:

- The Nenana River – just east of the Nenana River bridge (south end) mile 237.25 – across the river from ERA helicopters. This is a very good spot to collect *Oxytropis campestris* and *Leymus innovatus*.
- Along Riley Creek at the far end of the overflow parking area – lots of *Hedysarum alpinum* plants.

- The areas surrounding the RV parking area at the Denali Visitor Center (DVC) – this area was revegetated in 2007 and is a wonderful source for *Elymus sp.* seeds.

The west end collection areas were:

- Toklat rest area – good source for *Oxytropis campestris*, *Hedysarum Mackenzii*, and *Elymus sp.*
- Along the Park Rd. just west of Toklat rest area – great source for *Hedysarum alpinum*, *Leymus innovatus*, *Elymus sp.*, and *Delphinium glaucum*.
- Mile 62 – across from Stony pull-out – a fantastic source for *Arnica lessingii*.
- Mile 85 and the Wonder Lake Campground Rd. – *Elymus sp.* plants are plentiful here.

During the west end Need for Seed, native seeds were also planted in 20 out of the 23 steep cut slopes that were created during the Mile 80 – 84 Department of Transportation road upgrade and widening project. The steep cut bank slopes started at Mile 74 and continued to Mile 84. The seeds were mixed with a weed-free potting soil, hand sowed and hand raked on the slopes. The seeds in the native seed mix included: *Elymus sp.*, *Hedysarum alpinum*, *Hedysarum Mackenzii*, *Poa alpina*, *Calamagrostis canadensis*, *Alnus crispa*, *Shepherdia canadensis*, *Pedicularis sp.*, *Delphinium glaucum*, *Aconitum delphinifolium*, *Dryas octopetala*, *Parnassia palustris*, *Epilobium latifolium* and *Solidago multiradiata*.

Education and Outreach

This year's education and outreach efforts in the park were largely constrained to planning and preparation for future projects. While previous years' outreach campaigns have focused on oral presentations to park employees and visitors, this season outreach was focused on trying to reach as wide of an audience as possible. The most efficient means to go about reaching a wider and wider audience was to move away from irregular interpretive talks to small groups and focus on the distribution of printed information throughout the park.

The EPMT SCA intern completed an inventory of available outreach materials and available resources from the EPMT Alaska Regional Office. The outreach materials were mostly designed for distribution within the lower forty-eight states and did not address the majority of invasive species in Denali. Further, these pamphlets, posters, etc failed to offer relevant prevention information for Denali, suggesting tips such as the cleaning of watercraft and a prohibition on hiking off-trail, neither of which applies to Denali's open backcountry. Even Alaska-specific information tended to be too general, again detailing a variety of more aggressive invasive plants present elsewhere in Alaska but not in Denali.

Through consultation with the regional EPMT staff, Denali's Media Specialist, and the rangers at the Backcountry Information Center, the EPMT staff laid out a rough plan for a public outreach campaign. The intern also generated sample interpretive text concerning the invasive plants within the park, the EPMT, and park treatment policies. This general interpretive text will

hopefully be of some use to future EPMT SCA interns looking to step up a public outreach campaign earlier in the season.

Backcountry Information Center Addendum

The Backcountry Information Center (BIC) is the first stop for anyone hoping to overnight in the backcountry. Backpackers are shown a half-hour safety video and given a brief ten minute oral presentation by a ranger on additional safety topics, the logistics of backcountry travel and a brief reminder concerning Leave No Trace principles. The supervisor for the BIC seemed more than open to instating a brief addendum to the ranger's oral presentations, allotting a minute or two of time to reminders about gear hygiene to prevent the spread of invasive weeds and referring visitors to further printed materials.

The BIC is also in need of updated printed materials and a new poster for invasive species. Ideally, a new poster would have photos of the top 6-10 invasive species in Denali, information concerning each species, proper gear hygiene, and who to contact if you find an invasive species within the park. This visual and printed material would serve as an excellent complement to the ranger's addendum on weeds.

Other Outreach Efforts

While the majority of this season's outreach was relegated to the planning stages, there was some informal outreach to park employees and visitors. The EPMT SCA intern contributed to the weekly Denali newsletter *Denali this Week* with updates about dandelions, revegetation and control efforts as the season progressed. The EPMT SCA intern also contributed similar material to the internal Natural Resources update bulletin, including updates on the Dandelion Deveg program.

As the season progressed and the Denali EPMT team began doing more control work in the field, a large number of opportunities for informal interpretation presentations presented themselves, especially at the Wilderness Access Center. Dandelions are the most prevalent species in that area and so these brief informal visitor contacts centered around invasive and native dandelions, seed dispersal, gear hygiene, and Denali's general policies on invasive weeds. In addition to talking to visitors, the EPMT staff distributed caches of dandelion digger tools, bags, and keys to native and invasive dandelions to several locations in the park including the Natural Resources building at Park HQ, the Recreation Hall at C-Camp and the Denali North Face Lodge near Kantishna. This is a yearly occurrence for the Denali EPMT team, but sadly these caches serve primarily as informative displays. The tools and bags remained unused throughout the season.



Figure 6. Dandelion tools cache

The Denali EPMT group also makes an active effort to ensure that all volunteers receive as much information as possible about invasive plants. The Boy Scout troop that assisted in the

revegetation project near the Shaffer Building on June 6th was working on getting the scouts their Conservation merit badges and the scouts were very interested in the entirety of the revegetation process. On July 19th, a small group of 5 very young volunteers and a parent assisted with some small-scale dandelion control work near the Denali Visitor Center and participated in part of a Crepis Sweep. This was a fantastic opportunity for the children to learn about the difference between invasive and native species, the impact invasive species can have on wildlife and the park in general, and a very direct hands-on lesson illustrating exactly how they can help by volunteering. The park's EPMT staff also worked with the SAGA crews to make sure that every day before and during their fieldwork the volunteers were receiving relevant information on the park's invasive plants and treatment plans.

Discussion

Sites treated and Recommendations

What follows is a brief discussion of the sites treated inside and outside the park and recommendations for the 2013 field season. The index is organized in roughly east-west order, with the sites outside the park along the George Parks Highway detailed at the end.

- The Sewage Lagoon is largely invasive free although the remaining narrowleaf hawksbeard in this area should be treated with herbicide in the 2013 field season.
- Riley Creek Campgrounds, where no invasive plants other than dandelions were detected this season. Previous infestations of narrowleaf hawksbeard and white sweetclover have occurred at this location, and, as a high-traffic area, it bears continued monitoring.
- On the shoulder of the road between the Post Office and Riley Creek Mercantile is a low dirt mound. Normally included in the crepis sweeps, this area merits special attention as a recurring infestation of bird vetch was treated with herbicide this season. In the 2013 field season, all bird vetch populations that were treated with herbicide should be monitored and again treated with the same Milestone VM herbicide if not eradicated.
- The Crepis Sweep area, along both sides of the Park Road from the Sewage Lagoon to the Wilderness Access Center, is host to not only narrowleaf hawksbeard but also foxtail barley and common dandelions. Continuing the Crepis Sweep to limit the spread of narrowleaf hawksbeard is of vital importance as it may possess the characteristics to spread into the backcountry if left unchecked.
- Just west of the Crepis Sweep area on the south side of the Park road (30 ft. from the Wilderness Access Center sign) is one infestation of bird vetch that was chemically treated this year. Monitor this population and retreat with herbicide if necessary.
- The Wilderness Access Center and Backcountry Information Center Parking Lots and Bus Terminal were mapped and controlled for the first time this season. In a rare happenstance, this campus is one of very few frontcountry areas almost entirely free from dandelions or any other invasive species. Taking an active role in safeguarding this high-traffic area may help reduce the amount of dandelion seeds and other invasive plants brought into the park by visitors and buses.
- The Railroad Depot is a continuing hotspot for a variety of invasive species seen nowhere else within the park. Scentless false mayweed, yellow toadflax, white sweetclover, foxtail barley and narrowleaf hawksbeard have all been spotted here. These species seem to be responding to manual treatment and should continue to be controlled.
- The McKinley Park Air Strip near the Denali Visitor Center is mostly free from invasive species other than the common dandelion and foxtail barley, but should be monitored for any other exotic invasives coming in from outside the park or attempting to hitchhike on planes into the backcountry areas. This is one of the areas where bird vetch was treated

with herbicide this season. Monitor this bird vetch population and retreat with herbicide if necessary.

- The dirt mounds surrounding the Power Plant are home to narrowleaf hawksbeard and two separate infestations of bird vetch that were treated with herbicide this year. Monitor both of these populations (one at the parking entrance to the Power Plant and one near the Power Plant door) and retreat with herbicide if necessary.
- The C-Camp propane fields, while apparently free from bird vetch this season, bear continued monitoring to ensure that an infestation doesn't reestablish itself.
- The Shaffer Building restoration and revegetation area should continue to be monitored for potential invasive plants until the native vegetation can reestablish itself. Both narrowleaf hawksbeard and scentless false mayweed were found in this area in the summer of 2012.
- Denali Park Headquarters is heavily infested with dandelions, but has also become home to foxtail barley, and, more worrisome still, a small infestation of white sweetclover. This population was found near the Barn parking area and bears monitoring in the 2013 season.
- The Kennels Road restoration and revegetation area should be monitored carefully as narrowleaf hawksbeard was spotted growing here this season.
- The unpaved portion of the Park Road is home to dandelions but, so far, no other invasive species. The Dandelion Deveg program should be continued along this corridor not only as a means of keeping the dandelion population in check, but also as a way to continue to monitor this area for other, more aggressive invasive species. The thickest dandelion infestations are at the far end of the Park Road in close proximity to Kantishna (mile 76-91) and near the Savage River Entry Box (mile 15-17).
- The Teklanika Gravel Pit received a clean bill of health this season, but should be checked again. Similarly, the Toklat Gravel Pit should be at least briefly investigated as the continuing construction projects along the gravel portion of the Park Road use gravel from this site.
- The Igloo, Teklanika, Sanctuary and Wonder Lake Campgrounds are all infested with dandelions, although Sanctuary and Wonder Lake seemed by far the most densely infested and should be priorities early in the 2013 season before the dandelions can go to seed.
- The Kantishna Horse Corral area is home to splitlip hempnettle and night flowering silene, two invasives seen nowhere else within the park, as well as dandelions and narrowleaf hawksbeard. While it is difficult to maintain a constant surveillance of this area, treating this remote location should be a high priority.

- Fannie Quigley's Cabin and the surrounding Friday Creek area are home to some of the densest dandelion infestations on the west end of the park. In addition, the only west-end bird vetch infestation is located near Fannie Quigley's Cabin. While this infestation is currently small, herbicide application should be considered in 2013.
- Kantishna Air Strip, like the McKinley Park Air Strip, seems to be mostly free from exotic weeds other than dandelions and plantain (*Plantago major*), but bears close monitoring. This is especially true given its remote location and the fact that, this year, the air strip was only partially inventoried due to time constraints on the west end Dandelion Deveg team.
- The George Parks Highway provides a number of locations to continue monitoring and controlling. Mile 231.25, mile 232.25, mile 237.25, mile 237.5, the McKinley Chalet area, and the entirety of the Glitter Gulch area should all be monitored for the more aggressive invasives that face the park, including narrowleaf hawksbeard, white sweetclover and bird vetch. Treating these species outside the park, while technically not covered under the Government Performance and Results Act, is important in order to prevent their introduction to the vulnerable disturbed soil in high-traffic frontcountry areas.
- Near the McKinley Village at mile 231.75 of the George Parks Highway marks a large disturbed area, potentially from a previous fiber optic cable installation. *Vicia cracca* and the only *Hieracium umbellatum* infestation near the park are both found here. Continue monitoring and controlling this area. Inquire about herbicide application to the rather large bird vetch population that is found here.
- Mile 232.25 of the George Parks Highway is important enough to stand on its own. Usually, this is a hotbed for white sweetclover and usually requires 40 person-work hours or more to manually treat. However, the Department of Transportation has completed a minor project in this area and turned the soil over, preventing any plants from sprouting this season. Currently, the ground is gravel cover with some unknown grass seeds mixed in. This site bears monitoring to ensure that the white sweetclover infestation, with a potential seed bank life of up to 81 years, does not return.
- Mile 237.25, west and east sides of the George Parks Highway, the Upper and Lower Trees area. This area is also occasionally known as the Outflow Pipe area. As the Sewage Lagoon was redone and became the Wastewater Treatment Plant, this area underwent a massive devegetation of native plants. In 2010, trees were planted here to help reestablish ground cover and in 2011 native plants were seeded here. Currently, this site is infested with narrowleaf hawksbeard and foxtail barley. The narrowleaf hawksbeard population in this area was quite robust in 2012 with some plants reaching 1 meter. The Crepis Sweep should include this area in the 2013 field season.

Education and Outreach Revisited

We suggest that it is worth considering the installation of boot brush stations around the park. This idea comes both from the EPMT regional staff and from rangers at the Backcountry Information Center. The Alaska EPMT group has a number of resources ready to roll on a project like this and EPMT SCA interns have installed boot brushes in other parks previously. This should be relatively feasible here in Denali. Possible locations include the Backcountry Information Center, the Wilderness Access Center, Teklanika and Toklat Rest Stops, Eielson Visitor Center, and the Wonder Lake Campground. Essentially, any high-traffic area in the park, particularly where people are boarding and leaving buses regularly and have a high chance of dropping seeds or carrying them into the backcountry. Not only would the boot brush stations assist in limiting the seed dispersal of exotic plants, it would also be an excellent outreach tool to educate the visitors on one of the many ways that invasive plants invade our environment.

Conclusion

This season as in the past, a great amount of the Denali EPMT effort has been controlling the expanse of the common dandelion which is the most prolific exotic species in Denali National Park. Since the inception of Dandelion Deveg in 1999 until the present with great assistance from volunteers, the dandelion has been kept in check as some populations have diminished and a few have been completely eradicated on the gravel portion of the Park Road. The Denali EPMT is in a unique position to be able to combat the war on dandelions since we do not have many species of exotic plants that exhibit highly invasive tendencies and that rank high on the AKEPIC invasive chart. Those highly ranked species that Denali does have are all located in human disturbed areas and are almost all in the frontcountry. Inside the Park, tall white sweetclover (invasive ranking of 81) is found sporadically and in small populations. Many of those small populations have been eradicated with consistent hand-pulling. There are 6 small populations of the dreaded bird vetch (invasive ranking of 73) inside the park and 5 of those were treated with herbicide in the 2012 field season. In the past 4 single and double stem populations of bird vetch have been eradicated by consistent hand-pulling. Even though narrowleaf hawksbeard only has an invasive ranking of 56, it has a continual presence in the first mile of the Park Rd. With the sewage lagoon population mostly decimated by herbicide, the narrowleaf hawksbeard population in Denali has dramatically diminished in size, but a constant vigilance needs to be kept on this invasive plant, especially in the newly constructed Kennels Rd, the Shaffer Building, the CLA Building, the Waste Water Treatment Plant and Outfill Pipe area, and the Mile 1 – 15 Culvert project. Even though it isn't included in our GPRA goals, targeting these highly ranked invasive plants outside of the park is crucial to the success of limiting their spread into the park.

With perseverance, dedication, diligence and consistency, the Denali EPMT can thwart the expanse of these highly invasive plant species so that they do not compromise the ecological integrity and natural diversity of the pristine ecosystem of Denali National Park.

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Appendix

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

- 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.