
Unalakleet Wild River Invasive Plant Management Plan



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Introduction

The establishment, growth, and persistence of non-native¹ plant species pose a serious threat to native ecosystems. Even though not all non-native species cause significant economic or ecological harm, *invasive*² plants (hereafter also referred to as weeds) are well known to alter community composition, successional pathways, nutrient cycling, hydrology, and fire regimes, as well as to reduce or eliminate threatened and endangered native species populations (U.S. Congress 1993, Busch 1995, Myers 1997, Brooks 1999, Stein *et al.* 2000).

While invasive plants constitute a major problem in the lower 48 states (*cf.* Randall 1996), Alaska has remained largely unaffected by non-native plants. However, over the last ten years there has been a marked acceleration in the rate of introduction of non-native plants to the state, probably driven by increases in population, commerce, development, gardening, and outdoor recreation activities (Carlson and Shephard 2007).

The susceptibility of native plant communities to invasion is largely a function of the degree to which communities are naturally or anthropogenically disturbed (Hobbs and Huenneke 1992). In Alaska, non-native plant occurrence is most strongly correlated with high-use areas, such as transportation routes (roads, trails, and railroads), campgrounds, cabins, and boat ramps. Increased opportunities for introduction and low-competition, disturbed substrates likely both contribute to the establishment of non-native plant in high-use areas. In some cases, however, invasive weeds have even been documented moving off the human footprint into natural ecosystems (Lapina *et al.* 2007; Cortés-Burns *et al.* 2007, 2008; Conn *et al.* 2008; Villano and Mulder 2008).

Background information and objectives

The Unalakleet National Wild River, located in northwestern Alaska, runs east to west through the Nulato Hills to the coastal village of Unalakleet, at the shores of Norton Sound. The river spans 105 river miles from its headwaters to its mouth; the upper 81 miles are designated “National Wild³” (NWR) and are administered by the Bureau of Land Management (BLM), Anchorage Field Office (AFO).

The Unalakleet river corridor served as a major trade route in the 19th century, connecting coastal Eskimos with Yukon River interior peoples and Russian merchants. In addition, a section of the Iditarod National Historic Trail, which was once used by Alaska Native hunters, Russian explorers, and gold seekers, runs parallel to the river, thus increasing the human footprint along the river’s banks.

At present, there are a number of native allotments in the lower reaches of the river (the last 24 river miles), some of which have cabins or other structures on them. In addition to the Native-owned parcels, there are two BLM-managed cabins in the upper reaches of the river (Tripod Flats and Old Woman), two

¹ Non-native plants are plants whose presence in a given area is due to the accidental or intentional introduction by humans (AKEPIC 2005)

² Invasive plants are non-native plants that produce viable offspring in large numbers and have the potential to establish and spread in natural areas (AKEPIC 2005). Some invasive plants have strong negative impacts on native ecosystems, cause important economic losses, or can be detrimental to human health.

³A "wild river" is free of impoundments, generally inaccessible except by trail, with primitive watersheds and shorelines, and has unpolluted waters. The BLM manages the [Unalakleet National Wild River](#) to provide high-quality primitive recreation opportunities, protect water quality, protect historic and archaeological values, and preserve the remarkable resources for which the river was designated.

abandoned structures closer to the river's mouth (old Mink Farm⁴ and Ryan Cabin), and a privately run fishing lodge located 10 miles upriver from Unalakleet that attracts visitors from outside the region ([Unalakleet River Fishing Lodge](#)). Covenant Bible Camp, located 10 miles up the North River (a tributary of the Unalakleet) is another high-use site in this area: each summer this camp houses hundreds of youth from rural villages across Alaska. Finally, the village of Unalakleet, which lies at the mouth of the river, has long been a major trade center as the terminus for the Kaltag Portage (a winter travel route) and therefore constitutes a historic and present-day high-use site.

In response to the acceleration in the rate of introduction of non-native plants to Alaska, land managers across the state have started to develop weed management plans to minimize additional introductions and mitigate the impacts of invasive plants on their lands (Slemmons 2007, BLM Central Yukon Field Office 2009, Gary 2010, Heidemann *et al.* 2010, Flagstad *et al.* 2011).

To develop an effective weed management plan, it is crucial to have good baseline information on existing infestations as well as on propagule source areas and dispersal vectors. To date, there has only been one project focused on recording the presence and abundance of non-native plants in the Norton Sound area: in 2009, the Iditarod National Historic Trail was inventoried for non-native plants. As part of this effort, checkpoints and other high-use areas along the trail, including Unalakleet, Tripod Flats Cabin, and Old Woman Cabin, were inspected (Flagstad and Cortés-Burns 2010).

In 2010, the BLM-AFO entered into an agreement with the Alaska Natural Heritage Program (AKNHP) and the Native Village of Unalakleet (NVU) whereby NVU would hire local youth and AKNHP would train them in invasive plant species identification, survey, and management. The main objectives of this partnership were to:

1. Survey high-use sites along the river corridor, recording additional infestations and identifying source areas, vectors of dispersal, and weed-free sites.
2. Have AKNHP assist the NVU trained youth in the development of a weed management plan for the area.
3. Encourage long-term stewardship of the area's natural resources.
4. Provide skills and employment in a region with fewer economic opportunities.

This report primarily describes the 2010 Unalakleet River survey findings, identifies sites and infestations for monitoring or control work, and provides recommendations on partnership and outreach opportunities to help manage existing and new invasive plant infestations in the area more effectively.

⁴ Mink Farm is a rare, intact example of the fur farms that operated in western Alaska in the early 1900s.

2010 weed training and survey results

Between July 26 and August 5, 2010, AKNHP worked with NVU to educate and train five youth from Unalakleet in invasive plant biology, identification, and survey techniques.

Invasive plant identification workshop (Unalakleet)

A weed biology and identification workshop developed by AKNHP was offered to the community of Unalakleet on July 26, 2010. The workshop began with a short introductory section that presented the problems associated with invasive plants in the lower 48 states as well as in Alaska, the threats invasive plants pose to landowners and land managers, and the methods by which the introduction of invasive plants into new areas can be prevented. Subsequently, pressed specimens (and when available, live material) of some of Alaska's most invasive non-native plants and some of the non-native plants that had been reported previously from the Unalakleet area (Flagstad and Cortés-Burns 2010) were passed around; AKNHP instructors (Helen Cortés-Burns and Erin Johnson) pointed out the diagnostic traits that distinguish these species from similar looking native and non-native species also found in Alaska. Four of the five youth hired by NVU were able to attend the workshop (see [Appendix I](#) for list of attendees).

Non-native plant surveys

Surveys were conducted by Dominique Collet (AKNHP), Erin Johnson (AKNHP), and the four NVU youth interns (see [Appendix I](#) for names) with logistical support from Henry Oyoumick and Wilfred Eakon. The field crew surveyed c. 45 river miles of the Unalakleet, from the mouth of the river to c. 3 miles past Mink Farm. Less than 30 of the 81 river miles administered by BLM were visited because the upper reaches of the river were not navigable at the time of the survey. In addition, plots were read in and around the village of Unalakleet (Fig. 1).

Plots were set up where non-native plants were most likely to occur: at high-use, man-made sites (e.g.: roads, cabins, summer camps, abandoned structures, the Iditarod trail) or in naturally disturbed sites (e.g. along the river, on unvegetated gravel bars, log jams, etc.). Data collected within each plot included the following: percent covers of dominant native and all non-native species, vegetation type (e.g. open white spruce forest), disturbance type (i.e. imported fill, brush cutting/mowing), description of substrate (i.e. percent and type of unvegetated ground cover), and control action (if any). If non-native plant species were observed, we documented the number of stems for that species (within the plot), as well as the estimated number of acres infested by it (not restricted to the plot). At a minimum, one voucher specimen was collected for each non-native plant recorded during the survey. If the specimens were in good condition, they were subsequently mounted. A list of the native and non-native plant specimens that were collected during this trip and are now housed at the University of Alaska Anchorage Herbarium (UAAH) is provided in [Appendix II](#).

In all, 25 plots were read: 12 along the Unalakleet River proper and 10 in nearby areas that seemed especially vulnerable to non-native plant invasion. An additional three plots were read by AKNHP botanist Helen Cortés-Burns and assistant Erin Johnson in the village of Unalakleet prior to the actual start of the river surveys (two of these were set up with the NVU youth in order to demonstrate how AKNHP collects data on non-native plant populations).

Approximately 2 acres of land were exhaustively⁵ inventoried for invasive species during this project, while almost 3 acres were estimated infested⁶ by at least one non-native species. Over 80 percent of the 3 acres corresponded to two large populations of very weakly invasive *Chenopodium album* (invasiveness rank 37, common lambsquarters)⁷, which were recorded at the cargo dock and on a stabilized erosion bank between the slough and a nearby dog lot in Unalakleet. The White Alice site, the nearby contaminated soil cleanup area, and Air Force Hill contained small populations of modestly invasive *Crepis tectorum* (54, narrowleaf hawksbeard) and *Taraxacum officinale* ssp. *officinale* (58, common dandelion). The only infestations recorded along the BLM-administered Wild portion of the Unalakleet River corresponded to small, discrete populations of *Chenopodium album* found at two naturally disturbed sites: a log jam bar (downriver of Mink Farm) and Point Bar (upriver of Mink Farm).



Figure 1. Project area (red striped polygon delimits the area surveyed in 2010).

⁵ Exhaustive inventories are those in which all non-native plant populations observed within a plot are recorded.

⁶ The number of acres estimated infested for a given non-native plant population can be smaller or larger than the size of the plot at which the population is observed. The former reflects that actual size of the infestation, while the latter captures the characteristics of the infestation within a given plot's boundaries.

⁷ The information summarized in brackets refers to the species' invasiveness rank and its common name. Rank refers to the points assigned to a given species by the Invasiveness Ranking System for Non-native Plants of Alaska (Carlson *et al.* 2008). This method ranks species on a scale of 0 to 100, with 100 being an extremely invasive species. Hereafter, whenever a species is first mentioned in the report, its common name and invasiveness rank will be provided in brackets in a similar fashion.

Unalakleet village and vicinity

While conducting the invasive species identification workshop, AKNHP botanist Helen Cortés-Burns and assistant Erin Johnson read three plots in the village of Unalakleet: one to record non-native species growing along the main roads in the village and two to educate the interns on how to collect survey data on non-native plant infestations. Upon completion of the river trip, the field crew read an additional plot by the riverbank, in the village. The data collected from these in-town surveys (Fig. 2, Table 1) provided indications of which species were likely to occur further upriver.

The field crew also surveyed five high-use/high-disturbance sites located in the vicinity of Unalakleet and connected to the village by roads: the cargo dock, the pump house, Air Force Hill, Army Hill, and the White Alice military site (Fig. 3, Table 2).

Table 1. Non-native plants recorded in Unalakleet.

Scientific name	Invasiveness Rank*	village roads	by school playground	boat ramp, between AC store and slough	riverbank by slough and dog lot	Infested acres
<i>Capsella bursa-pastoris</i>	40		X			0.001
<i>Chenopodium album</i>	37		X	X	X	1.002
<i>Hordeum jubatum</i>	63	X		X	X	0.021
<i>Matricaria discoidea</i>	32		X	X	X	0.021
<i>Polygonum aviculare</i>	45	X	X			0.002
<i>Stellaria media</i>	42	X	X			0.002
<i>Taraxacum officinale</i> ssp. <i>officinale</i> ‡	58	X				0.001

*Management recommendations are only provided for non-native species with invasiveness ranks greater than or equal to 50 points.

‡ A few small and discrete populations of the (non-native) common dandelion, *Taraxacum officinale* ssp. *officinale*, were observed along the main roads

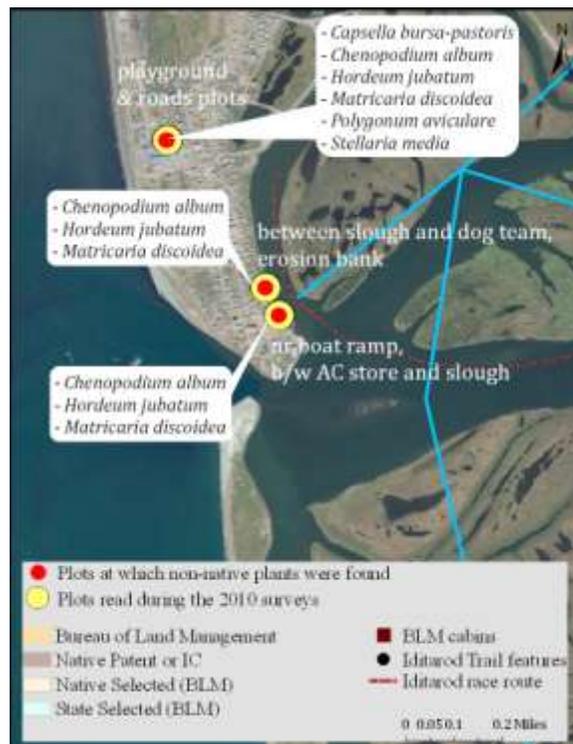


Figure 2. Unalakleet survey sites.

Half of the total acreage estimated to be infested during the 2010 surveys corresponded to a large (1.5 acre) population of very weakly invasive *Chenopodium album* (37, common lambsquarters) located at the village's cargo dock (Fig. 3a), growing alongside smaller populations of *Hordeum jubatum* (63, foxtail barley), *Matricaria discoidea* (32, pineapple weed), *Plantago major* (44, common plantain), and *Polygonum aviculare* (45, prostrate knotweed).

The second largest infestation, also of *Chenopodium album*, accounted for 30 percent of the total infested acreage and was located on a stabilized erosion bank between the slough and a nearby dog lot in the village (Fig. 2). Discrete populations of *Hordeum jubatum* and *Matricaria discoidea* were also recorded from this location.

The White Alice site (including the contaminated soil cleanup area) and Air Force Hill contained smaller but more highly aggressive non-native plant infestations. *Crepis tectorum* (54, narrowleaf hawksbeard, 0.1 acres) and *Taraxacum officinale* ssp. *officinale* (58, common dandelion) were recorded at both locations.

Air Force Hill is the only site in the area at which *Senecio vulgaris* (36, common groundsel) was detected. The closest known populations of *Senecio vulgaris* are located in Anchorage and Fairbanks. The Unalakleet population results in a notable range extension for this species.

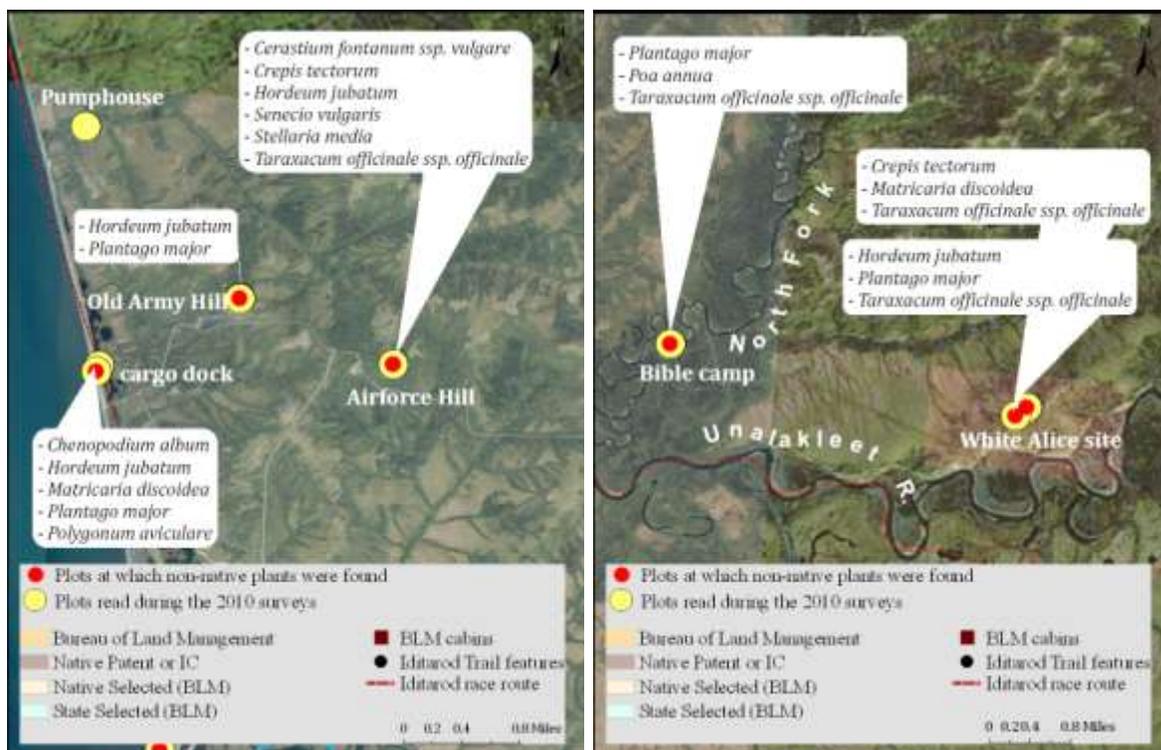


Figure 3. *Crepis tectorum* was recorded on Air Force Hill [left] and at the White Alice site [right].

Table 2. Non-native plants recorded at high-use sites near Unalakleet.

Scientific name	Invasiveness Rank*	Air Force Hill	Old Army Hill		Cargo dock		Pump house	White Alice site		Infested acres
			nr ATV trail		nr road	intertidal zone		tower	soil removal site	
<i>Chenopodium album</i>	37				X					1.5
<i>Crepis tectorum</i>	54	X						X		0.11
<i>Hordeum jubatum</i>	63	X	X	X	X			X		0.023
<i>Matricaria discoidea</i>	32				X			X		0.002
<i>Plantago major</i>	44			X	X			X		0.003
<i>Polygonum aviculare</i>	45				X					0.001
<i>Senecio vulgaris</i>	36	X								0.01
<i>Taraxacum officinale</i> ssp. <i>officinale</i>	58	X						X	X	0.021

*Management recommendations are only provided for non-native species with invasiveness ranks greater than or equal to 50 points.

Unalakleet River

The field crew visited Covenant Bible Camp, located on the shores of the North River (a tributary of the Unalakleet). This is a high-use area and could therefore constitute a potential source of weed propagules downstream to the Unalakleet. Three weakly to modestly invasive species were recorded at this summer camp (Fig. 3b, Table 3).

Further upstream, the crew read three plots on Native-owned portions of the river corridor: one along a river cut bank and two at Henry's cabin (Fig. 4, Table 3). All were weed-free.

Nine plots were read on BLM-administered sections of the Unalakleet. Areas targeted for surveying included Mink Farm (a historic high-use site), naturally highly disturbed sites (cut banks, log jams, and gravel bars), and areas where the Iditarod Trail runs close to or intersects the river. Only two small populations of *Chenopodium album* were recorded along this stretch of the river, and both were associated with the presence of bare mineral soil exposed by natural (fluvial) disturbances (Fig. 4b, Table 4).

Table 3. Non-native plants recorded on the North River and on Native lands along the Unalakleet.

Scientific name	Invasiveness Rank*	Henry's cabin, nr ridge	Henry's cabin	River cut bank	Bible Camp, nr chapel	Infested acres
<i>Plantago major</i>	44				X	0.01
<i>Poa annua</i>	46				X	0.01
<i>Taraxacum officinale</i> ssp. <i>officinale</i>	58				X	0.001

*Management recommendations are only provided for non-native species with invasiveness ranks greater than or equal to 50 points.

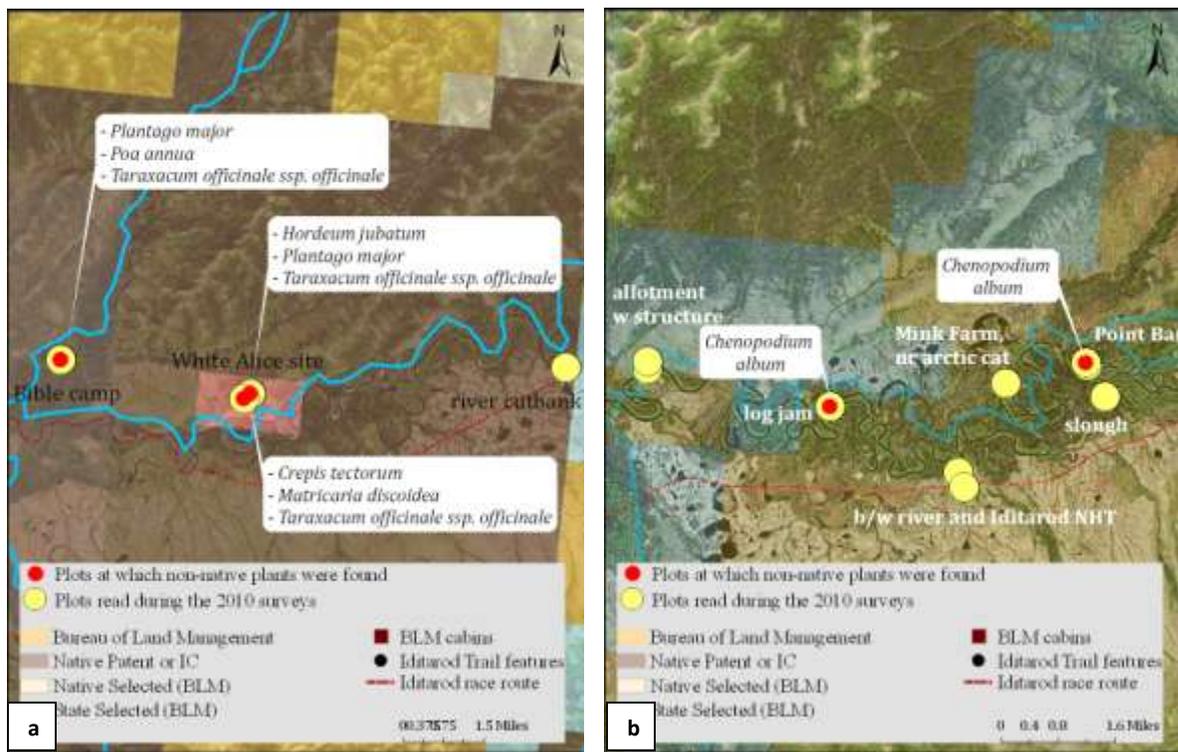


Figure 4. Native [a, b] and BLM [b] lands surveyed along the Unalakleet River.

Table 4. Non-native plants recorded on BLM-managed lands along the Unalakleet.

Scientific name	Invasiveness Rank*	Point Bar	UNK10-(04-07) riverbank plots	Mink Farm	Iditarod Trail: tundra between river and trail	Iditarod Trail: 100 yds west	Log jam, re-routed gravel bar	Infested acres
<i>Chenopodium album</i>	37	X					X	0.002

*Management recommendations are only provided for non-native species with invasiveness ranks greater than or equal to 50 points.

Weed management along the Unalakleet NWR

Existing conditions

The 2010 survey results indicate that the Unalakleet River and surrounding areas are still largely weed-free. Furthermore, most of the non-native plant populations recorded in 2010 were only very weakly to moderately invasive and extremely widely distributed throughout Alaska.

Riparian corridor

Only two non-native plants have been recorded thus far on the Unalakleet riverbanks: *Chenopodium album* (2010) and *Hordeum jubatum* (Flagstad and Cortés-Burns 2010).

The weakly invasive *Chenopodium album* (Fig. 5) accounted for **80 percent of the total acreage estimated infested** in 2010, and was the second most frequently occurring species after *Hordeum jubatum* within the project area. It was documented at two naturally disturbed river sites within BLM administered lands in 2010.



Figure 5. *Chenopodium album*: mature plant [left], at Point Bar [center], and at the log jam [right].

Although the crew was not able to access the two BLM cabins situated further upstream, previous work in the area (Flagstad and Cortés-Burns 2010) showed that Tripod Flats cabin was weed-free, while Old Woman Cabin had a small infestation of *Hordeum jubatum* (Fig. 6). This weed was likely introduced with straw but became established due to mineral soil having been exposed during clearing of the woody vegetation around the cabin (Flagstad and Cortés-Burns 2010).



Figure 6. Old Woman Cabin [left]. Detail of *Hordeum jubatum*'s purple spikes and long awns [right].

Of noteworthy importance is the absence of non-native plants at currently and historically anthropogenically disturbed sites such as Henry Oyoumick's cabin, Old Mink Farm, and the area between the river and the Iditarod Trail (Fig. 7).

Covenant Bible Camp, located 10 miles up the North River (a tributary of the Unalakleet), is the most heavily used/visited site along the project area's riparian corridors (Fig. 8). The camp runs five different programs, each of which hosts over 100 people per week, and has undergone lots of construction work in the past two years (during the 2010 surveys, they were building new staff housing, resulting in lots of new, unvegetated, disturbed clearings). Nonetheless, only three non-native plants were recorded here (*Taraxacum officinale* ssp. *officinale*, *Poa annua*, and *Plantago major*), all of which are widespread across Alaska, are strongly associated with trampling, and rarely are observed growing in undisturbed native vegetation.

The crew did not stop at the privately run fishing lodge located 10 miles upriver from Unalakleet ([Unalakleet River Fishing Lodge](#)). This site is reported to receive fewer visitors per year than Covenant Bible Camp. However, the fishing lodge is more likely to attract people from outside the region, thus increasing the likelihood that invasive plant propagules could be introduced here.



Figure 7. Old Mink Farm [left] and section of the river that parallels the Iditarod trail [right].



Figure 8. Covenant Bible Camp.

Village and vicinity

Populations for three modestly to moderately invasive species were documented during the 2010 surveys, all at high-use areas in or near Unalakleet. *Crepis tectorum* was recorded at the [White Alice site](#) and on Air Force Hill (Fig. 9); *Hordeum jubatum* was observed at the White Alice site, on Air Force hill, on Army hill, in town, and at the cargo dock; and *Taraxacum officinale* ssp. *officinale* was found at the White Alice site, on Air Force Hill, in town, and at the Bible Camp on the North River. All other non-native plant species recorded in the area (*Chenopodium album*, *Matricaria discoidea*, *Plantago major*, *Polygonum aviculare*, and *Senecio vulgaris*) are very weakly to weakly invasive and are not expected to spread beyond the disturbed areas they currently inhabit.

Other noteworthy observations made in 2010 were the *Senecio vulgaris* population on Air Force Hill, which resulted in a considerable range extension for this species, and the absence of weeds at the Pump House, a high-use site that is currently administered by the City of Unalakleet and is where the water for the village comes from (Fig. 10).



Figure 9. *Crepis tectorum* growing at the White Alice Site [left] and on Air Force Hill [right].



Figure 10. Pump House.

Sources and dispersal vectors of invasive plant propagules

After the fieldwork concluded, Laurie Thorpe (BLM-AFO) and Helen Cortés-Burns (AKNHP) returned to Unalakleet to meet with all survey participants and document their methods and the outcomes of the project. Below, we highlight weed propagule source areas and mechanisms or vectors that could assist in the dispersal of weeds within the region as determined by the surveys and/or comments made during the wrap-up meeting (notes from the wrap up meeting are provided in a separate PDF file).

Source areas

1. The barge dock

Although this site only contains very weakly to moderately invasive species, the large infestation of *Chenopodium album* recorded here in 2010 suggests that this high-use site is subject to frequent disturbances that favor the establishment of early successional plant species (a trait of many invasive species). The main concern with this site is not the weeds observed here in 2010 but, rather, the possibility of new, potentially more aggressively invasive plants being introduced (arriving as contaminants either on the barges or from the village), becoming established due to ground disturbance activities, and then spreading inland and upriver.

2. White Alice site

From 1958 to 1978, the U.S. Air Force operated the North River Radio Relay Station (RRS) in the Unalakleet area. The station was abandoned in 1978, and, in 2003, soil contaminated by polychlorinated biphenyls (PCBs) was discovered. To date, some of the contaminated soil has been removed either by sealing the contaminated soil in drums and airlifting it to Elmendorf Air Force Base for proper disposal or by placing it in double super-sacks, storing them in seavans, and barging them to a disposal facility in the lower 48. In some cases, the cleanup sites were backfilled with new gravel. In 2010, the military-managed White Alice land parcel contained populations of modestly to moderately invasive *Hordeum jubatum*, *Taraxacum officinale* ssp. *officinale* and *Crepis tectorum*. Because berry pickers and grouse and moose hunters use these lands, the likelihood that propagules of these aggressive weeds could spread to surrounding, weed-free sites is high, and the site therefore constitutes a management concern.

3. Army and Air Force Hills

Similar to the White Alice site, both hills contain a number of (weakly to moderately) invasive plants (Fig. 11) and are connected to the village by roads, which can act as weed dispersal corridors. Of special concern is the *Crepis tectorum* infestation at Air Force Hill.

4. Other places that could become source areas

Covenant Bible Camp and the Unalakleet River Fishing Lodge host visitors from across and outside the state every summer. Visitors could inadvertently bring invasive plant propagules to these sites on their gear and boots.

Furthermore, Covenant Bible Camp has recently undergone considerable construction work to provide new staff housing. This has resulted in the creation of clearings around the chapel area,



Figure 11. Old Army Hill.

which could facilitate the establishment of invasive plant propagules that are already present there or that could be introduced by camp participants or construction workers in the coming years.

Potential weed dispersal vectors

1. Roads, winter trails (including the Iditarod Trail), and river corridors

All three transportation routes facilitate not only the movement of goods and people, but also of weeds, as they represent clearings in what is otherwise native, undisturbed vegetation. In this context, it is important to note that the village of Unalakleet was paving its main roads in 2010. Road construction and maintenance projects are frequent sources of weed introductions in other parts of the state; however, most of the machinery used was local, and the gravel was from St. Paul. Nevertheless, it would be worthwhile to conduct cursory roadside surveys in 2011 and 2012 to determine whether any new invasive plants have been introduced through this work.

2. Hay and straw

Bales of hay and straw, such as those used by dog mushers during the Iditarod Race, constitute an important pathway for the introduction and movement of weeds in Alaska (Conn *et al.* 2010). Most bales purchased for use in Alaska are from the lower 48; even if bales from the lower 48 are designated weed-free, they still contain a greater diversity of more highly aggressive plant propagules than do locally produced bales (designated weed-free or not; Conn *et al.* 2010). Therefore, locally produced bales of hay and straw are preferable.

3. The airport

Invasive plant propagules can arrive as hitchhikers on cargo, planes, or travelers, and can easily become established along the largely unvegetated, constantly disturbed airstrip. It is therefore important to monitor this site for the early detection and eradication of non-native species that would be new to the area.

4. The fish counting tower

Crews from Unalakleet and other parts of Alaska are hired to work at the fish counting tower every summer. The NVU youth hired in 2010 spotted some *Matricaria discoidea* plants at this site in mid August, 2010 (as this observation was made after the weed surveys concluded, it is likely that other very weakly invasive weeds are also already present in this area but went undetected). Given the volume of people and boat traffic at this site and the near-absence of non-native plants further upriver, we recommend that the fish counting tower be monitored to prevent the establishment of new, more highly aggressive weeds that could then spread upstream.

5. Fishing, hunting, and berry picking activities

All subsistence and recreation activities involve the movement of people (locals or visitors) from Unalakleet to more remote sites in the area, potentially resulting in the accidental transport of weed propagules from infested to uninfested sites. In general, hunters and berry pickers will tend to go to sites that can be accessed from the roads (including Air Force Hill, Army Hill, and the White Alice site) or by river.

Proposed management strategies

1. Prevention and Best Management Practices (BMPs)

The most effective, economical, and ecologically sound approach to managing invasive plants is to prevent their invasion in the first place. Although control work may be necessary to limit the spread of existing infestations, a weed management plan that focuses on prevention or early detection of new invasions is the most efficient use of limited resources.

The following BMPs are central to actively preventing the introduction of weeds into an area:

1. During construction, maintenance, and soil cleanup projects
 - a. **Minimize soil disturbance**
 - b. Inspect and **clean gear** and equipment of weeds and their seeds at a controlled site
 - c. **Monitor** the controlled site for the establishment of new weed populations
 - d. **Avoid** moving gear and equipment **used in an infested area to weed-free areas**
2. Implement an “**Early Detection and Rapid Response**” (EDRR) program for the area (especially for **high-risk areas** such as human and animal transportation corridors, construction sites, and disturbed or bare ground) to detect and eliminate new patches of weeds (discussed in greater detail [below](#))
3. **Evaluate the effectiveness of the prevention plan** on an annual basis, so appropriate modifications can be implemented the following year
4. **Support** the development and distribution of **locally produced hay and straw** (and mulch)
5. **Educate** people on weed identification, biology, impacts, and effective prevention measures (see [below](#) for more details)
6. To be most effective, **unify landowners in implementing proactive weed management** as a cooperative group to maintain common weed-free areas (discussed in greater detail [below](#))

2. Early Detection and Rapid Response

Early detection and rapid response (EDRR) is the process of locating, assessing, and eliminating invasive species populations before they have a chance to spread beyond an initial foothold or grow to unmanageable levels. Invasive plant populations often exhibit a lag time before they cause serious ecological impacts. EDRR enables land managers to find incipient populations of invasive plants and eradicate them before they begin to spread, thus reducing environmental and economic impacts.

This strategy includes surveys for, collection, identification, and risk assessment of, and response to new and emerging species that have established self-perpetuating populations. Early detection of new infestations requires vigilance and regular monitoring of the managed area and surrounding ecosystem. EDRR efforts should be focused on lands within the Unalakleet National Wild River because they are likely not already infested with species of concern. This will aid in keeping “clean” lands free of weeds.

BLM is well suited to improve its early detection capabilities through the collaborative and coordinated efforts of numerous agency programs, field offices, and partners (see [Partnerships](#)). Populations identified through EDRR should be submitted to the [AKEPIC database](#) to maintain current knowledge on new infestations and movements of known populations within Alaska. Current knowledge of infestations is important for the development and adaptation of effective management strategies.

The species listed below are recommended for EDRR based on their proximity to the Unalakleet

National Wild River, occurrence along the Iditarod National Historic Trail, germination from locally produced or imported straw, or high likelihood of establishing in the area (Table 5).

Table 5. EDRR watch list of non-native plant species likely to establish along the Unalakleet.

Scientific Name	Invasiveness Rank	Known from Unalakleet area (site)	Known from Iditarod NHT†	Possible contaminant of straw*
<i>Melilotus alba</i>	81	--	--	--
<i>Bromus tectorum</i>	78	--	--	imported
<i>Caragana arborescens</i>	66	--	X	--
<i>Bromus inermis</i> ssp. <i>inermis</i>	62	--	X	local and imported
<i>Leucanthemum vulgare</i>	61	--	X	--
<i>Elymus repens</i>	59	--	--	imported
<i>Trifolium repens</i>	59	--	X	local and imported
<i>Taraxacum officinale</i> ssp. <i>officinale</i>	58	16, 17, 23, 24	X	local and imported
<i>Crepis tectorum</i>	54	17, 24	X	local
<i>Phleum pratense</i>	54	--	X	local and imported
<i>Brassica rapa</i>	51	--	X	local and imported
<i>Tripleurospermum inodorum</i>	48	--	--	--
<i>Hordeum vulgare</i>	NR	--	X	local and imported

†Species documented along the Iditarod National Historic Trail during the 2009 surveys (Flagstad and Cortés-Burns 2010).

*Non-native species germinated from seed contaminants in imported and/or locally produced straw that was not certified as weed-free (Conn *et al.* 2010).

3. Inventory and monitoring

Monitoring (periodic observation and documentation) is vital to a successful weed control program and, like education, EDRR, and control, is an ongoing and dynamic process. It is the collection of information (data) to determine the effectiveness of management actions in meeting the prescribed objectives. A monitoring program can determine which objectives are not being met, which actions need to be modified, and which actions should be ceased because they are not working.

Based on the 2010 non-native plant survey results, we recommend the following:

1. Sites that should be prioritized for a non-native plant inventory include:
 - a. The (privately owned) Unalakleet River Fishing Lodge
 - b. The NWR section of the Unalakleet River that was not navigable in 2010
2. Sites that should be prioritized for monitoring work within 1-2 years of the 2010 surveys are:
 - a. Unalakleet's roads, which were being paved in 2010
 - b. Covenant Bible Camp (due to ongoing construction work between 2008 and 2010)
 - c. The military-owned White Alice site
3. Sites that should be prioritized for monitoring on a 2-4 year cycle include:
 - a. The barge dock
 - b. Army and Air Force Hills
 - c. The fish-counting tower
 - d. Unalakleet airport and roads

4. Control

When invasive species become established in an ecosystem, a strategic approach for control is required to minimize their effects or limit their spread. Effective control relies on a clear understanding of the target species, including its biology, the ecosystem it has infested, pathways associated with its introduction, and effective control tools. Effective control also relies on persistent follow-through with monitoring of control efficacy. Successful management and eradication of invasive plant infestations typically require several years of treatment and follow-up monitoring.

Integrated weed management

A single technique is rarely adequate for successful control of multiple species or infestations; under an integrated approach, all control methods are considered, resulting in greater success. Specific treatment prescriptions are determined by the biology of the particular plant species, site characteristics, and management objectives. The following management techniques for weed control should be considered on a site- and species-specific basis:

- *Physical/Mechanical:* The use of physical or mechanical methods for weed control can be effective on small infestations of annual or biennial species. Hand grubbing, mowing, tilling, and burning are commonly used to physically destroy weeds or interfere with their reproduction. To be effective, treatment must typically take place before seed production. Plants that have flowered must be removed from the site and destroyed (plants can be placed in double bags and transported to a designated disposal site; if possible, they should be incinerated). Repeated mowing or tilling during the growing season can effectively control or contain many weed species. Generally, physical/mechanical methods are not recommended as the sole approach for control of species that spread vegetatively.
- *Chemical:* Herbicides are an effective and efficient tool for the control of noxious weeds. Chemical control methods, along with appropriate cultural practices, are likely to be the best option for larger infestations and for tough to control perennial species. The particular herbicide used and its rate of application depend on specific site characteristics, target plant, location, non-target vegetation, and land use. Herbicides are a particularly important method of treatment when complete eradication of a plant population is the management objective. Treatment at the earliest stage of invasion will greatly reduce the future need for additional herbicide applications. Herbicides often provide the only effective and feasible control of rhizomatous species, infestations in remote areas, and species for which hand pulling or cutting is not effective or feasible. Depending on the type of chemical used, herbicides have the least amount of impact on non-target species if they are used in a monoculture setting. Additionally, if applied in a specific manner according to the label, herbicides can be extremely effective in selectively removing weeds that are also mixed in with native vegetation. This approach reduces the amount of revegetation needed after the treatment is complete.
- *Biological:* This method involves the use of animals (usually insects) and pathogens that are known to attack or eat the non-native species. Introduced biological control species usually have no natural enemies; therefore, they have the potential to become invasive themselves and attack non-targeted species. A lengthy process of evaluation and permitting through APHIS is required prior to the release of biocontrol agents. This type of control is only used on very large infestations (big enough to support the insect or pathogen population) and, to date, has not been used on any species in Alaska.

Prioritizing infestations for control work

Infestations of non-native plant species are prioritized for control work based on a number of factors, including placement on the State of Alaska Noxious Weed List or an invasiveness rank of 50 or more (or a suspicion that the species is highly invasive even if it is unranked).

Control of invasive species that are still uncommon in Alaska should take precedence over invasive species that are widespread on state and local scales. Similarly, populations that are small and disjunct or that are invading (or capable of invading) undisturbed native vegetation should be prioritized over populations that are continuous and large, or that tend to remain restricted to anthropogenically disturbed habitats.

Based on the 2010 non-native plant survey results, we recommend that BLM partner with landowners in the region to eradicate the *Crepis tectorum* infestations recorded at Air Force Hill and the White Alice site (see [Appendix III](#) for the diagnostic traits, biology, and control methods for *Crepis tectorum*).

Low priority 2010 non-native plant infestations:

1. *Chenopodium album* populations: Although *Chenopodium album* was the most frequent non-native weed recorded in 2010 and formed a large infestation at the barge dock, control work is recommended to focus on other species. *Chenopodium album* thrives in naturally and anthropogenically disturbed habitats that are sparsely vegetated or have bare soil, but it will eventually be replaced by other (native) species in the absence of regular disturbances. Its seeds can remain viable for up to 40 years; however, they have no specialized adaptations for dispersal, and most land near the parent plant. They are not buoyant and therefore are unlikely to be transported by water. Because this species is not considered aggressively invasive in Alaska, and any manual or mechanical control work performed on it will likely facilitate its germination and spread by increasing soil disturbance, we consider attempts to control infestations of *Chenopodium album* to be inefficient uses of time and resources that, given the longevity of the seeds, would have largely ineffective results. Simply promoting competition with native plants is likely to largely control populations of this species.
2. Infestations of *Taraxacum officinale* ssp. *officinale*, *Poa annua*, and *Plantago major*: Control of these non-native species is rarely effective because they are so widespread on local and regional scales and have large standing populations that provide persistent seed sources for reestablishment. However, *Taraxacum officinale* ssp. *officinale* may be a good candidate for community weed pulls in Unalakleet (see [Community Involvement](#)).
3. *Hordeum jubatum* populations: We do not recommend prioritizing populations of *Hordeum jubatum* for control, even though its removal may be desirable for dog owners. There are several issues surrounding *Hordeum jubatum* that complicate establishing clear management objectives for it (see [Appendix IV](#) for a discussion of its nativity and management considerations).

5. Education and Outreach

Developing an active awareness on the threats posed by invasive species through educational programs and outreach activities helps ensure a successful defense against weeds by engaging the stakeholders in the management process. Education and outreach should encompass all aspects of the weed management plan, including prevention, detection, control, and monitoring. Education on weed management will help bridge the gap between different land owners and user groups. Internal training programs and public involvement in weed management is essential for a successful long-term program. A partnership between agencies and organizations and active involvement with different user groups is necessary to ensure the success of the weed management plan.

Educational Displays

Education of the general public outlining problems caused by non-native plant species can be achieved by making the information widely available to the community. Local school students and Covenant Bible Camp participants can be encouraged to develop invasive species posters and flyers. NVU youth have already developed four informational posters. In addition, posters, flyers, and informational materials on *Crepis tectorum* and other EDRR species that include diagnostic traits, biological characteristics, and ecological impacts should be created for the general public. Informational materials posted throughout the Unalakleet community will increase awareness about invasive species known or expected to occur in the area. The post office, local stores, the NVU building, the Elder's building, the Unalakleet School, Unalakleet IRA Office, BLM/ADFG Bunkhouse, Unalakleet Airport, Unalakleet River Fishing Lodge, and Covenant Bible Camp would be highly visible locations for informational materials. Informational materials should be provided on or linked from the [BLM Unalakleet National Wild River](#) website. Additionally, land users can be targeted by including informational materials with recreation permits and hunting and fishing licenses.

Community Outreach

In addition to posting informational materials, BLM-AFO employees should contact businesses and schools, including the Unalakleet Native Corporation, Kawerak Inc., City of Unalakleet, Covenant Bible Camp, West Coast Construction, and Unalakleet River Fishing Lodge, providing information and informational materials directly. School teacher Ann Stone and the Bering Strait School District Advisory Board should be contacted to arrange the distribution of information within the school district. BLM-AFO employees should present information to the IRA and NVU and hold community seminars or workshops updating the public on the presence, identification, and biology of invasive species in the area and the impacts of invasive species on ecosystem processes. Discussions on methods to minimize the spread of weeds in the Unalakleet area should be provided with specific examples of techniques that can be used.

The BLM should provide basic training on local and state invasive species threats to federal and state field staff in the area. The BLM could develop additional incentive programs for its employees that encourage weed awareness, detection, and reporting, as well as identification of new invaders. Knowledgeable BLM-AFO employees functioning as "weed trainers" can work with other BLM employees, volunteers, and the public to increase knowledge about invasive species.

Community Involvement

The minor presence of *Taraxacum officinale* ssp. *officinale* in Unalakleet was unexpected and remarkable; fewer than five small infestations were observed. Furthermore, its native counterpart, *Taraxacum officinale* ssp. *ceratophorum*, was common in disturbed sites within the project area

(including the village's roads). In this context, the non-native dandelion constitutes a good candidate for community weed pulls: it is easy to identify and to distinguish from its native counterpart, both subspecies occur in the village and at the Bible Camp, and (as per the 2010 findings) it should still be possible to eradicate the non-native subspecies. Any community weed pull events should be advertised throughout the community and on local radio if possible.

Community volunteers should be educated on the diagnostic traits and biological characteristics of *Taraxacum officinale* ssp. *officinale* before they participate in weed pulls. This subspecies has a basal rosette of leaves, and long, leafless, hollow stems that end in one to few inflorescences composed of yellow ray florets. It is characterized by green involucral bracts that lack tubercles with a downward-pointing outermost row. In contrast, native *Taraxacum officinale* ssp. *ceratophorum* has involucral bracts that are all appressed, rather than downward-pointed, and have horns or tubercles at the tips (Fig. 12). Because both subspecies were found growing along the roadsides in Unalakleet, habitat cannot be used to differentiate these two subspecies. Young dandelions can be removed by pulling, before they produce a taproot and set seed. Once the taproot has formed, the entire plant, including the deep taproot, must be dug out, since new plants can sprout from small fragments left behind (for this, one can use a dandelion weeder with a forked blade or a hand weeder with a bent shaft).



Figure 12. *Taraxacum officinale*: ssp. *officinale* [non-native, left], ssp. *ceratophorum* [native, right].

6. Partnerships

Developing broad networks with many partners is beneficial to managing weeds along the Unalakleet river corridor and to detecting, containing, and eradicating new invasive species before they establish.

To ensure full monitoring and control of invasive species and provide effective weed management for BLM lands, BLM may find it necessary to suggest the creation of a Cooperative Weed Management Area (CWMA) for Unalakleet and the Unalakleet River. The purpose of a CWMA is to provide a partnership among agencies, organizations, and interests to prevent the reproduction and spread of weeds into and within the CWMA. The boundaries of the CWMA thus replace jurisdictional boundaries and allow weeds to be managed within natural boundaries instead. Partners jointly prioritize weed management efforts based on species or geographic area and work together to manage infestations, pooling labor and resources. Partners may include those who hold easements, special use permits, and private property, as well as state and federal land managers.

Among others, we suggest that a CWMA for the Unalakleet River and village include the following agencies and businesses:

- a. BLM
- b. ADF&G
- c. Native Village of Unalakleet
- d. Military (White Alice site)
- e. Unalakleet River Fishing Lodge
- f. Covenant Bible Camp

Through the CWMA, land managers and owners interested in maintaining the river corridor weed-free could collaboratively develop and follow best management practices (BMPs) aimed at minimizing the spread of existing infestations and preventing the introduction of new, more highly invasive plants into the river corridor. This will provide the most efficient use of labor and resources in managing weeds in the area. A CWMA would, for instance, facilitate the elimination of *Crepis tectorum* from White Alice and Air Force Hill, which will in turn prevent their spread to new, currently uninfested areas. The creation of a CWMA could be particularly advantageous to BLM and Native land owners, as it would allow them to manage and contain source populations of invasive species, preventing these from spreading upriver or to other more remote sites in the project area (which are more costly to access for control work).

Appendix I

List of participants at the Unalakleet community invasive plant identification workshop

Name	Agency	Department	Position
Helen Cortés-Burns	AKNHP	Botany	Botanist
Erin Johnson	AKNHP	Botany	Assistant Botanist
Dominique Collet	AKNHP contractual botanist	Botany	Naturalist
Katiya Erickson	NVU	N/A	ARRA youth intern
KerriAnn Grimes	NVU	N/A	ARRA youth intern
JoAnn Semaken	NVU	N/A	ARRA youth intern
Jodi Gilley	NVU	N/A	ARRA youth intern
JoAnn Anderson	NVU	N/A	ARRA youth intern

N.B.: Terri Panuptchuk (NVU) provided assistance with the logistics for the meeting. JoAnn Anderson (NVU ARRA youth intern) was hired for this project but was ill for the duration of it, and therefore did not participate in the workshop or the fieldwork.

Appendix II

List of voucher specimens collected on the Unalakleet River trip.

Collection Date	Family	Species	Nativity	Locality Description
8/3/2010	Chenopodiaceae	<i>Chenopodium album</i>	non-native	Between slough and dog team, stabilized erosion bank
8/4/2010	Chenopodiaceae	<i>Chenopodium album</i>	non-native	Beachside next to cargo dock and road
8/4/2010	Asteraceae	<i>Crepis tectorum</i>	non-native	On Air Force Hill, SW facing
8/5/2010	Asteraceae	<i>Crepis tectorum</i>	non-native	near White Alice; off road, at contaminated soil removal site
8/4/2010	Poaceae	<i>Hordeum jubatum</i>	non-native	Beachside next to cargo dock and road
8/5/2010	Poaceae	<i>Hordeum jubatum</i>	non-native	White Alice tower, formerly used defense site
8/4/2010	Asteraceae	<i>Matricaria discoidea</i>	non-native	Beachside next to cargo dock and road
8/3/2010	Plantaginaceae	<i>Plantago major</i>	non-native	Around chapel area, where new buildings have been constructed
8/4/2010	Plantaginaceae	<i>Plantago major</i>	non-native	Beachside next to cargo dock and road
8/5/2010	Plantaginaceae	<i>Plantago major</i>	non-native	White Alice tower, formerly used defense site
8/3/2010	Poaceae	<i>Poa annua</i>	non-native	Around chapel area, where new buildings have been constructed
8/1/2010	Poaceae	<i>Poa palustris</i>	non-native	Log jam, uneven ground, gravel bar that has been reworked
7/25/2010	Polygonaceae	<i>Polygonum aviculare</i>	non-native	UNK roads
8/4/2010	Polygonaceae	<i>Polygonum aviculare</i>	non-native	Beachside next to cargo dock and road
8/4/2010	Asteraceae	<i>Senecio vulgaris</i>	non-native	On Air Force Hill, SW facing
7/25/2010	Caryophyllaceae	<i>Stellaria media</i>	non-native	UNK roads
8/3/2010	Asteraceae	<i>Taraxacum officinale</i> ssp. <i>officinale</i>	non-native	Around chapel area, where new buildings have been constructed
8/5/2010	Asteraceae	<i>Achillea sibirica</i>	native	White Alice tower, formerly used defense site
8/4/2010	Ranunculaceae	<i>Aconitum delphinifolium</i>	native	On top of Old Army Hill, west of Plot UNK10-18
8/4/2010	Asteraceae	<i>Antennaria friesiana</i>	native	On top of Old Army Hill, SW side next to ATV trail
8/3/2010	Rosaceae	<i>Argentina anserina</i>	native	Between slough and dog team, stabilized erosion bank
8/4/2010	Asteraceae	<i>Arnica griseomii</i> ssp. <i>frigida</i>	native	On Air Force Hill, SW facing
8/4/2010	Fabaceae	<i>Astragalus alpinus</i>	native	On Air Force Hill, SW facing
7/29/2010	Poaceae	<i>Beckmannia syzigachne</i>	native	On Point Bar, c. 9m away from river in sandy area
8/4/2010	Ophioglossaceae	<i>Botrychium lunaria</i>	native	On Air Force Hill, SW facing
8/4/2010	Apiaceae	<i>Bupleurum americanum</i>	native	On top of Old Army Hill, SW side next to ATV trail
8/4/2010	Cyperaceae	<i>Carex lyngbei</i>	native	On top of Old Army Hill, west of Plot UNK10-18
8/4/2010	Cyperaceae	<i>Carex microchaeta</i>	native	On top of Old Army Hill, west of Plot UNK10-18
7/25/2010	Scrophulariaceae	<i>Castilleja caudata</i>	native	UNK roads
8/4/2010	Scrophulariaceae	<i>Castilleja elegans</i>	native	On top of Old Army Hill, west of Plot UNK10-18
8/5/2010	Caryophyllaceae	<i>Cerastium beeringianum</i>	native	near White Alice; off road, at contaminated soil removal site
8/4/2010	Caryophyllaceae	<i>Cerastium beeringianum</i> ssp. <i>beeringianum</i>	native	On Air Force Hill, SW facing
8/4/2010	Apiaceae	<i>Cicuta virosa</i>	native	Below sea level, open water in places
7/25/2010	Brassicaceae	<i>Cochlearia groenlandica</i>	native	UNK roads
8/3/2010	Brassicaceae	<i>Descurainia sophioides</i>	native	Around chapel area, where new buildings have been constructed
8/4/2010	Rosaceae	<i>Dryas octopetala</i>	native	On top of Old Army Hill, west of Plot UNK10-18
8/4/2010	Poaceae	<i>Elymus trachycaulus</i>	native	On Air Force Hill, SW facing
8/4/2010	Cyperaceae	<i>Eriophorum angustifolium</i>	native	Pump House - tundra, muskeg; some standing water; ATV disturbance
8/4/2010	Rubiaceae	<i>Galium trifidum</i>	native	Below sea level, open water in places
8/5/2010	Gentianaceae	<i>Gentianella propinqua</i>	native	near White Alice; off road, at contaminated soil removal site

Collection Date	Family	Species	Nativity	Locality Description
7/25/2010	Fabaceae	<i>Hedysarum alpinum</i>	native	UNK roads
8/4/2010	Hippuridaceae	<i>Hippuris tetraphylla</i>	native	Below sea level, open water in places
8/2/2010	Pinaceae	<i>Larix laricina</i>	native	On ridge behind Henry's cabin
8/4/2010	Fabaceae	<i>Lathyrus japonicus</i>	native	On Air Force Hill, SW facing
8/4/2010	Fabaceae	<i>Lupinus arcticus</i>	native	On top of Old Army Hill, SW side next to ATV trail
7/29/2010	Caryophyllaceae	<i>Minuartia dawsonensis</i>	native	On Point Bar, c. 9m away from river in sandy area
8/4/2010	Caryophyllaceae	<i>Minuartia obtusiloba</i>	native	On top of Old Army Hill, SW side next to ATV trail
7/31/2010	Saxifragaceae	<i>Parnassia palustris</i>	native	At the Mink Farm c. 15 m from river, near arctic cat
8/4/2010	Scrophulariaceae	<i>Pedicularis kanei</i>	native	Pump House - tundra, muskeg; some standing water; ATV disturbance
7/25/2010	Scrophulariaceae	<i>Pedicularis verticillata</i>	native	UNK roads
8/3/2010	Poaceae	<i>Poa eminens</i>	native	Between slough and dog team, stabilized erosion bank
8/4/2010	Poaceae	<i>Poa glauca</i>	native	On Air Force Hill, SW facing
8/4/2010	Poaceae	<i>Poa macrocalyx</i>	native	Beachside next to cargo dock and road
7/26/2010	Poaceae	<i>Poa pratensis</i> ssp. <i>alpigena</i>	native	In between playground and road in UNK
8/4/2010	Polygonaceae	<i>Polygonum alaskanum</i>	native	On top of Old Army Hill, SW side next to ATV trail
7/29/2010	Polygonaceae	<i>Polygonum humifusum</i> ssp. <i>caurianum</i>	native	On Point Bar, c. 9m away from river in sandy area
8/4/2010	Polygonaceae	<i>Polygonum viviparum</i>	native	On Air Force Hill, SW facing barley
8/4/2010	Rosaceae	<i>Potentilla norvegica</i>	native	On top of Old Army Hill, west of Plot UNK10-18
8/4/2010	Rosaceae	<i>Potentilla villosa</i>	native	On top of Old Army Hill, west of Plot UNK10-18
8/3/2010	Poaceae	<i>Puccinellia nuttalliana</i>	native	Between slough and dog team, stabilized erosion bank
7/25/2010	Crassulaceae	<i>Rhodiola rosea</i>	native	UNK roads
8/4/2010	Polygonaceae	<i>Rumex arcticus</i>	native	Below sea level, open water in places
8/3/2010	Asteraceae	<i>Saussurea nuda</i>	native	Between slough and dog team, stabilized erosion bank
8/4/2010	Caryophyllaceae	<i>Silene uralensis</i> ssp. <i>uralensis</i>	native	On top of Old Army Hill, west of Plot UNK10-18
8/4/2010	Caryophyllaceae	<i>Stellaria crassifolia</i>	native	On top of Old Army Hill, west of Plot UNK10-18
8/4/2010	Liliaceae	<i>Tofieldia coccinea</i>	native	On top of Old Army Hill, SW side next to ATV trail
7/31/2010	Ericaceae	<i>Vaccinium oxycoccus</i>	native	100 yds west of Iditarod trail
7/29/2010	Caryophyllaceae	<i>Wilhelmsia physodes</i>	native	On Point Bar, c. 9m away from river in sandy area
8/4/2010	Woodsiaceae	<i>Woodsia ilvensis</i>	native	On top of Old Army Hill, west of Plot UNK10-18

Appendix III

Crepis tectorum: Diagnostic Traits, Biology, and Control Methods and Priorities

Invasiveness Rank: **54**

Where found: southwest face of Air Force Hill, contaminated soil removal site at White Alice

Diagnostic Traits

Description: *Crepis tectorum* is an annual or winter annual plant that grows from 10 to 100 cm tall from a shallow taproot. All parts of the plant exude a milky sap when broken. Stems are branched, erect, slightly hairy, and leafy. Basal leaves are petiolated, lanceolate to oblanceolate, glabrous or short-hairy, 5 to 15 cm long, and 1 to 4 cm wide with entire to toothed or pinnately lobed margins. Stem leaves are reduced in size, alternate, sessile, clasping, and linear with entire margins. Leaf margins often roll under towards the midrib. Flower heads are arranged in groups of 5 to 20 or more at the ends of stems and are composed of 30 to 70 ray florets. Florets are yellow and 10 to 13 mm long. Involucres are 6 to 9 mm tall and 7 to 8 mm wide. Involucral bracts are arranged in two rows and are covered with soft-hairy pubescence. Seeds are spindle-shaped, 3 to 4 mm long, and dark red or purple-brown. Each seed has a pappus composed of numerous white bristles (Hultén 1968, Bogler 2006).

Similar Species: Many similar yellow-flowered members of the Asteraceae family grow in Alaska. *Crepis tectorum* can be distinguished from them by the presence of taproots, clasping stem leaves, petiolated basal leaves arranged in rosettes, multiple flower heads composed of yellow ray florets, and involucral bracts arranged in two rows (Fig. 13). *Crepis tectorum* is often confused with non-native *Hieracium umbellatum*; however, *Hieracium umbellatum* has involucral bracts of many different lengths.



Figure 13. *Crepis tectorum* traits: multiple flower heads [left], involucral bracts in two rows [right].

Biology

Crepis tectorum is native to Siberia and was introduced to eastern North America before 1890. Although it reproduces only by seeds, seed production is prolific. Plants in Canada produced from 3,360 to 49,420 seeds per plant. Seeds have extensive pappi which enable them to disperse long distances with wind and moving water and rapidly colonize disturbed and open areas. Seeds adhere to shoes, clothing, fur, and feathers. They are also a common contaminant in alfalfa seed. Seeds lack dormancy, and nearly all seeds lose their viability within 2½ years of maturation. In northern Alberta and British Columbia, seeds germinate throughout the growing season with peaks in germination occurring from mid-May to mid-June and August to September. Seeds mature from mid-July to the end of the growing season. *Crepis tectorum* is associated with many insect pests, parasites, fungi, and diseases (Najda *et al.* 1982).

Crepis tectorum readily colonizes anthropogenically disturbed sites and open areas (Najda *et al.* 1982); however, it has also been found in several naturally disturbed areas, such as sites disturbed by river action or animal activities (AKEPIC 2011). It is one of two non-native plant species that have invaded native vegetation affected by the 2004-2005 burns along the Dalton Highway in interior Alaska. The other invasive species that was observed spreading into these lightly burned areas was *Melilotus alba* (81, white sweetclover), which is a very aggressive weed species in Alaska (Cortés-Burns *et al.* 2008). Additionally, *Crepis tectorum* was observed growing in native *Chamerion angustifolium* – *Calamagrostis canadensis* meadows surrounding Rohn Cabin during the 2009 surveys of the Iditarod National Historic Trail (Flagstad and Cortés-Burns 2010). Once established, populations are capable of occurring at high densities. The population observed at Air Force Hill occurred at 19% ground cover, and the population at the White Alice site occurred at 10% ground cover; however, infestations in Alaska have been observed occurring at up to 100% ground cover (AKEPIC 2011)

While this species was not found on BLM lands during the 2010 surveys, it is likely to spread to BLM lands because of its location in high-use areas in close proximity to BLM lands, prolific seed production, long-distance dispersal characteristics, and ability to establish in naturally disturbed areas. Control is therefore recommended for *Crepis tectorum* on Air Force Hill and at the White Alice site if possible. If control is not possible at these locations, then we suggest that best management practices be implemented to prevent the further spread of this species.

Control Methods and Priorities

Eradication is often an unrealistic goal for large populations of invasive plant species, especially those located in high-use and urban areas where large standing populations provide a persistent seed source for reestablishment. However, small, isolated infestations, such as those observed on Air Force Hill and at the White Alice site, can be efficiently eradicated.

Populations of *Crepis tectorum* growing on non-human altered soils as well as all small (1-50 stems) infestations can be removed by repeated cycles of hand-pulling. As plants can resprout easily from the caudex (underground woody stem), the entire plant must be removed prior to seed set. All plants should be bagged and removed from the site to prevent seeds from dispersing after treatment. However, studies suggest that *Crepis tectorum* is best controlled using chemical methods, as hand pulling can be inefficient because seedlings are hard to find and do not pull up easily (Seefeldt 2007).

Large (more than 50 stems) or persistent (those not reduced after one year of hand-pulling) populations of *Crepis tectorum* are best controlled using chemical methods (Table 6). Herbicides containing glyphosate (e.g. brand name Roundup, manufactured by Monsanto) or metsulfuron-methyl (e.g. brand

name Ally, manufactured by DuPont) are recommended⁸. These dicot-specific herbicides will kill most of the broadleaf vegetation that they are sprayed on, but monocots, such as grasses will not be harmed. Control of plants during the cotyledon stage is most effective; this appears to be the only stage at which the plants can be killed. Control during stem elongation, flowering, and seed set appears only to weaken the plants. Application of metsulfuron-methyl early in the spring when *Crepis tectorum* is in the cotyledon stage is thought to be the most effective method of control for this species. Because *Crepis tectorum* is able to overwinter as a rosette, it typically develops cotyledons before most of the native broadleaf vegetation has sprouted. The short soil residence time of metsulfuron-methyl will make a second application in the fall necessary to weaken rosettes prior to overwintering. The infested area, plus a 15 m buffer, should be treated with 70 grams per hectare. The area within at least a 200-meter radius and any disturbed areas within 0.8 km should be scouted for new plants. Annual monitoring for at least three years will be necessary to confirm that no new plants have established (Seefeldt 2007).

Table 6. Control recommendations for *Crepis tectorum*.

<i>Crepis tectorum</i>	Human-disturbed site	Naturally-disturbed and unaltered sites
Small infestation (<50 stems)	<ul style="list-style-type: none"> • Hand pull, including underground parts if possible • Bag and remove plants • Monitor for 1 year – if unsuccessful, start herbicide application 	<ul style="list-style-type: none"> • Hand pull, including underground parts if possible
Large infestation (>50 stems)	<ul style="list-style-type: none"> • Herbicide application • Monitor annually for 3+ years 	<ul style="list-style-type: none"> • Bag and remove plants • Monitor for 3+ years

⁸ The active ingredients glyphosate and metsulfuron-methyl have been approved for use on BLM-administered lands in Alaska under the BLM Vegetation Treatments Using Herbicides Final Programmatic EIS Record of Decision (2007).

Appendix IV

Hordeum jubatum: Native Status and Management Considerations

Invasiveness Rank: **63**

Where found: Army and Air Force Hills, White Alice site, cargo dock, along Unalakleet village roads

Native Status

Hordeum jubatum is native to eastern Siberia and much of North America to Mexico. However, the native status of *Hordeum jubatum* in Alaska has been disputed. While some authors consider that humans introduced this species into the arctic regions of the world (Elven 2007), others propose that it is native to our region (von Bothmer *et al.* 2007). *Hordeum jubatum* was present in Alaska at least by 1931 (ALA Herbarium records, [Arctos Database](#)), although it is difficult to tell if the few early collections were only associated with anthropogenic disturbances. This species was likely present in eastern, interior Alaska prior to European contact, and native and non-native genotypes of *Hordeum jubatum* are probably present within the state. These genotypes cannot be distinguished phenotypically. Reproduction between the native and non-native genotypes is possible, further blurring the distinction between these two (potential) taxa.

Hordeum jubatum appears to have spread dramatically during the last half century, a trend that is associated with the acceleration in anthropogenic disturbances. Currently, this species is commonly associated with anthropogenically disturbed sites throughout Alaska (AKEPIC 2011). It was observed only in anthropogenically disturbed, high-use areas during the 2010 surveys, none of which fall on BLM lands: Unalakleet, Air Force Hill, Army Hill, the barge dock, and the White Alice site.

Management Considerations

Although *Hordeum jubatum* is only moderately invasive and does not typically disperse beyond its area of introduction, it is known to negatively impact dogs and wildlife. Its barbed awns can burrow into an animal's mouth or skin, causing infected sores (USFS 1937); for this reason *Hordeum jubatum* is considered a nuisance weed. *Hordeum jubatum* is strongly associated with straw (Aiken *et al.* 1995). During the 2009 surveys of the Iditarod National Historic Trail, it was found associated with straw in remote sites (Flagstad and Cortés-Burns 2010). This species has also been observed growing in straw on winter trails in Yukon Flats National Wildlife Refuge (Cortés-Burns and Carlson 2006). Therefore, despite its disputed non-nativity, the occurrence of *Hordeum jubatum* can be considered a management concern because of its capacity to harm dogs and association with straw.

Hordeum jubatum is not usually considered a high-priority for control in developed areas, such as the areas in which it was found during the 2010 surveys, because its distribution is largely restricted to areas of medium to high disturbance. It does not typically invade late-seral, native plant communities. Because *Hordeum jubatum* typically occurs in human-disturbed or early-seral habitats, it is expected that populations will be reduced where natural succession is allowed to proceed.

References Cited

- Aiken, S., L. Consaul, and M. Dallwitz. 1995. Poaceae of the Canadian Arctic Archipelago: Descriptions, Illustrations, Identification, and Information Retrieval. Version: 10th December 2001. <http://www.mun.ca/biology/delta/arctic/>
- AKEPIC. 2005. Invasive Plants of Alaska. Alaska Exotic Plant Information Clearinghouse Database, Alaska Association of Conservation Districts Publication. Anchorage, AK. 294 pp.
- AKEPIC database. Alaska Exotic Plant Information Clearinghouse Database. 2011. Available: <http://akweeds.uaa.alaska.edu/>
- BLM Central Yukon Field Office. 2009. Draft Dalton Management Area Integrated Invasive Plant Strategic Plan. Central Yukon Field Office, Bureau of Land Management, U.S. Department of the Interior. Fairbanks, AK. 24 pp.
- BLM Final Vegetation Treatments Using Herbicides Programmatic EIS Record of Decision. 2007. http://www.blm.gov/wo/st/en/prog/more/veg_eis.html
- Bogler, D. 2006. *Crepis tectorum* Linnaeus. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico. 12+ vols. New York and Oxford. Vol. 19, p. 185.
- Brooks, M. 1999. Alien annual grasses and fire in the Mojave Desert. *Madroño*, 46(1): 13–19.
- Busch, D. 1995. Effects of fire on southwestern riparian plant community structure. *The Southwestern Naturalist*, 40(3): 259–267.
- Carlson, M., and M. Shephard. 2007. Is the spread of non-native plants in Alaska accelerating? *In*: Harrington, T., and S. Reichard (eds.). Meeting the challenge: invasive plants in Pacific Northwest ecosystems. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland, OR. General Technical Report PNW-GTR-694: 111-127.
- Carlson, M., I. Lapina, M. Shephard, J. Conn, R. Densmore, P. Spencer, J. Heys, J. Riley, and J. Nielsen. 2008. Invasiveness Ranking System for Non-Native Plants of Alaska. Alaska Region, Forest Service, U.S. Department of Agriculture. R10-TP-143. 218 pp.
- Conn, J., K. Beattie, M. Shephard, M. Carlson, I. Lapina, M. Hebert, R. Gronquist, R. Densmore, and M. Rasy. 2008. Alaska *Melilotus* Invasions: Distribution, Origin, and Susceptibility of Plant Communities. *Arctic and Alpine Research*. 40(2): 298-308.
- Conn, J., C. Stockdale, N. Werdin-Pfisterer, and J. Morgan. 2010. Characterizing Pathways of Invasive Plant Spread to Alaska: II. Propagules from Imported Hay and Straw. *Invasive Plant Science and Management*. 3(3): 276-285.
- Cortés-Burns, H., and M. Carlson. 2006. BAER Final Report: Invasive plant monitoring (in Kenai, Tetlin, Kanuti, and Yukon Flats refuges) following 2004 fires. USFWS National Wildlife Refuges - Alaska Region. Final report for the Alaska Regional Office, U.S. Fish and Wildlife Service, U.S. Department of the Interior. Anchorage, AK. February 2006. 46 pp.
- Cortés-Burns, H., I. Lapina, S. Klein, and M. Carlson. 2007. Invasive Plant Species Monitoring and Control - Areas impacted by 2004 and 2005 Fires in Interior Alaska: A survey of Alaska BLM lands along the Dalton, Steese, and Taylor Highways. Report funded by the Alaska State Office, Bureau of Land Management, U.S. Department of the Interior. Anchorage, AK. 91 pp.
- Cortés-Burns, H., I. Lapina, S. Klein, M. Carlson, and L. Flagstad. 2008. Invasive Plant Species Monitoring and Control - Areas impacted by 2004 and 2005 Fires in Interior Alaska: A survey of Alaska BLM lands along the Dalton, Steese, and Taylor Highways (revisit work). Report funded by the Alaska State Office, Bureau of Land Management, U.S. Department of the Interior. Anchorage, AK. 162 pp.
- Elven, R. (Ed). 2007. Checklist of the Panarctic Flora (PAF) Vascular Plants. Version: May 2007. <http://www.binran.ru/infsys/paflist/index.htm>, Accessed January, 2011.

- Flagstad, L., and H. Cortés-Burns. 2010. [Tracking weeds along the Iditarod National Historic Trail, Final Report](#). Report for Anchorage Field Office, Bureau of Land Management, U.S. Department of the Interior. Anchorage, AK. 51 pp.
- Flagstad, L., H. Cortés-Burns, C. Norlen, H. Klein, and L. Simpson. 2011. Draft BLM Campbell Tract Invasive Plant Management Plan. Report for Anchorage Field Office, Bureau of Land Management, U.S. Department of the Interior. Anchorage, AK. 36 pp.
- Gary, G. 2010. Municipality of Anchorage Invasive Plant Management Plan. Report for Municipality of Anchorage and Anchorage Cooperative Weed Management Area. Anchorage, AK. 62 pp.
- Heidemann, M., G. Aguiar, C. Ashlock, A. Christie, J. Day, G. Finstad, G. Garcia, J. Guritz, M. Herbert, J. Jack, D. Masiak, N. Nordstrand, S. Seefeldt, and A. Tonne. 2010. UAF Campus Invasive Plant Management Plan. Recommendations from the Invasive Plant Task Force. School of Natural Resources and Agricultural Sciences, University of Alaska Fairbanks. Fairbanks, AK. 33 pp.
- Hobbs, R., and L. Huenneke. 1992. Disturbance, Diversity, and Invasion: Implications for Conservation. *Conservation Biology* 6(3): 324-337.
- Hultén, E. 1968. *Flora of Alaska and Neighboring Territories; A manual of the vascular plants*. Stanford University Press. Stanford, CA. 1008 pp.
- Lapina, I., S. Klein, and M. Carlson. 2007. Non-native Plant Species of the Fairbanks Region: 2005 - 2006 Surveys. Alaska Natural Heritage Program, University of Alaska, Anchorage. Report funded by and prepared for State and Private Forestry, Forest Service, U.S. Department of Agriculture. 50 pp.
- Myers, N. 1997. Global biodiversity II: Losses and threats. In Meffe, G., and C. Carroll (eds.). *Principles of Conservation Biology* 2nd Edition. Sinauer Associates. Sunderland, Massachusetts. 729 pp.
- Najda, H., A. Darwent, and G. Hamilton. 1982. The Biology of Canadian Weeds. 54. *Crepis tectorum* L. *Canadian Journal of Plant Science*. 62(2): 473-481.
- Randall, J. 1996. Weed control for the preservation of biological diversity. *Weed technology*, 10(2): 370-383.
- Seefeldt, S. 2007. [Control methods for non-indigenous plant species found in the Yukon and Interior] Unpublished raw data.
- Slemmons, C. 2007. Integrated Weed Management Strategy Focusing on Early Detection/Rapid Response for the Kenai Peninsula – Cooperative Weed Management Area. Report for Kenai Peninsula – Cooperative Weed Management Area. Homer, AK. 19 pp.
- Stein, B., L. Kutner, and J. Adams. 2000. *Precious heritage: the status of biodiversity in the United States*. Oxford University Press, Oxford. 416 pp.
- U.S. Congress, Office of Technology Assessment. 1993. *Harmful non-indigenous species in the United States*. OTA-F-565. U.S. Government Printing Office, Washington, D.C. 391 pp.
- USFS. 1937. *Range Plant Handbook*. Forest Service, U.S. Department of Agriculture. Washington, DC. 532 pp.
- Villano, K., and C. Mulder. 2008. Invasive plant spread in burned lands of interior Alaska. Final report for Alaska Region, National Park Service, U.S. Department of the Interior and National Aeronautics and Space Administration. Fairbanks, AK. 25 pp.
- von Bothmer, R., C. Baden, and N. Jacobsen. 2007. *Hordeum*. In: Flora of North America Editorial Committee, eds. 1993+. *Flora of North America North of Mexico*. 15+ vols. New York and Oxford. Vol. 24, pp. 241-258.