



# Invasive and Exotic Plant Management in Denali National Park and Preserve

## *2014 Summary Report*

Natural Resource Data Series NPS/DENA/NRDS—2014/739



**ON THE COVER**

Top: A volunteer crew assists with revegetation on the park road near Sanctuary River. Bottom Right: SCA crew working near C-Camp. Bottom Left: Volunteer assists with exotic plant removal near the Meadow Vista Trail.

Photographs by: Taylor Keegan

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## Abstract

During the 2014 Season, the Exotic Plant Management Team (EPMT) in Denali National Park and Preserve worked to prevent the influx of exotic species in the park including *Taraxacum officinale*, *Crepis tectorum*, *Vicia cracca* and *Hordeum jubatum*. Because exotic plants are typically spread in places that are frequented by people and follow disturbance, Denali National Park EPMT focused on several key areas of the park including the first 40 and last 20 miles of the Park Road, and numerous locations such as the Kantishna horse corral, the sewage lagoon, C-Camp and maintenance areas, and some areas of Headquarters. Furthermore, this season included a few revegetation projects located in around the Shaffer Building, adjacent to a section of the Rock Creek Trail, and along the park road at Sanctuary River and mile four of the Denali Park Road. Almost all of these efforts were completed by Wendy Mahovlic, the residing supervisor for EPMT and DENA Revegetation, Taylor Keegan a Student Conservation Association intern, and three volunteer crews from SAGA and SCA respectively. Manual treatment is the preferred method of exotic species management at Denali. Herbicide was administered to *Vicia cracca* and *Taraxacum officinale*. The result of the 2014 season's work included 3,163 pounds of pulled invasive plants and 1,524 hours of volunteer help. Data was collected utilizing the TrimbleGeoXT 2008 and Pathfinder Office and ArcGIS were used for correcting and editing data. This data is utilized by the Regional NPS office and contributes to the database available at the Alaska Exotic Plants Information Clearinghouse (AKEPIC) from the Alaska National Heritage Program (AKNHP).

## Acknowledgements

We would like to thank the following National Park Service employees for their contributions to the Exotic Plant Management team in 2014: Carl Roland for his support and supervision of the Botany Program at Denali National Park and Preserve, Wendy Mahovlic for her dedication and knowledge in restoration of native plant ecology throughout the park, Chris Overbaugh from the Anchorage NPS office for his oversight of EPMT across the Alaskan National Parks, Peter Frank for his technical support and experience with EPMT and data collection, Britta Schroeder for her technical support at Denali National Park, and Phoebe Gilbert for her volunteer work at Friday Creek. We would also like to thank the three volunteer groups from SAGA and SCA; these groups made the amount of manual treatment of exotic plants possible. We would also like to thank the youth group from New Jersey who helped with *T. officinale* around Riley Creek Campground. We would also like to thank our individual volunteers throughout the summer: Joe Craig, Robert Keegan, Erin Keegan, Jim Fairchild, and Maya Heubner. Without this vast support network, the EPMT would not be nearly as successful as it is each year, this year being no exception.

## **Acronyms**

**AKNHP** Alaska's Natural Heritage Program

**AKEPIC** Alaska Exotic Plants Information Clearinghouse

**CORS** Continuously Operating Reference Stations

**CLA** Concession Land Assessment

**DENA** Denali National Park and Preserve

**EPMT** Exotic Plant Management Team

**GIS** Geographic Information System

**GPS** Global Positioning System

**NFS** Need For Seed

**NPS** National Park Service

**SAGA** Southeast Alaska Guidance Association

**SCA** Student Conservation Association

**WWTP** Waste Water Treatment Plant

## Introduction

Denali National Park and Preserve is located on the interior of Alaska, and contains 6 million acres of wilderness; it is an exceptional example of conservation with fully intact ecosystems and limited human disturbance. On average, the park welcomes nearly a half a million visitors each season, all of which pass through the first few miles of the park. As it is home to the tallest mountain in North America, Mount McKinley or Denali (meaning “the high one”), Denali National Park and Preserve has had many advocates that have enabled the land, and those who inhabit it, to be protected and respected.



**Figure 1.** Denali from Wonder Lake campground

Unlike many National Parks in the continuous United States, Denali National Park and Preserve is in a position to control and contain the amount of invasive species that enter into the boundaries of the park. Denali National Park and Preserve has been working to contain exotic plants since 1999, with the last 11 years coordinated with the NPS Regional Office in Anchorage. The EPMT has been able to target and contain 29 species of non-native plants to a few select areas of disturbance in the park.

The majority of invasive plants are carried into the park by people who track them in on their vehicles, clothing, or even pets. A second major means of importation is through soils brought from the surrounding areas such as Fairbanks or Anchorage that may contain invasive seeds. Different types of education and outreach are important to inform the public about minimizing non-native seed transport. It is also vital to remain attentive and continue inspection of any soil importation into the park.

Additionally, Denali National Park and Preserve’s EPMT is responsible for native seed collection through the Need for Seed program, started by Mahovlic, and various revegetation projects throughout the park. In past years, revegetation for larger projects has included the use of tundra mats to facilitate succession, and native seed collection that is expanded on each season. For the 2014 season, four revegetation areas were added: Mile four of the park road; an area near Sanctuary River on the park road; an area along Rock Creek Trail; and two areas in C-Camp surrounding the Shaffer Building. Three areas were monitored through photo-monitoring

three years after revegetation: The Dog Sled Depot, various areas of C-Camp and Shaffer Building, and near the Concession Land Assessment building.

The following pages outline the inventory and monitoring that coincides with exotic plant management and native seed collection that occurs within the park. It also describes the current methods for containment or eradication of exotic species within the park, any revegetation and restoration, and also education and outreach for the season.

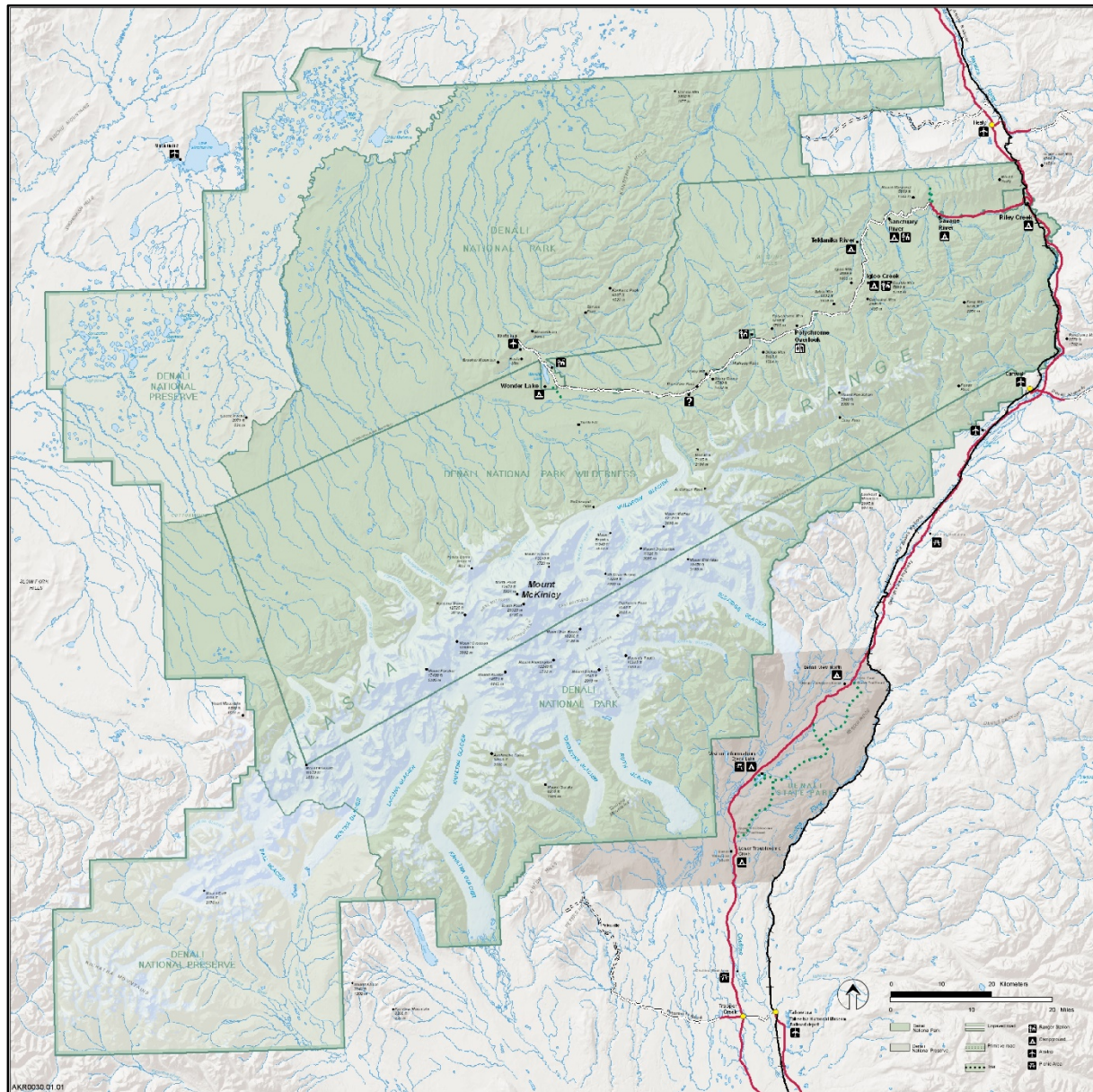


**Figure 2.** Map of Denali National Park and Preserve

## Site Selection

Under the guidance of Wendy Mahovlic, past EPMT summary reports, and site observation, the 2014 Denali EPMT was able to inventory, monitor, and remove many of the targeted exotic plant species throughout the park. As dictated by the Early Detection, Rapid Response (EDRR) strategy utilized by the Alaskan Regional Park office, Denali National Park and Preserve utilized federal goals set by the Government Performance and Results Act (GPRA); The GRPA goals as well as the strategies born from the EDRR play a large role in promoting greater efficiency in exotic plant management across Alaska.

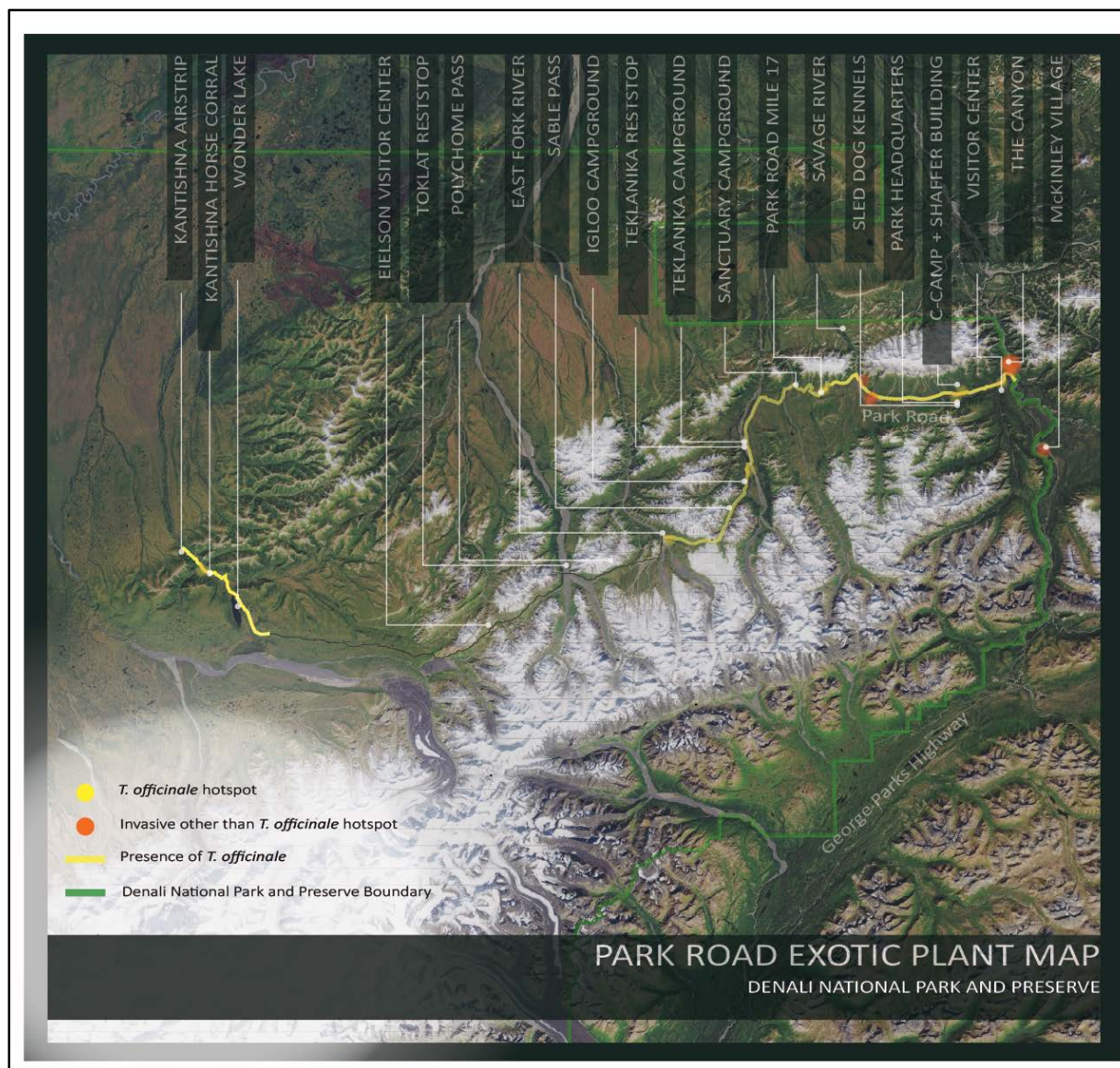


**Figure 3.** Exotic Plant Presence along the Park Road in 2014

The primary species targeted during the 2014 season were the Common Dandelion (*Taraxacum officinale*), Clover (*Melilotus sp.*) Bird Vetch (*Vicia cracca*), and Narrowleaf Hawksbeard (*Crepis tectorum*). *T. officinale*, is the first species of season that the EPMT tackles; the objective

is to remove as much of this plant as possible before the beginning of July when it goes to seed and may be transported throughout the park by vehicle or foot. Because common dandelion is prevalent outside the park, it is nearly impossible to eradicate. There are certain spots on the east end of the park road that *T. officinale* is removed, however the Denali EPMT makes a concerted effort to remove any *T. officinale* from miles 15-40 of the Park Road. This includes rest stops or campgrounds along the way, including the Murie Cabin at East Fork River, Teklanika Rest Stop, Igloo Campground and the Cabin, Sanctuary Campground, and Primrose rest stops. Other areas from mile 54-70 were scanned and any exotics in bloom were mapped and removed by manual treatment.

Furthermore, there is a significant *Taraxacum officinale* infestation due to the higher amounts of people and vehicles that have frequented the lodges in Kantishna. The west end's history as a mining district is also a suspect result of the exotic plant concentration. In addition to miles 70-92 of the park road, stops are made at the Wonder Lake Campground, Fannie Quigley's Cabin, Friday Creek Cabins, The West End Ranger Station, The Kantishna Horse Corral, and the entrance to the Kantishna Roadhouse and Denali Backcountry Lodge. For the 2015 season, it will be important to map the Kantishna Area, due to a flood event that occurred in the park and wiped out areas near Friday and Eureka Creeks, each of which are close proximity to the Kantishna Horse Corral and Denali Backcountry Lodge.

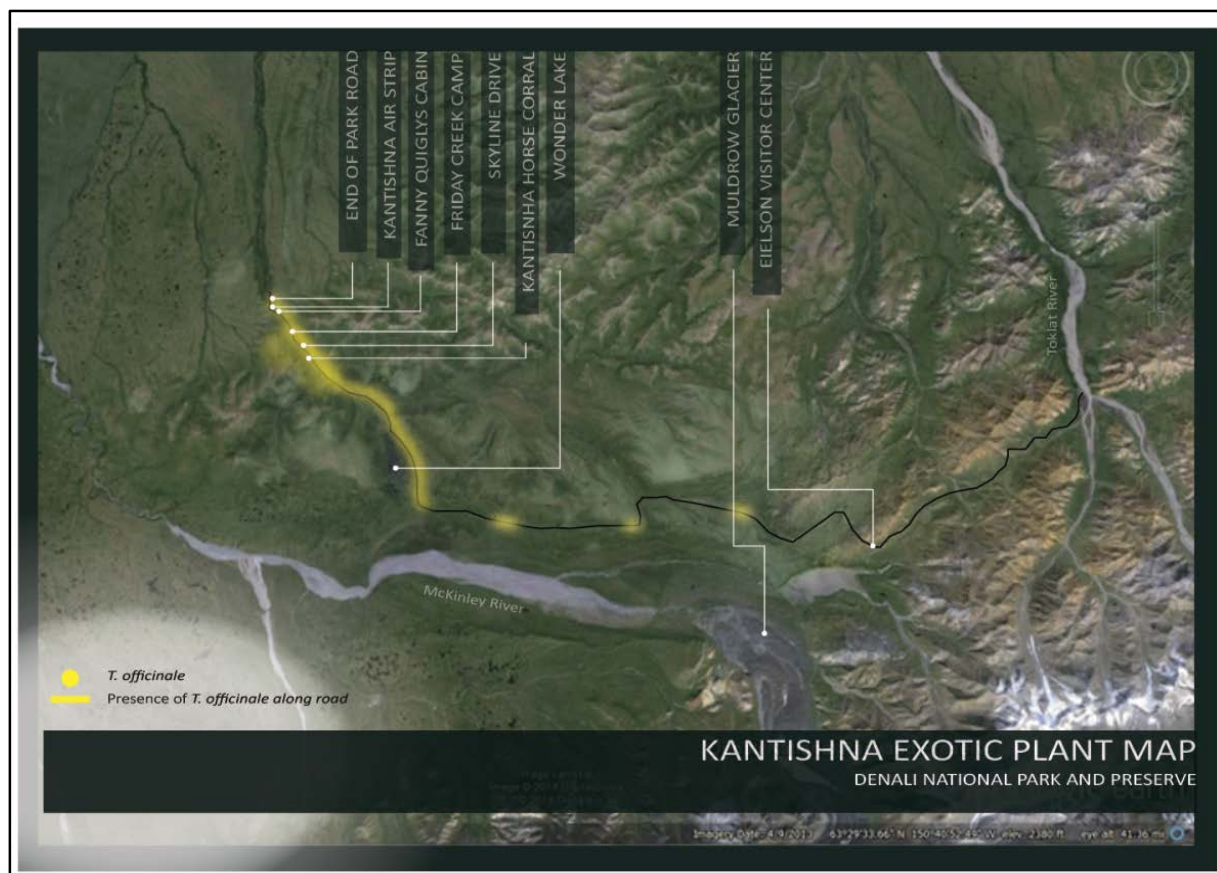


**Figure 4.** West End Exotic Plant Map

Bird Vetch (*Vicia cracca*) has an invasive ranking of 73 and is found in The Canyon near the Princess Resort and the Power Plant by the Denali Visitor Center. Furthermore, the Denali EPMT takes a proactive stance on containing the spreading Narrowleaf Hawksbeard (*Crepis tectorum*) in the park through weekly *Crepis* sweeps beginning in July when the plant starts to flower. *C. tectorum* is ranked as a 53 according to Alaska Natural Heritage Program (AKNHP).

In addition to selecting and surveying sites that are frequented by foot and vehicle traffic, the EPMT targets areas close to recent revegetation sites. This year, EPMT made an effort to clear dandelions near the C-Camp revegetation sites, the Dog Sled Depot revegetation project and along the Mile Four and Sanctuary River revegetation projects.

### Mapping and Inventorying

The primary sources for plant identification and revegetation information are *Wildflowers of Denali National Park* (Pratt and Pratt 1993), *The Flora of Alaska and Neighboring Territories* (Hulten 1968), *Flora of the Yukon Territory* (Cody 2000), *Native Plant Revegetation Manual for Denali National Park and Preserve* (Densmore, Vandermeer and Dunkle 2000).

Data was collected using TrimbleGeoXT data loggers and Pathfinder Office was used to differentially correct and edit the field data. The primary Continuously Operating Reference Stations (CORS) utilized for differential correction this season were the Denali National Park - Network Version and CORS, GRNX\_AKDA\_AK2004 (GRNX), ALASKA (ITRF00 (1997). Some of the information collected is utilized by the EPMT Technicians at Denali National Park; all of the information is sent to the Regional office for entry into the National Park Service's database throughout the season (Frank, 2013).

The Alaska Natural Heritage Program (AKNHP) provides information through the Alaska Exotic Plants Information Clearinghouse (AKEPIC) which makes different types of data available for public use; furthermore, the AKNHP is responsible for the invasiveness ranking scale. As outlined for each invasive species found in the park, the AKNHP provides a framework for prioritizing treatments. Plants are ranked on a scale from 1-100 based on their potential ecological impacts on the local and regional ecosystem and the potential for spread and disturbance. (Carlson et al 2008).



**Figure 5.** Wendy inventories along the George Parks Highway.



**Figure 6.** A SAGA crew manually treats dandelions in Sanctuary Campground

### Manual Treatment

Denali EPMT's primary method of exotic plant removal is through manual treatment. The success of the EPMT is made possible through the hard work of the seasonal crew and the volunteer crews that will come for short periods of time and assist with eradication and revegetation within Denali National Park and along the George Parks Highway. For the 2014 season, the EPMT focused on a few projects including removing many of the *Taraxacum* in the C-Camp and Maintenance areas, removal of *Crepis* from the sewage lagoon, and continuing efforts along the park road.

### Chemical Treatment

The use of herbicides within the park was limited to a few sites and was administered by a trained and certified technician. The first application of herbicide was used on small infestation of *Vicia cracca* at the Power Plant near the Denali Visitor Center. The second application of herbicide was in the Headquarters area to control the *Taraxacum officinale* outside of the Barn. This effort was made because many of the permanent residents and vehicles that enter the park drive in this area and may transport seeds further into the park. Chemical treatment was done after a first round of manual treatment and before many of the plants began to flower.

# Results

## Overview

In the 2014 season, the Denali EPMT staff inventoried 80.56 acres of the park. 6.28 acres were infested with invasive species and of those infested acres, 0.84 species acres were treated (Table 1). The majority of Denali's infestations occur in the frontcountry.

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

| Year | EPMT Personnel |             | Volunteer Crews |             | Total Person Field Hours | Invasive GPS Data<br>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 <sup>1</sup> (2.958)                  | 16.866 (0.349)          | 10.211 (0.121) |
| 2007 | 2 <sup>2</sup> | 743         | 16              | 1,173       | 1,916                    | 805.951 <sup>1</sup> (7.826)                  | 11.329 (0.301)          | 8.368 (0.289)  |
| 2008 | 2 <sup>2</sup> | 626         | 10              | 454         | 1,080                    | 741.687 <sup>1</sup> (11.982)                 | 12.750 (7.968)          | 11.051 (0.649) |
| 2009 | 2 <sup>2</sup> | 571         | 5               | 385         | 956                      | 749.459 <sup>1</sup> (4.210)                  | 20.437 (0.317)          | 11.370 (0.317) |
| 2010 | 3 <sup>3</sup> | 1,893       | 16              | 2,560       | 4,453                    | 159.034 (35.245)                              | 16.766 (2.616)          | 14.125 (2.586) |
| 2011 | 3 <sup>4</sup> | 764         | 3               | 143         | 907                      | 290.592 (23.395)                              | 29.348 (7.228)          | 10.290 (2.010) |
| 2012 | 2 <sup>2</sup> | 478         | 35              | 912         | 1390                     | 61.872 (6.397)                                | 19.108 (2.366)          | 10.519         |
| 2013 | 2 <sup>2</sup> | 500         | 27              | 980         | 1480                     | 118.85 (8.3)                                  | 5.783 (1.89)            | 4.56 (.461)    |
| 2014 | 2 <sup>2</sup> | 443         | 14              | 337         | 780                      | 80.33 (0.23)                                  | 6.24 (0.04)             | 0.84 (0.03)    |

\* 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.

<sup>1</sup>-This acreage includes the actual road surface of the Denali Park Road.

<sup>2</sup>-Includes one SCA intern

<sup>3</sup>-Includes two SCA interns

<sup>4</sup>-Includes one SCA intern and one international SCA intern

## Dandelion Removal

*Taraxacum officinale* is the primary focus of the EPMT for Denali National Park and Preserve; our volunteer crews and much of our summer is dedicated to preventing the spread of this species along the park road and throughout the park. Constant vigilance is required to contain this species to the known infestation sites.



**Figure 7.** Youth Crew removing Common Dandelion in July



**Figure 8.** The SAGA crew pulling weeds for the east end dandelion removal

This year the team mapped the park road from the park entrance to mile 17 to show the extent of infestation within the park. These records will be included in the AKEPIC database.

### **Crepis sweeps**

Narrowleaf hawksbeard (*Crepis tectorum*) is a highly-targeted species inside the park; manual treatment begins at the end of June when it begins to bloom. The Denali EPMT began to focus on *C. tectorum* during the 2006 season when it was spotted near the Sewage Lagoon. Part of the aster family, its flower is similar to the common dandelion, but it grows to be much taller, with a shorter taproot and a slender stalk. Because it is difficult to spot when it is not in bloom, the Denali EPMT finds it most effective to sweep certain areas in the park and manually treat this plant while in full bloom. The survey, or “sweep” includes both sides of the Park Road from the Sewage Lagoon, where large populations are historically found, up to Riley Creek Campground Road, and into the Aramark Bus and Employee Parking Lots and in between the Denali Visitor Center and Park Road.

Because this species is relatively new to Denali National Park and Preserve and has shown a fair amount of aggression in its advance up the park road, it is crucial to do the sweeps on a weekly basis to prevent this species from further encroaching into the park. This species should be sought out specifically near disturbed areas such as construction sites or areas where buses frequently stop.

## Species Specific Accomplishments

During the 2014 season, the Denali EPMT treated 7 species in the park. Table 2 outlines the species, its invasiveness ranking and location, the acres inventoried, and acres treated.

**Table 2.** Species specific monitoring and treatment throughout the season.

| Latin Name                                         | Common Name                  | AKEPIC Rank | Location*             | Acres Infested | Acres Treated |
|----------------------------------------------------|------------------------------|-------------|-----------------------|----------------|---------------|
| <i>Crepis tectorum</i>                             | Narrowleaf hawksbeard        | 56          | F, HC, PH, PK, TD     | 1.91           | 1.91          |
| <i>Hieracium umbellatum</i>                        | Narrowleaf hawkweed          | 51          | PH                    |                |               |
| <i>Hordeum jubatum</i>                             | Foxtail barley               | 63          | F, PH, PK, TD         | .907           | .907          |
| <i>Melilotus alba</i>                              | White sweetclover            | 81          | F, PH, TD             | .024           | .024          |
| <i>Melilotus officinalis</i>                       | Yellow sweetclover           | 69          | PK                    | *              | *             |
| <i>Plantago major</i>                              | Common plantain              | 44          | F, FQ, HC PK, PH, TD  | **             | **            |
| <i>Taraxacum officinale</i> ssp. <i>Officinale</i> | Common dandelion             | 58          | F, FQ, HC, PH, PK, TD | 4.31           | 2.70          |
| <i>Trifolium</i> spp.                              | Alsike, red and white clover | 57, 53, 59  | F, HC, PH, PK         | *              | *             |
| <i>Vicia cracca</i>                                | Bird vetch                   | 73          | F, FQ, PH, PK, TD     | .0068          | .0068         |

\* 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.

\* Significant population on private property

\*\* Not EPMT focus, yet present in park

<sup>1</sup> 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.

### **Narrowleaf hawksbeard (*Crepis tectorum*)**

Narrowleaf hawksbeard is a high priority exotic species for control and management in Denali. With an invasive ranking of 56, dense stands of this plant have the ability to shade out native colonizers, specifically native meadow plants. Its negative impacts include reducing moisture availability in soil delaying the establishment of native species on naturally disturbed soil and potentially altering native plant-pollinator interactions (Klein, 2011a). Each plant can have up to 49,000 seeds, which is the only way *C. tectorum* reproduces (Klien, 2011b). *C. tectorum* can be confused with Narrowleaf hawkweed (*Hieracium umbellatum*), which is another invasive plant that has been found in Denali National Park; *H. umbellatum* was not encountered in the 2014 season.

The first infestation of *C. tectorum* was mapped in 2004, and has been slowly increasing in size and creeping up the park road. This year it was spotted in the Savage River area at mile 14.5 on the north side of the road before the visitor parking area.

Historically, *C. tectorum* has been treated with herbicide in the Sewage Lagoon Area (Evans and Knapick, 2010; Walter and Mahovlic, 2011). Since that point in time, the infestation has decreased in size in that specific area. In the 2014 season, a SCA crew of 8 plus the revegetation technician pulled 872 pounds of *C. tectorum* in only two hours. This infestation was the main reason that the gravel quarry and construction vehicle inspection policy was implemented in 2008. See the appendix for the full report on this issue.

### **Foxtail barley (*Hordeum jubatum*)**

With an AKNHP invasive ranking of 63, *H. jubatum*'s nativity is actually disputed within Alaska. AKNHP acknowledges this, asserting that control should only be applied to populations where non-nativity is known or if the plant is considered a nuisance weed. In eastern interior Alaska, herbarium records have indicated that the plant may have been present. Each plant can produce up to 180 seeds, and 67% of foxtail barley seeds remain viable after being buried in the soil for one year; this number drops significantly with only 1% of buried seeds remaining viable after seven years (Klein, 2011b).



Figure 9. *Hordeum jubatum* along the Meadow Vista Trail

In early summer *H. jubatum* is considered a food source for grazing animals; however in late summer the awns become sharp and are dangerous for animals who may consume it. This is specifically relevant for Denali National Park's sled dogs, which frequent the park and will occasionally chew on an assortment of vegetation in the area. If ingested, it has potential to damage the mouths, eyes, skin, and even internal organs of the sled dogs.



Figure 10. Yellow Toadflax along the railroad tracks

The targeted locations for this species include the area surrounding the Kennel and Headquarters. An infestation was treated along the Meadow Vista trail on the old airstrip and along the Park Road where the sled dogs are typically walked during the warm season.

### **Yellow toadflax (*Linaria vulgaris*)**

*Linaria vulgaris* has an AKNHP invasive ranking of 69; this is primarily due to its aggressive and colonizing nature. It is known to suppress native grasses and perennials through its adaptation to compete for limited soil moisture (Flagstad, 2011). Each plant can produce up to 30,000 seeds, although seed viability is generally low and the dormancy of each seed ranges from nine to ten years (Flagstad, 2011). This species has been known to spread along roadsides by wind, or even as contaminate in commercial seeds.

*L. vulgaris* has been found on the tracks near the Alaska Railroad Depot. In the past, SAGA crews have removed a few pounds of *Linaria vulgaris* from this area; 2 pounds in 2012 season, and 4 pounds in the 2011 season. This year the two EPMT staff were escorted by an employee of the Alaska Railroad Company down the tracks to do a sweep and found three different patches of *L. vulgaris*. This sweep was not exhaustive and only covered the area where the northbound head engine tends to stop. In the future, it will be important to survey where both the north and southbound head engines stop to pick up and drop off of visitors. Furthermore, because of the rhizomatous root structure of *L. vulgaris*, it is highly likely that it will be present for the 2015 summer season.

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

*Melilotus alba* and *M. officinalis* are a top priority for the EPMT at Denali; ranked 81 and 69, these species have been contained to the George Parks Highway for the past several years and no plants have been found inside the park boundary. As mentioned in prior reports, one *M. Alba* can produce 350,000 seeds per plant (Klein, 2011a), and each of those can remain viable for up to 81 years. *Melilotus* sp. is known to overtop native grassland communities by shading out native species and is also said to have potential to alter sedimentation rates on river ecosystems (Klein, 2011a). It is toxic to animals, and distracts native pollinators such as bees, wasps and flies. For these reasons, eradication is the ultimate goal for the park and its surrounding areas.

This year the EPMT did a sweep of The Canyon and George Parks Highway. Since the efforts made near the Nenana Bridge on mile 237.75 in 2012, the presence of *M. alba* has been significantly diminished along the highway.

A second infestation was found on mile 231 of the George Parks Highway near the McKinley Village on the south side of the Nenana River Bridge. Infestations were found on both sides of the road, with the larger clumps next to the highway but smaller patches of *M. alba* creeping down the hill slope indicative of seed moving with higher velocity water. This infestation is important to track as it is close to the entrance of the Triple Lakes Trailhead on the George Parks highway and could spread along the trailside if not monitored.



Figure 11. Yellow and white sweetclover

The third infestation of *M. alba* was found inside Denali National Park and Preserve on mile 14 of the parks road in conjunction with *C. tectorum*. This infestation needs to be eradicated in the upcoming seasons, as it is within the park boundary and is a heavily trafficked area giving *M. alba* more opportunity to spread.

There is a significant population of *M. officinalis* in the Princess Resort area, specifically on the access road on the south side of the McKinley Chalet. Because this is private property, we informed a member of the grounds crew on invasive species management. It will be important to

monitor the *Melilotus* sp. and continue outreach with the Princess Resort staff on participating regional exotic plant management.

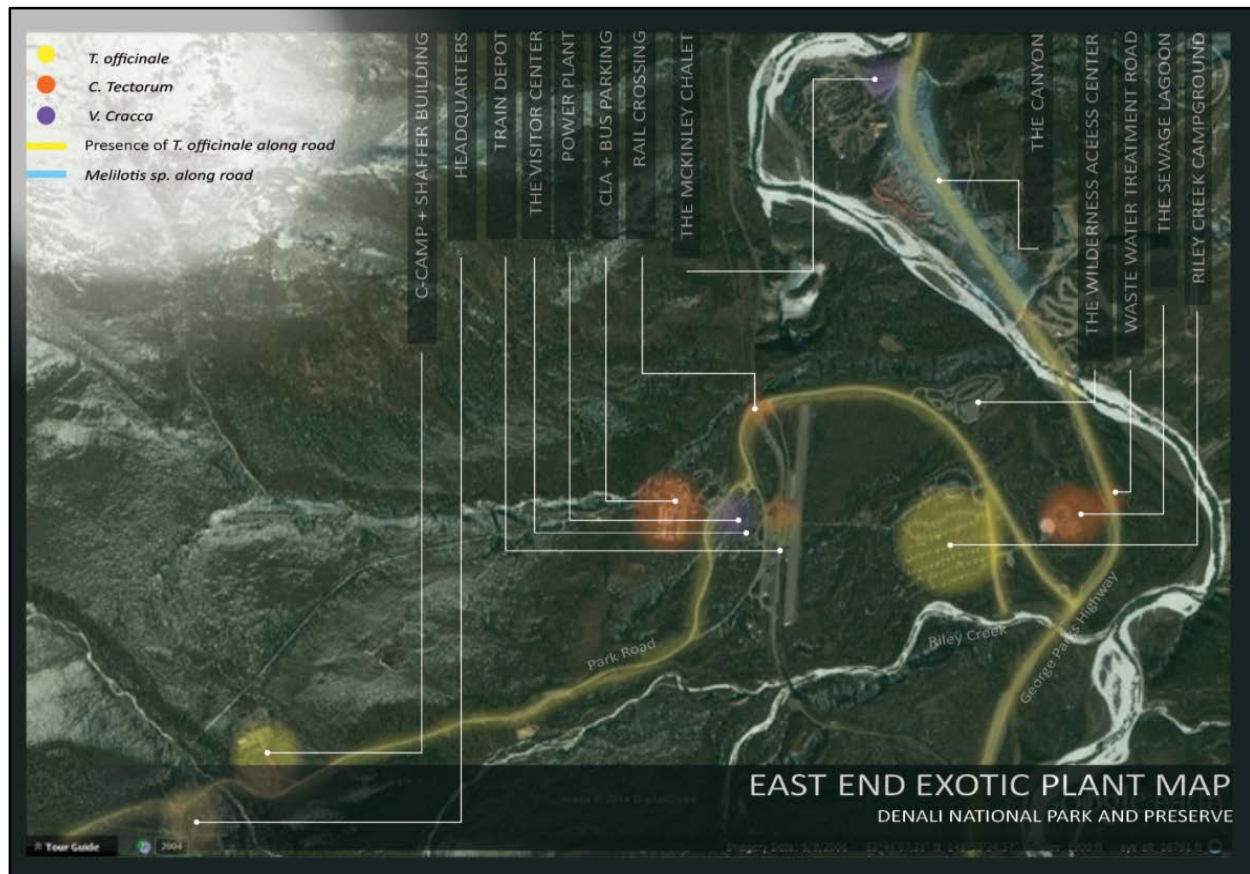


**Figure 12.** East End Exotic Plant Map

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

With an invasiveness ranking of 58, *T. officinale* is the most common invasive found in Denali National Park and Preserve. This perennial herb can grow from 5-50 cm tall, and forms a thick deep taproot, making it difficult to eradicate through manual treatment methods. According to the AKNHP, the common dandelion is a fierce competitor with native plants in taking moisture and nutrients and has been found to provide nectar and pollen for bees in Alaska. Each plant can produce up to 5,000 seeds per year and seeds can remain viable in the soil from 5-9 years (Klein, 2011c).

Although this has not been thoroughly tested with our native pollinators, the common dandelion is said to be potentially altering “the pollination ecologies of co-occurring plants” (Klein, 2011c). Furthermore, this species will often establish quickly after disturbances and influence succession, altering the successional processes after disturbance. This is relevant for Denali National Park and Preserve, as to carefully monitor any dandelion presence in newly revegetated sites.

In Denali National Park and Preserve, *T. officinale* has not spread into the boreal forest or tundra and has remained primarily in disturbed areas and along roadsides. It is highly adaptive, however, and has shown signs of hybridization with some of the native dandelions within the

park. In Alaska, it has invaded the meadows in Glacier Bay National Park and Preserve and is found in the gravel bars of the Nenana River (Klein, 2011c). For this reason, it is important to monitor this species for future spread.



**Figure 13.** Two exotic clovers found within the park. *T. repens* and *T. pratense* pictured left to right

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

Found commonly on the George Parks highway and in the first few miles of the park, *Trifolium* sp. is present among the highly trafficked areas of the park road. *Trifolium repens*, *Trifolium hybridum* and *Trifolium pratense* are ranked 59, 57, and 53 respectively. *Trifolium* spp is considered a nitrogen fixer and could delay the establishment of native species and facilitate the growth of other exotic species. *T. hybridum* and *repens* are used in seed mixes as a forage and cover crop and for erosion control.

#### ***Bird vetch (Vicia cracca)***

Bird Vetch is one of the higher priority species that the Denali National Park and Preserve EPMT encounters. It is ranked 73 on the invasiveness scale, with an aggressive growth habit and is listed as a noxious species in Alaska. This year *V. cracca* was found inside the park near the Power Plant and Visitor Center as it has in past years, and was also found outside the park in The Canyon along the Parks Highway, in the planters of the parking lot at the McKinley Chalet, at Mile 231.75 Parks Hwy, and along the Old Highway on the way to the Denali Education Center (DEC).



**Figure 14.** Bird vetch, *Vicia cracca*

It is difficult to successfully treat by hand pulling and therefore it is one of the species treated with herbicide within the park. This year, the only infestation that needed chemical treatment included the area surrounding the Power Plant. The EPMT uses Milestone herbicide, and all chemical treatments comply with park and state guidelines, which can be found in the appendix. In the Canyon, it will be critical to work with the Princess employees and mobilize their help in eliminating *V. cracca* from their property. It is suspected it came in the soil in the potted plants,

which they would have ordered from Fairbanks or Anchorage. Understanding potential sources of invasive species can help prevent a lot of work in the future.

### **Revegetation and seed collection as a prevention mechanism**

Four revegetation projects were undertaken this year by the EPMT crew. The first one was along mile four of the Park Road, the second along the Sanctuary River corridor on the north side of the park road, the third was along the Rock Creek Trail, the fourth included two smaller areas near the Shaffer Building. The two projects along the park road were due to road construction while the other two were due to smaller disturbances from regular maintenance activities.

Seeds used for the project were harvested within a 20 mile radius of each project and included early succession and gravel bar species such as: Wheatgrass (*Elymus sp.*), Milk vetch (*Oxytropis campestris*), Eskimo potato (*Hedysarum alpinum*), Sweet Pea (*Hedysarum mackenzii*) and the non-native plant annual rye (*Lolium multiflorum*). These seeds come from the Need for Seed project, which uses volunteers to collect native seeds from the park and parks highway.

In addition to native seed, the revegetation efforts included placing live stakes along the mile four project in areas that appeared to be heavily eroded. In conjunction with the planning for the El Dorado Stream restoration project in Kantishna, which calls for live stakes in its revegetation plan, the EPMT found it important to test the planting suggestions from the *Native Plant Revegetation Manual for Denali National Park and Preserve*. The plantings took place on the week of June 1<sup>st</sup>, as suggested in the manual. The team utilized felt willow cuttings, approximately 25-45cm in length, and 1.0-2.5 cm in diameter for each stake. Planting included digging shallow holes at approximately 45 degree angles, allowing approximately 5-8cm of the cutting to protrude from the soil. The team used Agriform fertilizer tablets (approximately half a tablet/stake), and were sure to place the tablet so it would not be touching the cutting. Throughout the season the cuttings did not seem to take hold; it will be important to note their success by the end of next summer, as to allow a full season for them to establish. It may be useful to add a rooting hormone and be sure to plant deeper holes, as the ones in the slope could not be planted as deep as the *Native Plant Revegetation Manual for Denali National Park and Preserve* suggested due to a thin layer of topsoil and then rock.

Photos from the 2010 Kennels Road Project, the Shaffer Building revegetation, and the Waste Water Treatment Plant (WWTP) and were taken as inventory and monitoring. In the summer of 2014, 2.28 acres were revegetated by planting native seeds.



**Figure 15.** SCA Crew members use pulaskis to reduce the amount of soil compaction in the revegetation area near C-Camp

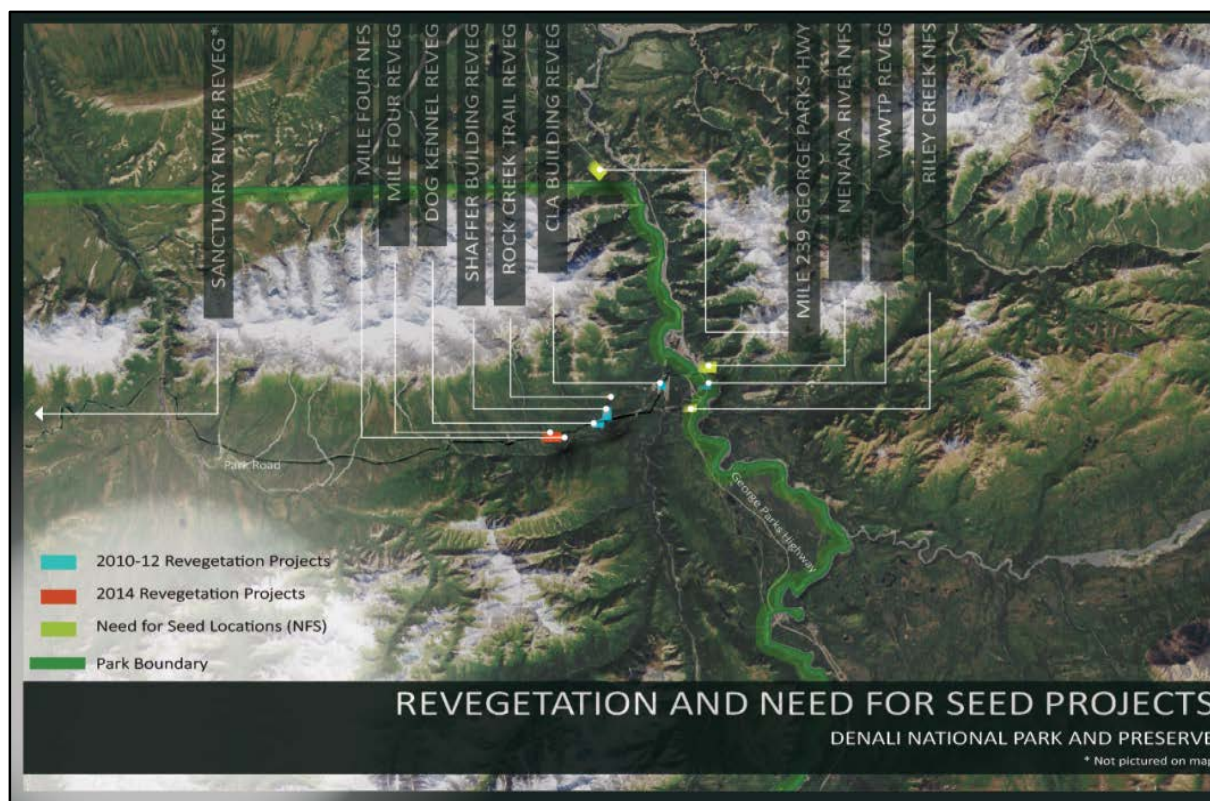


**Figure 16.** Map of Revegetation and Need for Seed Projects

The Need for Seed is a yearly seed collection that focuses on gathering native seed for park revegetation projects. A total of 26 lbs. of native seeds were collected this year. The EPMT mapped the Need for Seed locations on the East End. These locations included:

- The Nenana River – On the south side of the Nenana River, east of the Nenana River bridge on mile 237.25 Parks Hwy. This area is currently the primary seed collection location for *Oxytropis campestris* and *Leymus innovatus*.
- Riley Creek- This seed collection area can be accessed by a social trail that begins at the far end (south) of the overflow parking area for the Riley Creek Campground. This area is where many of the seeds for *Hedysarum alpinum* are found.
- George Parks Highway- On mile 239 of the Parks Hwy, *Hedysarum mackenzii* seeds were collected. Due to the anticipated construction, this site may not be available for upcoming seasons.
- 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 Need for Seed locations are:

- 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 great source for *Arnica lessingii*.
- Mile 85 and the Wonder Lake Campground Rd. – *Elymus* sp. can be found here.



**Figure 17.** Wendy making the Native Seed Mix for a revegetation project.

### Education and Outreach

This season's outreach was primarily focused on educating individuals and groups that would pass through any control areas. Considering the wide area that the EPMT covers, this method is quite effective in educating both locals and visitors about exotic plant management and the importance of native seed collection and revegetation.

### Teklanika Vegetation Beds

Teklanika rest stop is an opportunity to educate visitors on native plant communities and invasive species in, and outside the park. There are currently raised beds in the rest stop area that contain various native plant species that can be found throughout the park. Including information on native plant species provides a greater context for why there are efforts to control exotic, invasive plant species.



**Figure 18.** Teklanika Vegetation Beds

The EPMT staff has recommendations for these beds that could be fulfilled in future years to help capitalize on the location of these beds, and the time that the visitors are exploring the rest stop. These recommendations include reseeded one of the beds to demonstrate succession of native plant communities. In conjunction with re-seeding one bed, placing a tundra mat in the other would also help demonstrate what a “mature” or undisturbed area looks like versus a newly disturbed area. Additionally, none of the fireweed was in bloom, which resulted in a more “weedy” look; it may be helpful to seed swaths of plants so it

is easier to label and also more accessible to the average visitor. It also may be helpful to have some sort of flipchart or species identification sign to demonstrate the native plants or the native plant communities within the park.

### **Other Outreach Efforts**

In 2012, a concerted effort was made to create multiple ways to educate visitors as they moved through the park. This was continued in 2013 and 2014. Volunteers that participated in invasive plant control work at the park received identification booklets and other educational handouts that could be shared with their respective communities.

Another yearly effort is to distribute information and tools for exotic plant management throughout the park. This included the Dog Sled Kennels, the Recreation Hall at C-Camp, and the Denali North Face Lodge in Kantishna. The dual benefit of this is to provide resources for action and education throughout the park.

In future years it will be worthwhile to pursue programs that include areas in the Canyon, and perhaps facilitate learning within the existing framework of tours that exist within and outside the park boundary. This could include programs such as eco-tourism or volunteer tourism that would get more of the transient community involved in exotic plant management.



**Figure 19.** Education and Outreach

# Discussion

## Sites treated and Recommendations

The following outlines recommendations for the 2015 field season.

- Revegetation photos should be taken in the 2016 season of the four projects seeded by the team this year: The two areas near the Shaffer Building, along Rock Creek Trail, mile four of the Park Road and the area near Sanctuary River along the Park Road.
- This year, the EPMT spent a significant amount of time working on *Taraxacum officinale* treatment in Kantishna, specifically the areas of Friday Creek near the Denali Backcountry Lodge and the Horse Corral near Eureka Creek. Both of these areas experienced a high degree of disturbance due to the flooding that occurred in June 2014. This disturbance most likely wiped out much of the *T. officinale* in the area; it will be crucial to monitor this area and remove any *T. officinale* in the surrounding areas (for example Friday Creek Camp), to capitalize on the fresh start the floods provided.
- Park Road maintenance: The floods mentioned in Kantishna created a high degree of disturbance, especially along the Park Road corridor, leading to road maintenance in this area. Furthermore, an area on mile 89 of the park road known as “Eagles Nest.” As some of the resources were not inspected (i.e. soils, equipment) by the EPMT, it will be important to monitor these areas for invasive species beginning in early summer.
- This season, the EPMT SCA intern made some visual representations of exotic plants in the park. These maps were done with a combination of the data collected with the Trimble units over the summer, Pathfinder, ArcMap and Adobe Illustrator and InDesign. These maps were not to scale and aimed to provide a visual aid to exotic plant management in Denali National Park. It will be interesting to compile data in future years in ArcMap and get a better idea for how specific species have moved within the park, and provide scaled maps with more accurate data.
- The sewage lagoon area contains a significant population of *Crepis tectorum*. This year, with the help of SCA volunteers, a large portion of it was removed. There is also a significant population of *C. tectorum* along the outflow pipe of the WWTP, now a revegetated area, leading across the George Parks Highway and down to the Nenana River (Mile 237.25 Parks Hwy). Crepis sweeps should continue along this area of the park.
- One project that the EPMT was not able to get to for the 2014 season was hanging Gypsy Moth Traps in the Riley Creek Campground. Due to time constraints, the traps would not have been hung at an appropriate time in the summer. This should be a project undertaken in the 2015 season, as Gypsy Moths have been known to cause extreme damage to native flora.
- Mile 237.25, west and east sides of the George Parks Highway, also known as the Waste Water Treatment Plant Revegetation, are infested with *C. tectorum* and should be carefully monitored along with the Sewage Lagoon.

- As mentioned by Ring and Mahvolic 2012, “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.” This recommendation should be continued in the 2015 season.
- For the El Dorado Creek Restoration, the live willow stakes should be planted in June utilizing a rooting hormone and fertilizer as suggested by the *Native Plant Revegetation Manual for Denali National Park and Preserve*.

## Conclusion

As discussed, the focus of the 2014 EPMT at Denali National Park and Preserve is to continue controlling *T. officinale*, and preventing the spread of *Melilotis sp.*, *V. Cracca* and *C. tectorum* into the park. This year, *C. tectorum* appeared to continue its march up the park road, and so it should be a primary focus of the 2015 EPMT team to continue aggressively with the crepis sweeps in the front country of the park. *T. officinale* is found along the roadside and should continue to be monitored and manually treated. It may be good to treat a larger portion of the Headquarters area as many of the park vehicles are stationed here and frequently are taken further into the park. Furthermore, opening up communication with the Princess Resorts landscape crew would be fruitful, as it would open up more opportunities for education and outreach and prevent many of the exotic species within the Canyon area from spreading into the park.

The work that the Denali National Park and Preserve EPMT crew and its volunteers do each year is ultimately to conserve the ever diminishing wilderness that was once expansive across the nation. Through continued education and outreach, improved technologies in data collection and distribution, and a passion for conservation and restoration, Denali National Park and Preserve has an opportunity to serve as an example of what our country represents and will remain a place of peace and true wilderness for future generations to enjoy.

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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, and 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.



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

NPS 184/127397, December 2014

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