Tracking weeds along the Iditarod National Historic Trail

Rohn Cabin; historic roadhouse and modern day checkpoint for the Iditarod Great Sled Race

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Abstract

The Alaska Natural Heritage Program (AKNHP), University of Alaska Anchorage completed non-native plant surveys on Bureau of Land Management (BLM) lands along the Iditarod National Historic Trail (NHT) during the 2009 field season. The locations and abundance of all non-native and the dominant native vascular plants were recorded at high-use and BLM-managed sections of the trail.

Results indicate that the occurrence of non-native species is largely restricted to disturbed or developed areas. Cabins and remote airstrips support the greatest abundance and diversity of non-native plant species whereas the trail itself is predominantly weed-free. Rohn Cabin and vicinity is the most infested of any remote location surveyed along the trail. Additional remote locations of concern include the BLM shelter cabins Old Woman and Bear Creek. We suggest that these three sites be prioritized for control work.

We recorded the presence of several potentially problematic invasive species at low frequency; these include (listed in decreasing order of threat): narrow leaf hawk's beard (*Crepis tectorum*), rapeseed (*Brassica rapa*), hempnettle (*Galeopsis tetrahit* s.l.[1]), flixweed (*Descurainia sophia*), and common timothy (*Phleum pratense*). Foxtail barley (*Hordeum jubatum*[2]), which is a straw-associate along the trail and a nuisance weed, was detected at higher frequency, together with other modestly to very weakly invasive species. This report proposes that these six species be targeted for control, and provides detailed recommendations on how to eliminate their populations.

Non-native species have established along the trail system presumably via historical use (e.g. travel along the trail between villages, mining towns, roadhouses, etc.) and, more recently, as contaminants associated with aircraft, machinery, goods, and the bedding straw used by mushers. The non-native grass, *Hordeum jubatum*[2], did co-occur with leftover straw; however the exposure of mineral soil, either through human-induced or natural erosion processes, appeared to facilitate the establishment of ruderal (weedy native and non-native) species more so than the presence of straw *per se*. Consequently, best management practices should aim to prevent propagule introductions as well as mitigate activities resulting in soil disturbance.

This survey provides the baseline information on the abundance, diversity, and distribution of non-native plant species along the Iditarod NHT that is necessary to make informed land management decisions. The non-native species of concern and priority locations for control identified herein will allow better protection of this historic trail, the pristine ecosystems it passes through, and the subsistence resources these ecosystems support.

[1] s.l.: sensu lato. Latin expression used by taxonomists when referring to a particular taxonomic unit (species, genus, etc.) in its wider circumscription. See "Species biographies and control recommendations" for details on the taxonomic treatment of the genus *Galeopsis* in this report.

[2] The non-nativity of this species is questionable; please see the 'Species of concern' section for further discussion.

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Introduction

The Alaska Natural Heritage Program (AKNHP), University of Alaska Anchorage completed non-native weed surveys on Bureau of Land Management (BLM) lands along the Iditarod National Historic Trail (NHT) during the 2009 field season. This survey was initiated to collect baseline information on the abundance, diversity, and distribution of non-native weeds along the Iditarod National Historic Trail (NHT) so that informed decisions on invasive plant management can be made. Specifically we identify problematic non-native species, prioritize locations for control, and identify potential routes of introduction as well as which habitats are most vulnerable to invasion.

The establishment, growth, and persistence of non-native[3] plant species pose a serious threat to native ecosystems. Even though not all non-native species cause significant economic or ecological harm, *invasive*[4] plants are able to alter plant community composition, successional pathways, nutrient cycling, hydrology, and fire regimes, as well as 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 have been a major problem in the Lower 48 states for some time (*cf*. Randall 1996), Alaska remained relatively unaffected by non-native plants until recently. Over the last ten years there has been a marked acceleration in the rate of introduction of non-native plants to the state, likely driven by increases in the global movement of people and goods (Carlson and Shephard 2007). In several cases, invasive weeds have been documented moving off the human footprint into natural ecosystems, especially those that are recently burned or in an early-seral successional status (Cortés-Burns *et al*. 2007, 2008; Lapina *et al*. 2007; Villano and Mulder 2008).

The susceptibility of native plant communities to invasion is largely a function of the degree of natural or anthropogenic disturbance that characterizes the habitat (Hobbs and Huenneke 1992). In Alaska, non-native plant occurrence is most strongly correlated with high-use and anthropogenically disturbed areas such as urban centers and transportation routes. It is particularly concerning when these infestations are proximal to pristine habitats (e.g. trails, campgrounds, cabins, and boat ramps) as they can act as foci for the introduction and spread of invasive weeds off the human footprint into native ecosystems. Particular to this study area, the straw used as dog bedding during the Iditarod Great Sled Race may act as a vector for the introduction of non-native plants along the trail. Indeed, the non-native grass, foxtail barley (*Hordeum jubatum*) has been observed growing in straw at several locations along the Iditarod NHT (this study) as well as along winter trails in the Yukon Flats National Wildlife Refuge (Cortés-Burns and Carlson 2006). Furthermore, viable seeds of numerous non-native plant species have been found in germination studies of both locally-produced and imported straw (Conn et al. unpublished data).

[3] Non-native plants are plants whose presence in a given area are due to the accidental or intentional introduction by humans (AKEPIC 2005); also referred to as 'weeds' herein.

[4] Invasive plants are those that do not naturally occur in a specific area and whose introduction has the potential to cause environmental or economic harm, or harm to human health.

The Iditarod NHT represents a unique system to study the introduction, dispersal and persistence of non-native species. Because the history of the trail route and its use are relatively well documented we are better able to infer the possible timing and vectors of introduction and dispersal of non-native weedy species along the trail. Some of the more interesting questions regarding weeds along the trail are: Do non-native species persist at long-abandoned locations such as the town of Iditarod which once supported large numbers of people? Can recent introductions of non-native species be tied spatially or temporally to a shift in trail use such as the 1970s resurgence of mushing activity? The results presented here cannot fully answer such questions but they do narrow the field of possible explanations and provide baseline information that will be vital to the management and protection of this historic trail system.

Methods

Survey work targeted high-use and BLM-managed[5] sections of the trail. To maximize the efficiency of our inventorying efforts, pre-fieldwork included speaking with BLM AFO staff, analyzing the maps and photos furnished by the BLM and corresponding with Iditarod race officials (Stan Hooley, Executive Director; Mark Nordman, Race Marshall) and mushers (Zack and Anjanette Steer, Alan Peck). Conversations with race officials and participants were extremely helpful to our understanding of how and where straw is used and disposed of at checkpoints and along the trail.

Fieldwork was completed in two phases. In Phase I of this project AKNHP staff (Helen Cortés-Burns and Lindsey Flagstad) flew the southern race route during the 2009 race (March 19 and 20) by fixed-wing plane to locate areas of straw use (e.g. checkpoints, campsites and rest stops). To document these locations, the trail was flown at low altitude and slow speed. Sites at which straw was observed were marked with a Garmin GPSMap 76CSx handheld GPS unit and photographed with a digital camera. These images were later georeferenced using the software program GPS-Photo Link.

In Phase II, AKNHP staff (Helen Cortés-Burns and Trevor Roberts) and BLM Natural Resource Specialist, Laurie Thorpe surveyed the Rohn Cabin, airstrip, all nearby structures and approximately one kilometer of trail leading into and out of the cabin during July 20-22, 2009. The remainder of the trail was surveyed August 4-10, 2009 by AKNHP staff (Lindsey Flagstad and Cassandra Wright) by helicopter. Phase II work visited all BLM cabins (Rohn, Bear Creek, Tripod Flats, and Old Woman) and targeted BLM-managed trail sections. We attempted to place at least one site within each section of BLM-managed trail. Because findings from the Rohn Cabin surveys indicated that non-native species did not typically occur along undisturbed sections of trail, target sites along BLM-managed sections were selected to capture the most disturbed area of the trail or to relocate areas of straw use identified in Phase I of this study. For example, if a shelter cabin, remote airstrip or area of straw use documented in Phase I occurred within a given section of BLM-managed trail, then we would give priority to that location. To reduce relocation error during Phase II, we surveyed the trail for approximately 100 meters in either direction from the location of straw use recorded during Phase I. In open land this distance was survey by helicopter (and often exceeded 100 meters); in forested locations the distance was surveyed by foot.

A total of 42 sites were completed along the trail between Rohn Cabin and Nome. We curtailed our survey south of Rohn Cabin as there are no BLM-managed trail sections between the Rohn checkpoint and the official race start in Willow. Both northern and southern routes were surveyed (1,101 trail miles) with coverage at approximately one site per 25 trail miles (see Appendix I for study area map). At each site the survey was initiated at the point of greatest disturbance and moved out into native undisturbed vegetation. If the site was undisturbed, the area was surveyed until the dominant (> 5% foliar cover) native plant species were documented. An average of one hour was spent at

[5] BLM-managed land includes land owned by the BLM as well as Native- and State-selected parcels.

each site. The occurrences of high-priority, non-native, and dominant native species were recorded at each site (see Appendix III for example datasheet). Site attributes including geographical position, slope, elevation, aspect, survey area, and unvegetated ground cover (e.g. percent surface area occupied by litter, sand, rock etc.) were also collected (Appendix V). Infestations of high-priority non-native species were hand-pulled, bagged, and removed from the site when possible.

When plants could not be adequately identified in the field, a voucher specimen was collected. All vouchers were identified by AKNHP botanists; invasive plant specialist, Helen Cortés-Burns, confirmed the identity of all non-native plant collections. Vouchers of non-native species and uncommon native species have been mounted and curated in the University of Alaska Anchorage Herbarium (UAAH), which is currently housed at AKNHP, and are available to BLM staff upon request (see Appendix IV for a voucher list).

In addition, non-native species data collected will be formatted for upload to the BLM National Invasive Species Information Management System (NISIMS) weeds database and have also been entered into the Alaska Exotic Plants Information Clearinghouse (AKEPIC database) by AKNHP staff.

The surveying of checkpoints was not a requirement of this project; however we often stopped in village checkpoints for lodging and fuel (e.g. Nome, Unalakleet, Galena, and McGrath). These areas were surveyed for non-native species as time and logistics allowed. The identities of non-native plant species documented in these locations provide a valuable list of potential invaders to the Iditarod NHT.

Results and Discussion

The majority of the Iditarod NHT is routed through pristine areas of interior and coastal Alaska and thus is largely weed-free. The non-native plant populations that are present along the trail tend to be concentrated in developed or high-use areas such as villages and remote cabins. A total of 25 non-native species were documented (Table 1, Appendices I, II). This total captures 8% of the diversity of the roughly 300 non-native species known to occur in Alaska (AKEPIC tracking list). We recorded the presence of several potentially problematic invasive species at low frequency; these include (listed in decreasing order of threat); narrow leaf hawk's beard (*Crepis tectorum*[6]; Invasiveness Rank[7] 54), field mustard (*Brassica rapa*; NR), hempnettle (*Galeopsis tetrahit* s.l.; 40), flixweed (*Descurainia sophia*; 41), and common timothy (*Phleum pratense*; 56). See the following 'Species of concern' and 'Species biographies and control recommendations' sections for further discussion of these species.

The non-native species encountered with the greatest frequency (listed in decreasing order of frequency of occurrence) are: common plantain (*Plantago major*; 44), foxtail barley (*Hordeum jubatum*; 63), pineapple weed (*Matricaria discoidea*; 32), common dandelion (*Taraxacum officinale* ssp. *officinale*; 58), lambsquarters (*Chenopodium album*[8]; 35), prostrate knotweed (*Polygonum aviculare*; 45), and white clover (*Trifolium repens*; 59). Results indicate that the diversity and abundance of non-native species is evenly distributed along the trail; no latitudinal gradients of weed occurrence were recognized.

[6] Common names are given at the first reference to a species in the text; thereafter the species will be referred to by its scientific name.

[7] Invasiveness 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). Species are ranked on a scale of 0 to 100 with 100 being an extremely invasive species. Species that were not ranked in this publication (Carlson et al. 2008) are designated as 'NR', not ranked.

[8] The non-nativity of this species is questionable; please see the 'Species of concern' section for further taxonomic discussion.

Table 1: Frequency of non-native species occurrences along the Iditarod National Historic Trail

Frequency is calculated as the number of times a species occurs relative to the total number of non-native species occurrences, presented as a proportion of one. Thus a value of 0.13 indicated the species accounts for 13% of all non-native plant occurrences.

Scientific Name	Common name	Invasiveness rank	Frequency of occurrence
Plantago major	Common Plantain	44	0.13
*Hordeum jubatum**	Foxtail Barley	63	0.12
Matricaria discoidea	Pineapple Weed	32	0.10
Taraxacum officinale ssp. *officinale*	Common Dandelion	58	0.09
*Chenopodium album**	Lambsquarters	37	0.06
Polygonum aviculare	Prostrate Knotweed	45	0.06
Trifolium repens	White Clover	59	0.04
Euphrasia nemorosa^	Common Eyebright	NR	0.03
Poa annua	Annual Bluegrass	46	0.03
Poa pratensis ssp. *irrigata*	Spreading Bluegrass	52	0.03
Poa pratensis ssp. *pratensis*	Kentucky Bluegrass	52	0.03
Stellaria media	Common Chickweed	42	0.03
Tripleurospermum perforatum	Scentless False Mayweed	48	0.03
Bromus inermis ssp. *inermis*	Smooth Brome	62	0.02
Capsella bursa-pastoris	Shepherd's Purse	40	0.02
Crepis tectorum	Narrowleaf Hawksbeard	54	0.02
Descurainia sophia	Herb Sophia	41	0.02
Galeopsis tetrahit s.l.	Brittlestem Hempnettle	40	0.02
Hordeum vulgare	Common Barley	NR	0.02
Brassica rapa	Field Mustard	NR	0.01
Caragana arborescens	Siberian Peashrub	66	0.01
Cerastium fontanum	Common Mouse-Ear Chickweed	36	0.01
Leucanthemum vulgare	Oxeye Daisy	61	0.01
Phleum pratense	Timothy Grass	54	0.01
Trifolium hybridum	Alsike Clover	57	0.01
Viola tricolor	Johnny Jumpup	NR	0.01

Notes:
*non-nativity of species disputed
^taxonomic identity tentative

With the exception of *Hordeum jubatum*, which is considered a nuisance weed, we do not recommend prioritizing for control any of the top seven most frequently encountered species. *Plantago major*, *Matricaria discoidea*, *Chenopodium album*, and *Polygonum aviculare* are weakly invasive and are not expected to spread beyond the disturbed areas they currently inhabit. In the cases of *Taraxacum officinale* ssp. *officinale*, *Trifolium repens*, *Poa pratensis* ssp. *irrigata*, *P. pratensis* ssp. *pratensis*, and *Trifolium hybridum*, control of these non-native species is rarely effective because they are widespread on local and state scales and their large standing populations provide a persistent seed source for reestablishment. Greater gains are often achieved by targeting non-native species with few populations that are small in numbers of individuals and spatial extent.

Although smooth brome (*Bromus inermis* ssp. *inermis*, 62), Siberian pea shrub (*Caragana arborescens*, 66), and oxeye daisy (*Leucanthemum vulgare*, 61) are moderately invasive, and common barley (*Hordeum vulgare*, NR) is a known straw-associate, their occurrences are currently restricted to villages (i.e. high use areas that fall outside the jurisdiction of the BLM). Given their current location, we do not list them for eradication in this report. We do, however, recommend informal monitoring of trail sections closest to these potential source locations of problematic species.

Bromus inermis ssp. *inermis* was detected at both the Galena and McGrath Checkpoints, indicating that this species may be a straw-associate. This highly competitive grass is able to form a dense sod that often excludes native species (Butterfield et al. 1996, Rutledge and McLendon). In Alaska, this species has been documented forming dense monocultures along the Dalton and Steese Highways (Cortés-Burns et al. 2007).

Caragana arborescens occurred as an ornamental planting in front of the McGrath Library. As a member of the pea family, this winter-hardy shrub is able to alter natural soil nutrient status by fixing atmospheric nitrogen which enables it to establish quickly in poor soils. Furthermore, *Caragana arborescens* can reproduce both by seed and vegetatively, from rootstock shoots, and develops into a dense shrub at maturity which reduces light availability, thereby compromising native tree and shrub regeneration. This combination of morphological and physiological traits has allowed *Caragana arborescens* to become one of the most aggressive invaders of mixed forests in the Matanuska-Susitna area (Lapina and Carlson 2005). *Caragana arborescens* has also been documented dispersing beyond its initial planting at a semi-remote location on the Steese Highway and in the town of Eagle at the terminus of the Taylor Highway (Cortés-Burns et al. 2008).

Leucanthemum vulgare was observed on Front Street in Nome. This ornamental forb easily escapes cultivation and is able to grow in a wide range of environmental conditions, doing particularly well in nutrient poor soils. Its broad environmental tolerance allows it to invade disturbed areas and form dense colonies that displace and reduce the diversity of native species. *Leucanthemum vulgare* is common and widespread in urban centers and developed areas throughout Alaska (AKEPIC 2005).

Hordeum vulgare was recorded at one percent cover at the McGrath checkpoint. Although the invasiveness of *Hordeum vulgare* has not been formally assessed, this annual grass is generally restricted to low-competition, open habitats (von Bothmer et al. 2007) and thus natural successional processes are likely to reduce its populations. *Hordeum vulgare* has been recorded in Alaska previously but its distribution has been restricted to the road system. The occurrence of *Hordeum vulgare* on the Iditarod NHT is concerning more due to its association with straw than its potential invasiveness. *Hordeum vulgare* is a known contaminant of both locally-produced straw as well as straw imported from Washington and Oregon (Conn et al. unpublished data) and as such could be dispersed further along the trail through the use of non-certified straw.

The occurrence of *Bromus inermis* ssp. *inermis*, *Caragana arborescens*, *Leucanthemum vulgare*, and *Hordeum vulgare* in locations proximal to the pristine habitats that characterize most of the Iditarod NHT is concerning. While elimination of these populations would decrease the probability of invasion along the trail, we recognize that this action is likely not feasible. We therefore recommend monitoring of the local distributions of these species every two to five years.

Taxonomic Considerations

The occurrence of wormseed wallflower (*Erysimum cheiranthoides*) is noteworthy as the nativity of this species is disputed. While Hultén (1968) divided *Erysimum cheiranthoides* into two subspecies (ssp. *cheiranthoides*, introduced from Europe, and ssp. *altum*, native to Alaska), Cody (1996) presents a single native species: *Erysimum cheiranthoides*. In our experience, we have found that Cody's Flora of the Yukon Territory (1996) is often a more accurate guide to the plants of Interior Alaska than Hultén's (1968) Flora of Alaska and Neighboring Territories. In addition, the occurrence of this species in remote areas of the Yukon Flats National Wildlife Refuge (Cortés-Burns and Carlson 2006) and now along the Iditarod Trail where it occurs in both remote (Innoko River crossing and Rohn checkpoint) as well as village locations (White Mountain, Nome and Ophir) leads us to conclude that the '*Erysimum cheiranthoides* ssp. *cheiranthoides-altum*' complex is most likely native to Alaska and/or represents a melding of native and non-native genotypes. As such, we do not recommend any action for this species nor do we include it in the analyses presented here. However, its occurrence is documented in this report in case any future revisions of this species' taxonomy indicates that it is, in fact, an introduced (sub)species.

Similar to *Erysimum cheiranthoides*, the taxonomy of *Chenopodium album* is unclear. The two (potentially) introduced species of *Chenopodium* that occur in Alaska are *C. album* and *C. berlandieri*. Hultén (1968) considers *C. berlandieri* 'introduced from México' but Cody (1996) claims that this species is native to all North America. These two *Chenopodium* species are differentiated by the size and surface texture of their seeds. The seeds of *Chenopodium album* are greater than 1 mm in diameter with a smooth surface, whereas the seeds of *C. berlandieri* are less than 1 mm in diameter and pitted (Hultén 1968). Unfortunately, seed had not yet developed on the plants found in this survey and thus we were unable to fully determine the taxonomic identity of the specimens found. For this reason, the occurrence of *Chenopodium album* is conditionally reported.

The occurrence of unranked common eyebright (*Euphrasia nemorosa*, NR) at the Ophir airstrip, McGrath checkpoint and the Bear Creek Cabin is noteworthy as a possible range extension; this non-native species was only recently documented in Anchorage and was previously restricted to a single location in southeastern Alaska. A reliable key for distinguishing it from native species in Alaska does not exist. We did not collect a voucher for this specimen and therefore the identity of these plants is considered tentative. We would encourage the BLM to collect additional plant material on upcoming trips to any of the locations at which *Euphrasia nemorosa* was reported so that the

taxonomy of these plants can be adequately determined. Where its identity has been confirmed, (e.g. Klondike Gold Rush National Park and Anchorage's Kincaid Park) *Euphrasia nemorosa* appears to be an invader of sparsely vegetated soils disturbed by trampling (Cortés-Burns and Flagstad 2009). Although this species is not likely to cause major impacts to the ecosystem, its restricted occurrence in Alaska indicates that it may be possible to eliminate this species from the state. *Euphrasia nemorosa* (if definitively present) could be eradicated manually at the Bear Creek Cabin, as repeated hand pulling of *Euphrasia nemorosa* plants at infested sites in Klondike Gold Rush National Park has proven moderately effective (AKEPIC 2005).

Species of Concern

The occurrence of narrow-leaf hawk's beard (*Crepis tectorum;* 54), field mustard (*Brassica rapa;* NR), hempnettle (*Galeopsis tetrahit* s.l.; 40), flixweed (*Descurainia sophia;* 41), common timothy (*Phleum pratense;* 54) and foxtail barley (*Hordeum jubatum*; 63) at remote locations along the Iditarod Trail is concerning as these species are moderately to modestly invasive, are strongly associated with straw, or are considered nuisance weeds.

The invasive composite, *Crepis tectorum* was documented at the Rohn Cabin and the McGrath Checkpoint; this species' occurrence at Rohn represents the highest control priority along the trail. *Galeopsis tetrahit* s.l. occurred in Galena and at the Rohn Cabin and *Descurainia sophia*, *Brassica rapa* and *Phleum pratense* were detected at the Rohn Checkpoint locations only. Control recommendations and summaries of species biology and ecology are provided for these high-priority species in the following sections ("Locations of concern" and "Species Biographies and Control Recommendations").

Figure 1: *Hordeum jubatum* growing in straw at the Rohn Checkpoint

In the context of this survey, *Hordeum jubatum* is treated as a species of concern because it is a nuisance weed and known straw associate (Aiken et al. 1995). There are several issues surrounding the appropriate treatment of *Hordeum jubatum*. First, the nativity of this species is 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). It 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 human caused-disturbance. This species appears to be spreading extensively in the last few decades. Second, although *Hordeum jubatum* is only moderately invasive and does not typically disperse beyond its area of introduction, its barbed awns can burrow into an animal's mouth or skin causing infected sores (USFS 1937); for this reason *H. jubatum* is considered a nuisance weed. Third, *Hordeum jubatum* is strongly associated with straw (Aiken et al. 1995). Although *Hordeum jubatum* occurs commonly along the Iditarod Trail in developed sites such as

the villages of White Mountain, Nome, Unalakleet, Galena, Ophir, and McGrath, it was also found at remote sites where it was often associated with straw (BLM Old Woman, Bear Creek, and Rohn shelter cabins, Figure 1) or occurred as a colonizer of disturbed ground (Innoko River crossing site). This species has also been observed growing in straw on winter trails in Yukon Flats National Wildlife Refuge (Cortés-Burns and Carlson 2006; Figure 2). Therefore, despite its disputed non-nativity, the occurrence of *Hordeum jubatum* along the Iditarod NHT is treated as problematic due to its association with straw and capacity to harm dogs.

Locations of Concern

The occurrence of non-native species along the Iditarod NHT is largely restricted to high use areas. Outside of villages, cabins and remote airstrips hosted the greatest abundance and diversity of non-native species, whereas the trail itself is predominantly weed-free. Of the 42 sites surveyed, 20 had non-native species[9] (Table 2). Villages and otherwise developed lands were surveyed as time allowed. The checkpoint villages of Nome, Unalakleet, and Galena were surveyed for the presence non-native plants only. Full surveys for both native and non-native plants and their abundances were conducted at the White Mountain, Ophir, Eagle Island, Iditarod, and McGrath Checkpoints. These locations typically supported the greatest diversity and abundance of non-native species and the associated data is presented herein. However, we do not provide control and mitigation recommendations for these sites as a) they are not BLM-managed lands and b) the invasive populations are often too large or widespread to allow effective management at this time. This information was collected largely to identify potential threats to the pristine ecosystems the Iditarod Trail passes through.

Figure 2: *Hordeum jubatum* and associated straw at a remote site in Yukon Flats National Wildlife Refuge. *Bromus inermis* ssp. *inermis*, *Chenopodium album*, and *Erysimum cheiranthoides* ssp. *cheiranthoides* were documented at this site.

Locations of recent straw use documented during the winter survey of the trail (Phase I) that were coincident with BLM-managed sections of the trail were relocated to determine if straw remained and/or non-native plant species had established (Phase II). Of the 11 sites identified in Phase I that were revisited in Phase II, only three sites supported non-native species (Nome, White Mountain, and Rohn) and straw remained at two sites (Don's Cabin and Rohn). The low presence of non-native species at the straw-use sites is likely due to the use of weed-free straw and/or the inability of non-native plant seeds to germinate and survive. However, it is also possible that this is a false negative result due

[9] Please note that this statistic includes village and checkpoint locations. See text for further explanation.

to our inability, in some cases, to relocated exact sites where straw was used. Relocation errors could be due to restrictions in collecting a low-error GPS position from a moving plane and difficulties in identifying straw-use from the air.

Table 2: Number and percent cover of non-native species recorded along the Iditarod National Historic Trail

Sites are listed primarily in decreasing order of control priority and secondarily in decreasing order of percent non-native species cover. Red, orange and yellow cells indicate high-, moderate-, and low-priority locations, respectively; tan cells indicate the presence of non-native species and unfilled cells indicate the absence of non-native species. T indicates trace cover, NA indicates not available.

Site	Location description	Number of non-native species recorded	Percent cover of non-native species	Straw present?	Mineral soil exposed?
38.2	Rohn Cabin	13	36	**Y**	N
38.1	Rohn Airstrip	2	6	N	N
38.0	Kuksokwim River shore	1	5	N	**Y**
36.0	Bear Creek Cabin	2	5	N	N
13.0	Old Woman Cabin	1	2	**Y**	**Y**
28.0	Innoko River crossing	4	3	N	**Y**
15.0	Four-mile Cabin	2	T	N	**Y**
21.1	downstream on Yukon from Eagle Island	1	3	N	**Y**
22.0	collapsed cabin on Yukon River	1	2	N	**Y**
23.0	abandoned cabin on West bank of Yukon River	1	2	N	**Y**
29.0	Ophir runway	10	30	N	**Y**
33.1	McGrath Checkpoint, City Building	11	32	N	**Y**
5.0	White Mountain dog staging area	7	24	N	**Y**
17.0	Ruby-Poorman Road	7	12	N	**Y**
20.0	Galena small boat launch to Yukon River	6	9	N	**Y**
12.0	Unalakleet Checkpoint	4	3	N	**Y**
20.1	Galena gravel quary, Yukon River bank	6	NA	N	**Y**
5.1	White Mountain beach	5	NA	N	**Y**
7.0	Front Street, Nome	8	NA	N	**Y**
33.0	McGrath Library	3	NA	N	**Y**
1.0	Tommy Johnsons Cabin	0	0	N	N
2.0	Topkok Mushers Cabin	0	0	N	N
3.0	Suprize Creek Cabin	0	0	N	N
4.0	bank of Mudyutok River	0	0	N	N
6.0	Divide Elim Portage	0	0	N	N
8.0	Lowland; broad, sloping drainage	0	0	N	N
9.1	Beach bluff below New Little Mountain Cabin	0	0	**Y**	**Y**
10.0	South End Besson Slough	0	0	N	N
11.0	flat plain near Unalakleet River	0	0	N	N
14.0	Tripod Flats Cabin	0	0	N	N
16.0	Yukon River bank between Galena and Ruby	0	0	N	**Y**
18.0	Sulatna River crossing/bridge	0	0	N	**Y**
19.0	unnamed abandoned cabin	0	0	N	N
21.0	Eagle Island Checkpoint	0	0	**Y**	N
24.0	bog between Anvik and Shageluk	0	0	N	N
25.0	lowland bog	0	0	N	N
26.0	Town of Iditarod, abandoned mine	0	0	N	N
27.0	Don's Cabin	0	0	**Y**	**Y**
30.0	bog south of Ophir	0	0	N	N
31.0	McGrath-Takotna Trail crossing	0	0	N	N
35.0	Sullivan Creek Bridge	0	0	N	**Y**
37.0	cabin ruin East of Fairwell Lake	0	0	N	N

High-priority Locations

Rohn Cabin, airstrip and vicinity

The Rohn Checkpoint represents the most infested remote site surveyed along the trail (Figure 3). Fifteen non-native species totaling 53 percent cover (cumulative among the three Rohn checkpoint sites inventoried) were identified. The potentially problematic invasive species (listed in decreasing order of relative threat) encountered are: *Crepis tectorum, Brassica rapa, Galeopsis tetrahit* s.l.. *Descurainia sophia, Capsella bursa-pastoris, Cerastium fontanum, Phleum pratense,* and *Hordeum jubatum.* The other non-native species (listed in decreasing order of abundance) recorded at this checkpoint are: *Erysimum cheiranthoides*[10]*, Chenopodium album, Poa pratensis* ssp. *irrigata, Matricaria discoidea, Plantago major, Polygonum aviculare,* and *Poa annua.* All species are associated with the cabin; *Poa pratensis* ssp. *irrigata, Erysimum cheiranthoides*[10] and *Poa annua* (listed in decreasing order of abundance at the airstrip) were also found at the Airstrip, which is leased by the Federal Aviation Administration; finally, *Descurainia sophia* and *Erysimum cheiranthoides*[10] (listed in decreasing order of abundance at the shore location) occur on the shore of the Kuskokwim, which is the purported location of dog food dumping after the race.

Non-native species were controlled as time allowed during the July visit. Any *Crepis tectorum, Descurainia sophia, Brassica rapa, Galeopsis tetrahit* s.l., *Capsella bursa-pastoris,* and *Cerastium fontanum* plants that were found were hand-pulled, bagged, and removed from the cabin site (approximately three full trash bags were collected in under two hours). In addition, *Descurainia sophia* plants were pulled from two sites along the shore of the Kuskokwim River: one at the end of the airstrip, and the other in the area behind the cabin (control effort totaled ca. 5-6 hours and resulted in five full trash bags). In late September, an additional 20 pounds of weeds were hand-pulled, bagged and removed by BLM personnel at Rohn Cabin. The species controlled were the invasive mustards *Descurainia sophia* and *Brassica rapa,* four *Crepis tectorum* stems, and 20 *Galeopsis tetrahit* s.l. plants.

Figure 3: BLM facilities and lands at Rohn Cabin (Site 38.2), Airstrip (Site 38.1) and Kuskokwim River bank (Site 38.0)

[10] The nativity of *Erysimum cheiranthoides* is disputed; however this species is currently treated as native to Alaska. See the 'Taxonomic Considerations" section for further taxonomic discussion.

We recommend that *Crepis tectorum, Brassica rapa, Galeopsis tetrahit* s.l., *Descurainia sophia, Capsella bursa-pastoris, Cerastium fontanum, Phleum pratense*, and *Hordeum jubatum* be controlled. The other non-native species present at Rohn are either not aggressive invaders or are so widespread in our state that they cannot be efficiently eradicated. Except for *Crepis tectorum*, which has been observed colonizing recently burned areas in Interior Alaska (Cortés-Burns et al. 2008) the non-native species recommended for treatment are disturbance specialists and rarely persist in established competitive habitats.

Due to their invasiveness and/or difficulty of eradication, *Crepis tectorum*, *Brassica rapa*, and *Galeopsis tetrahit* s.l. should be the primary targets for control work at the Rohn Checkpoint. Secondary priorities are *Descurainia sophia*, *Capsella bursa-pastoris*, *Cerastium fontanum, Phleum pratense*, and *Hordeum jubatum*. *Descurainia sophia* is recommended for control due to its high abundance and its occurrence along the Kuskokwim River, given that waterways can act as effective dispersal corridors for propagules of many plant species. *Capsella bursa-pastoris, Cerastium fontanum,* and *Phleum pratense* are recommended for control due to their currently small population sizes and consequent opportunity to eradicate them completely from this site. *Hordeum jubatum* is recommended for control due to its potential to harm dogs and other animals.

An overarching weed mitigation measure for the Rohn Checkpoint would be to promote the establishment and growth of early seral native grasses and forbs in the disturbed areas surrounding the Rohn Cabin, airstrip, and riverbanks (e.g. Canada bluejoint [*Calamagrostis canadensis*], fireweed [*Chamerion angustifolium*], dwarf fireweed [*Chamerion latifolium*], yellowcress [*Rorippa barbareifolia* and *R. islandica*], and Siberian yarrow [*Achillea sibirica*]). The BLM, through the Seeds of Success program and in partnership with the Department of Natural Resources Plant Material Center and the AKNHP is currently pursuing the production of seed derived from region-specific, wild populations of Alaska-native plant species for use on BLM (and other) lands in reclamation and restoration activities. In the near future, this program could provide a reliable seed source for revegetation efforts along the Iditarod NHT.

Species-specific control methods include seeding areas heavily infested by *Hordeum jubatum* with native grasses or to spot treat populations with herbicides. Small *Capsella bursa-pastoris, Cerastium fontanum*, and *Phleum pratense* populations can generally be controlled by hand-pulling; if the existing populations of *Phleum pratense* grow or additional, larger populations are found, mowing before seed set would be a more effective control method. Continued hand-pulling is suggested for *Crepis tectorum*, *Descurainia sophia*, and *Brassica rapa*. However, if this method proves ineffective after one year, herbicide application should be considered. *Galeopsis tetrahit* s.l. populations can be mown before seed set or treated with herbicide (Manitoba Agriculture, Food, and Rural Initiatives 2001). See the following "Species Biographies and Control Recommendations" section for more detailed control and management practices for each species.

Control efforts at the Rohn Checkpoint should be scheduled early in the growing season, prior to seed set (early to mid June) and should be continued for several years to confirm depletion of the seed bank (e.g. three or more years for *Crepis tectorum* and *Descurainia sophia* [Seefeldt 2007]). Care should be taken to survey the area and ensure that all target plants are treated, as individual plants can produce hundreds to thousands of seeds and replenish the seed bank.

Old Woman Cabin

The Old Woman Cabin is a BLM shelter cabin located between Unalakleet and Kaltag (Figure 4). *Hordeum jubatum* (present at two percent foliar cover) is the only non-native species occurring at this site and was associated with straw that had blown and collected at the forest edge surrounding the cabin clearing. Interestingly, mineral soil had also been exposed at the forest edge during clearing of the woody vegetation around the cabin. It appears that the combination of exposed mineral soil and the presence of straw presumably contaminated with *Hordeum jubatum* seed led to the establishment of this non-native at the site. All *Hordeum jubatum* plants were hand-pulled and bagged during the field visit. We recommend that this site be monitored for reestablishment of *Hordeum jubatum* and introduction of any additional non-native species. Any remaining straw should be collected and destroyed. Care should be taken to reduce or prevent disturbance of the vegetated organic soil surface mat and the subsequent exposure of mineral soil during any future construction and maintenance activity at the site.

Figure 4: Old Woman Cabin; Site 13.0
BLM shelter cabin and leftover straw in the cleared area around the cabin. The only non-native weed recorded at this site was *Hordeum jubatum*, which was presumably introduced to the site as a contaminant in straw.

Bear Creek Cabin

The Bear Creek Cabin is a BLM shelter cabin located between Nikolai and Rohn Cabin (Figure 5). *Hordeum jubatum* (present at five percent foliar cover) and trace *Euphrasia nemorosa*[11] are the only (potentially) non-native species recorded at this site. Both occurred in the disturbed area around the cabin; there was no evidence of straw at this

[11] The taxonomic identification of *Euphrasia nemorosa* is tentative at this site. Absolute determination of this species identity pends the collection of additional plant material.

site. All identifiable *Hordeum jubatum* plants (those with seed heads) were hand-pulled, bagged, and removed from the site. *Euphrasia nemorosa* plants were not controlled as the identity of these plants is tentative and because this species is considered to be only weakly invasive with presumably limited capability to disperse from disturbed to pristine habitats (Carlson pers. comm.). We recommend that this site be monitored for expansion of the existing non-native plant populations and establishment of additional non-native species. Any remaining *Hordeum jubatum* plants should be hand-pulled and removed from the site. Similar to recommendations for the Old Woman Cabin, care should be taken to reduce or prevent disturbance of the vegetated organic soil surface mat and the subsequent exposure of mineral soil at this site during any future construction and maintenance activity.

Figure 5: Bear Creek Cabin, Site 36.0.
Hordeum jubatum growing adjacent to porch.

Moderate-priority Locations

Innoko River Crossing

Several private cabins are being built on an island close to the point at which the Iditarod NHT crosses the Innoko River (Figure 6). Construction activities are likely responsible for the introduction of *Plantago major*, *Erysimum cheiranthoides*[12], *Hordeum jubatum*, *Poa pratensis* ssp. *pratensis*, and *Taraxacum officinale* ssp. *officinale* (listed in decreasing order of abundance) to this site. *Hordeum jubatum* and *Taraxacum officinale* ssp. *officinale* plants were pulled, bagged, and removed from this site.

Figure 6: Innoko River Crossing, Site 28.0

[12] The nativity of *Erysimum cheiranthoides* is disputed; however this species is currently treated as native to Alaska. See the 'Species of concern' section for further taxonomic discussion.

Despite the diversity and abundance of non-native species detected here, this location is only a moderate control priority because the suspected point of weed introductions is not located on BLM-owned or -managed land and because the non-native species present are only moderately to weakly invasive. However, construction activity adjacent to a waterway has the potential to introduce and facilitate the dispersal of more aggressive invasive species. We recommend contacting the local land owner(s) to discuss ways of minimizing non-native species introductions and monitoring this remote site if possible.

Four-mile Cabin, Site 15.0

The land surrounding an abandoned cabin on the west bank of the Yukon River, located between Grayling and Eagle Island, is generally disturbed and supports two weakly invasive non-native species (*Plantago major* and *Polygonum aviculare*), both present in trace amounts (Figure 7). The occurrence of non-native species at this site is noteworthy due to its remote location. If possible, this site should be monitored for the expansion of the established non-native plant populations and the introduction of additional non-native species.

Figure 7: Four-mile cabin on the west bank of the Yukon River; Site 15.0
BLM tag on cabin reads: serial no. 5-13678 7/2/197X

Low-priority Locations

Site 21.1 (downstream from Eagle Island on the west bank of the Yukon River)
Site 22.0 (near cabin ruin on the west bank of the Yukon River between Grayling and Eagle Island)
Site 23.0 (near an abandoned cabin on the west bank of the Yukon River between Grayling and Eagle Island)

These remote sites support the weakly invasive non-native species *Plantago major* at two to three percent cover and are low priorities for control due to the weak invasiveness of *Plantago major*. We believe that these non-native populations will not cause significant harm to the local ecology and if sites were treated they would likely be quickly re-invaded. In many cases, natural community succession will likely result in the extirpation of these populations (Carlson pers. com.). Casual monitoring is recommended, if possible.

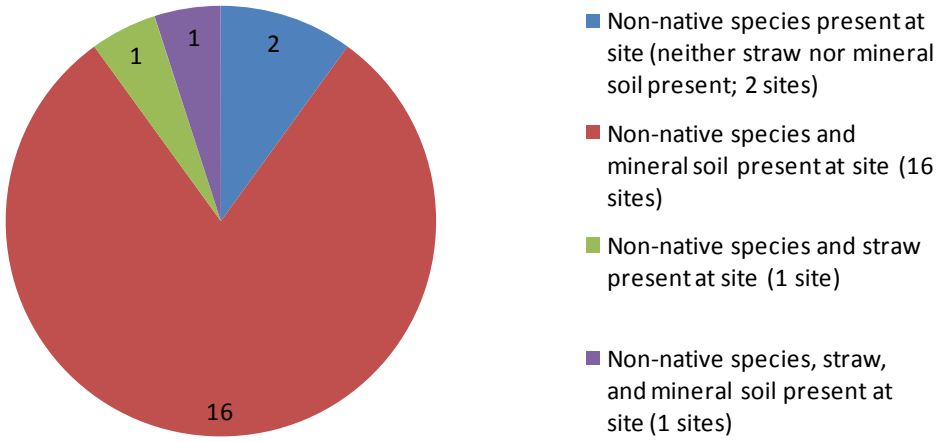
Potential Routes of Non-native Species Introduction

The concentration of non-native species at high-use areas along the Iditarod NHT suggest that the majority of non-native plants have been introduced as a result of both historical (e.g. travel between villages, roadhouses and mines) and contemporary (e.g. travel to remote airstrips and cabins) use.

This project was initiated in part to determine if contaminated bedding straw used by mushers acts as a vector for non-native species introductions. The Iditarod Great Sled Race permit issued by the BLM stipulates that any straw used must be certified weed-free, but there is some concern that the criteria are not enforced and/or that the straw supplied as "weed-free" may nonetheless contain plant propagules of species that are considered non-native to Alaska. The situation is further complicated by the fact that some of the weed-free straw comes from the Lower 48, where a number of Alaska's non-native species are considered native.

Our results show that the non-native grass, *Hordeum jubatum* does co-occur with leftover straw. Further, the exposure of mineral soil, either through human-induced or natural erosion processes appears to facilitate the establishment of non-native species more so than the presence of straw *per se*. In the majority (90%, Figure 8) of cases, sites infested with non-native plants were also characterized by exposed mineral soil. In contrast, only one site that supported non-native species had straw present but no exposed mineral soil. Despite their uncommon occurrence, cases of non-native establishment that occur in the absence of exposed mineral soil may be particularly threatening, as plants that are able to establish in undisturbed organic soils are more likely to persist and spread in boreal habitats. Last, it is important to emphasize that while few non-natives appear to have established from bedding straw, rare dispersal events can have very significant consequences. For example, the contamination of straw by orange hawkweed or Canada thistle seed (*Hieracium aurantiacum* and *Cirsium arvense*; not observed in this survey), which are able to establish in organic soil, could result in the proliferation of highly-invasive and difficult to eradicate non-native species.

Figure 8: Comparison of the number of sites at which non-native species, straw and/or exposed mineral occurred along the Iditarod National Historic Trail.
Pie wedge labels indicate the number of sites meeting the criteria set forth in the legend.



More than half (64%; 16 out of 25) of the non-native species documented in this work have been reported as contaminants of straw that was produced locally, and three quarters of these have also been found in straw imported from Washington and Oregon (75%; 12 of 16 species; see below list). Straw tested was not certified as weed-free (Conn et al. unpublished data).

Non-native species associated with **locally-produced and imported** straw that were also documented on the Iditarod NHT:

- Smooth brome (*Bromus inermis*, 62)
- Field mustard (*Brassica rapa*, NR)
- Shepherd's purse (*Capsella bursa-pastoris*, 40)
- Lambsquarters (*Chenopodium album*, 37)
- Narrowleaf hawksbeard (*Crepis tectorum*, 54)*
- Flixweed (*Descurainia sophia*, 41)+
- Foxtail barley (*Hordeum jubatum*, 63)*
- Common barley (*Hordeum vulgare*, NR)
- Pineappleweed (*Matricaria discoidea*, 32)*
- Common timothy (*Phleum pratense*, 54)
- Common plantain (*Plantago major*, 44)
- Annual bluegrass (*Poa annua*, 46)
- Kentucky bluegrass (*Poa pratensis*, 52)
- Prostrate knotweed (*Polygonum aviculare*, 45)*

- Common chickweed (*Stellaria media,* 54)
- Common dandelion (*Taraxacum officinale*, 58)
- White clover (*Trifolium repens*, 59)

*species germinated from locally-produced straw only
+species germinated from imported straw only

The non-native species in the following list were germinated from seed contaminants in locally and/or imported straw (Conn et al. unpublished data), yet were not documented along the Iditarod Trail. These species are listed on the AKEPIC tracking list and represent non-native species that are present in Alaska and whose invasiveness has been assessed (invasiveness rank listed) or is largely unknown (NR = not ranked). These species constitute a watch list of species that could be introduced to the Iditarod Trail through the use of non-certified straw.

Non-native species associated with **locally-produced** and **imported** straw, not recorded along the Iditarod NHT, but which occur on the AKEPIC tracking list:

- Water foxtail (*Alopecurus geniculatus,* NR)+
- Meadow foxtail (*Alopecurus pratensis*, NR)+
- Redroot pigweed (*Amaranthus retroflexus,* NR)+
- Mayweed chamomile (*Anthemis cotula*, 41)+
- Oat (*Avena sativa,* NR)+
- Downy brome (*Bromus tectorum*, 78)+
- Hairy chickweed (*Cerastium glomeratum,* 36)
- Quackgrass (*Elymus repens,* 59)+
- Storkbill (*Erodium circitarium,* NR)+
- Hare barley (*Hordeum murinum* ssp. *leporinum,* 60)
- Prickly lettuce (*Lactuca serriola*, NR)+
- Hawkbit (*Leontodon autumnalis,* NR)
- Italian ryegrass (*Lolium multiflorum,* 41)+
- Perennial ryegrass (*Lolium perenne,* NR)+
- Canada bluegrass (*Poa compressa,* 39)+
- Wild buckwheat (*Polygonum convolvulus*, NR)*
- Common groundsel (*Senecio vulgaris,* 32)+
- Tumble mustard (*Sisymbrium altissimum,* NR)+
- Annual sowthistle (*Sonchus asper,* NR)+
- Corn spurry (*Spergula arvensis,* 32)
- Green foxtail (*Setaria viridis,* NR)+
- Wheat (*Triticum aestivum,* NR)

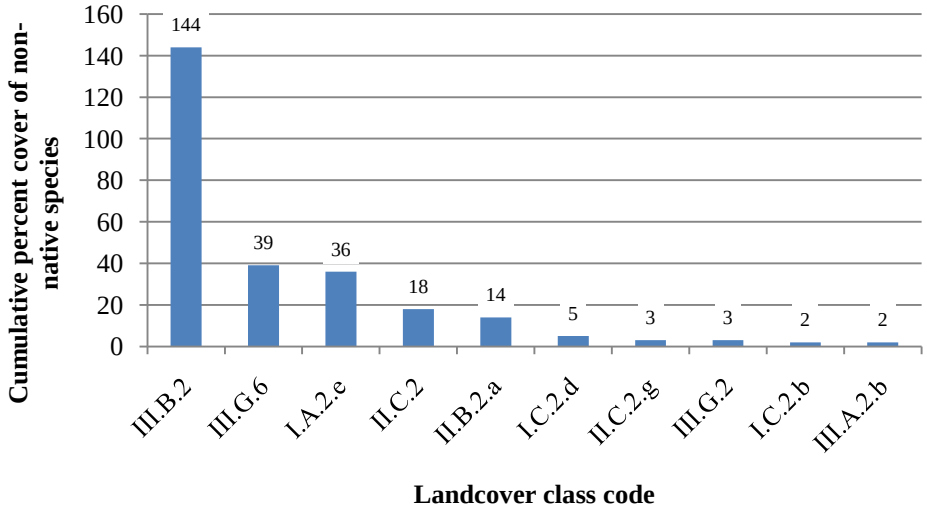
* species germinated from locally-produced straw only
+ species germinated from imported straw only

The large number (n=17) of non-native species that were found along the Iditarod NHT that also occur as common contaminants of straw combined with the large number (n=22) of non-native species that have been found to germinate from non-certified straw but that have fortunately not been observed along the trail yet highlights the importance of using weed-free straw of local origin.

Landcover Classes Susceptible to Invasion

In general, high diversity and abundance of non-native species along the Iditarod NHT is correlated with early seral (e.g. mesic forb and open shrub) or disturbed (e.g. roadsides/lot) habitats (Figure 9). The highest cumulative cover of non-native plants is found in early-seral mesic forb herbaceous habitats (144%), followed by mixed herbaceous-shrub habitats (39%). The prevalence of weeds in open spruce forest (36%) is superficially surprising. However, Rohn Cabin is located in an open white spruce forest and weeds at this site account for the total 36% cover of non-native species associated with this landcover class. The prevalence of weeds at this site is likely more a reflection of a landcover mosaic where weeds occurred in smaller patches of open and disturbed land distributed among the larger spruce stands, rather than the susceptibility of forested landcover classes to non-native species invasions. Significant cover of non-native plants was also associated with early-seral open low scrub (18%) and open tall willow shrub (14%).

Figure 9: Cumulative non-native percent foliar cover presented by landcover class.
Non-native percent cover is summed across all sites of a given landcover class sampled in this survey.
Landcover class is taken from Viereck et al. 1992.



Legend:
III.B.2 Mesic Forb Herbaceous
III.G.6 Mixed Herbaceous-Shrub Roadside/Lot
I.A.2.e Open White Spruce Forest
II.C.2 Open Low Scrub
II.B.2.a Open Tall Willow Shrub
I.C.2.d Open Spruce-Balsam Poplar Forest
II.C.2.g Open Low Willow Shrub
III.G.2 Graminoid Roadside/Lot
I.C.2.b Open Quaking Aspen-Spruce Forest
III.A.2.b Bluejoint-Herb

The susceptibility of early-seral and naturally- or human-disturbed lands to non-native species invasions is well supported in the literature (Sandlund et al. 1999). As previously

suggested, allowing natural succession to proceed will often exclude non-native species from the developing plant community due to competitive pressure from mid- to late-seral native species.

Species Biographies and Control Recommendations

The biographies and control recommendations that follow are provided for the most problematic non-native plant species encountered in this survey. These species are included because they are strongly associated with straw, are nuisance weeds, are moderately to weakly invasive species occurring in remote locations, and/or because their level of invasiveness is uncertain. The remainder of the non-native species that were detected in this survey are not addressed here because they are either very weakly invasive and do not require control or because they occur outside BLM lands, such as checkpoint villages. Control actions follow for the below-listed species:

- narrow-leaf hawk's beard (*Crepis tectorum*; 54)
- field mustard (*Brassica rapa*; NR)
- hempnettle (*Galeopsis tetrahit* s.l.; 40)
- flixweed (*Descurainia sophia*; 41)
- foxtail barley (*Hordeum jubatum*; 63)
- common timothy (*Phleum pratense*; 56)

Narrowleaf hawks beard (*Crepis tectorum*)

Invasiveness Rank = **54** points

Where found: McGrath Checkpoint (Site 33.1), Rohn Cabin (Site 38.2), see Appendix VI for distribution map

Species biography

Crepis tectorum only reproduces by seed, but each plant is capable of producing over 49,000 seeds (Royer and Dickinson 1999), which allows this species to rapidly colonize disturbed and open areas. Diagnostic characters of the *Crepis* genus include green involucral bracts that are arranged in two distinct rows (Figure 10). *Crepis tectorum* can be confused with the yellow-flowered invasive, narrowleaf hawkweed (*Hieracium umbellatum*, 54), which, unlike *Crepis tectorum*, has dark green to black involucral bracts of variable lengths. Diagnostic features of *Crepis tectorum* include its annual habit, minute hairs on the inside surface of its involucral bracts and dark-reddish to purplish brown seed (Bogler 1997). *Crepis tectorum* grows to three feet high (native *Crepis* species often grow less than one foot high), has leaf bases that clasp at the stem, and has a basal rosette of leaves, which withers early in the season (AKEPIC, 2005).

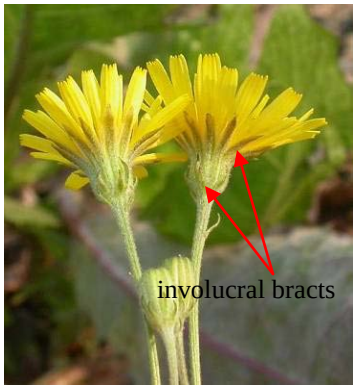


Figure 10: *Crepis tectorum*
Note the two distinct lengths of involucral bracts.

Although it is most commonly found along roadsides and in waste areas, *Crepis tectorum* is one of two non-native plants that have invaded native vegetation affected by the 2004-2005 burns along the Dalton Highway in interior Alaska (Cortés-Burns et al. 2008). The other invasive species that was observed spreading into these lightly burned areas was white sweetclover (*Melilotus alba*; 81), which is a very aggressive weed species in Alaska. The occurrence of this species in native fireweed-Canada bluejoint meadows surrounding the Rohn Cabin is additional evidence of the aggressiveness of *Crepis tectorum* in Alaska. Despite its comparatively low rank, this species is the highest priority for monitoring and control along the Iditarod Trail.

Control and management recommendations

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 can be efficiently eradicated. We therefore recommend that the infestations at Rohn Cabin be targeted for eradication work, but for the infestation at the McGrath Checkpoint we suggest that best management practices, such as the use and proper disposal of weed-free straw, be implemented.

Fairbanks-based Agricultural Research Station weed scientist Steve Seefeldt (2007) suggests that 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 further dispersal. 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 3). Herbicides containing glyphosate (e.g. brand name Roundup, manufactured by Monsanto) or metsulfuron-methyl (e.g. brand name Ally, manufactured by DuPont) are recommended. The infestation area, plus a 50 foot buffer, should be treated with one fluid ounce per acre. These dicot-specific herbicides will kill most of the broadleaf vegetation that it is sprayed on, but monocots, such as grasses will not be harmed. Annual monitoring for at least three years will be necessary to confirm that no new plants have established. The area within at least a 200-meter radius and any disturbed areas within 0.8 km should be scouted for new plants (Seefeldt 2007).

Table 3: Control recommendations for *Crepis tectorum*

Crepis tectorum	**Human-disturbed site**	**Naturally-disturbed and unaltered sites**
Small infestation (<50 stems)	• Hand pull, including underground parts if possible • Bag and remove plants • Monitor for 1 year – if unsuccessful, start herbicide application	• Hand pull, including underground parts if possible • Bag and remove plants • Monitor for 3+ years
Large infestation (>50 stems)	• Herbicide application • Monitor annually for 3+ years	

Field mustard (*Brassica rapa*)

Invasiveness not ranked

Where found: Rohn Cabin (Site 38.2), see Appendix VII for distribution map

Figure 11: *Brassica rapa*
Clasping leaf base © N. Kramer and flowers overtopping buds © P. Slichter

Species biography

Brassica rapa has flowers that, when open, overtop or equal buds, and petals that are deep yellow to yellow, smaller and narrower

Brassica rapa is a yellow-flowered mustard with clasping upper stem leaves (Figure 11). This species can be distinguished from *Brassica napus* (also non-native) by its flowers, that, when open overtop or equal the closed buds and its deep yellow to yellow petals that are on average, shorter and narrower (6-11 mm long and 3-6 mm wide) than those of *Brassica napus*. In comparison, *Brassica napus* buds overtop or equal open flowers, and petals are golden to creamy or pale yellow, and are larger and broader (10-16 mm long and 6-9 mm wide) than those of *Brassica rapa*. Additional traits used to distinguish these two species are foliage color and pubescence; *Brassica rapa* has bright green foliage and pubescent lower leaves, whereas the foliage of *Brassica napus* is glaucous with glabrous lower leaves. *Brassica rapa* reproduces by seed only and is both wind and insect pollinated (Duke 1983).

Control and management recommendations

Brassica rapa is the wild relative of the crop species *Brassica napus*. Genetically modified cultivars of *Brassica napus* are resistant to herbicides (glyphosate, glufosinate, and imidazolinone) and are able to confer this resistance to progeny of crosses with wild types such as *B. rapa* (Warwick et al. 2007). Due to the presence of herbicide resistance genes in the population, integrated management techniques, including herbicide rotations, herbicide mixtures, and non-chemical controls are thought to be most effective (Hall et al. 2000). We recommend that the small populations of *Brassica rapa* at Rohn Cabin (the only occurrence documented in this survey) are pulled by hand and monitored for reestablishment or further dispersal.

Hempnettle (*Galeopsis tetrahit* s.l.)

Invasiveness Rank = **40** points

Where found: Galena (Site 20.1), Rohn Cabin (Site 38.2), see Appendix VIII for distribution map

Species biography

The *Galeopsis tetrahit* species complex (or *Galeopsis tetrahit* sensu lato) includes both *Galeopsis bifida* and *G. tetrahit.* There is little consensus on the taxonomic and morphological separation between these two species. *Galeopsis bifida* and *G. tetrahit* have been treated as separate species (Kartesz; ITIS 2009, www.itis.gov) or as varieties of *Galeopsis tetrahit* (Hitchcock et al. 1984). Distinguishing traits often intergrade to the extent that the two taxa cannot be separated in the field (Figure 12).

Figure 12: *Galeopsis tetrahit* s.l.
The two morphological traits typically used to distinguish *Galeopsis bifida* and *G. tetrahit* are flower size (smaller in the case of *Galeopsis bifida*) and the shape of the lower corolla lip margin (cleft in *G. bifida*) as shown in left photo. Right photo © Carl Farmer.

Galeopsis tetrahit s.l. plants only reproduce by seed. Seeds are large and do not have any apparent adaptations for long-distance dispersal, but can remain dormant in the soil for several years. This species appears to spread as a contaminant of hay or other agricultural products and typically establishes in disturbed sites (AKEPIC 2005).

Populations of *Galeopsis tetrahit* s.l. were recorded at the Rohn Cabin and at the Galena gravel quarry. The presence and abundance of *Galeopsis tetrahit* s.l. at the Rohn Cabin and along recreational trails in Anchorage (Cortés-Burns and Flagstad 2009) indicates that this species complex merits monitoring and control despite its low rank.

Control and management recommendations:

Both taxa (*Galeopsis bifida* and *G. tetrahit*) are reportedly difficult to eradicate once established, thus we recommend that current infestations be contained to prevent new areas from becoming infested (AKEPIC 2005). Established infestations can be contained by cutting or mowing before seed sets. In agricultural settings *Galeopsis tetrahit* s.l. may be inhibited by dense cover crops planted early; herbicides may also be effective (Manitoba Agriculture, Food, and Rural Initiatives 2001).

Flixweed (*Descurainia sophia*)

Invasiveness Rank = **41** points

Where found: Kuskokwim River shore (Site 38.0), Rohn Cabin (Site 38.2), see Appendix IX for distribution map

Species biography

Descurainia sophia can be confused with a number of other pinnately leaved, yellow-flowered mustards of Alaska. However, this species has stellate (star-shaped) and not glandular hairs on the stem, which are visible under 5-10X magnification (Figure 13). Specimens with both stellate and glandular hairs are thought to be hybrids of the non-native *Descurainia sophia* and native *Descurainia sophioides*. *Erysimum* species are superficially similar to *Descurainia*, but this genus has closely appressed, straight, 2-3 pronged hairs (AKEPIC 2005).

Figure 13: *Descurainia sophia*
General morphology of *Descurainia sophia* (left photo © Paul Drobot) and example of stellate hairs (right photo).

Descurainia sophia is a pioneer species of disturbed substrates that facilitates the establishment of other introduced species (e.g. *Bromus tectorum*; Howard 2003). Large, dense stands can become a fire hazard when dry. *Descurainia sophia* grows rapidly, reproduces entirely by seed, and is able to cross- and self-pollinate (AKEPIC 2005). Buried seeds remained viable for at least four years in Fairbanks, allowing development of a semi-persistent seed bank (Conn 1990). Seeds can be dispersed by wind, water, and animals. The mucilaginous seedcoat of *Descurainia sophia* sticks to feathers, fur, and vehicles (Howard 2003, WSSA 2003).

Control and management recommendations

As an early-seral species, *Descurainia sophia* infestations are often reduced by natural successional processes. If long-term management of the site will not allow litter accumulation, canopy closure, and the establishment of late-seral species, then effective control can be achieved with repeated hand-pulling for small infestations (1-50 stems) or herbicide treatments for large infestations (more than 50 stems, Table 4). Seedlings are sensitive to most herbicides, even at low dosages (Howard 2003). We recommend that the populations of *Descurainia sophia* at the Rohn Checkpoint (the only occurrences of this species recorded in this survey) be hand-pulled on an annual basis. Infested areas should be monitored for at least three years to ensure depletion of the seed bank.

Table 4: Control recommendations for *Descurainia sophia*

Descurainia sophia	**Human-disturbed site**	**Naturally-disturbed and unaltered sites**
Small infestation (<50 stems)	• Hand pull • Bag and remove plants • Monitor for 1 year – if unsuccessful, start herbicide application	• Hand pull • Bag and remove plants • Monitor for 3+ years
Large infestation (>50 stems)	• Herbicide application • Monitor annually for 3+ years	

Foxtail barley (*Hordeum jubatum*)

Invasiveness Rank = **63** points

Figure 15: *Hordeum jubatum* Inflorescence highlighting the often reddish awns; © Trevor Roberts, AKNHP

Figure 14: *Hordeum vulgare* Inflorescence showing inflated florets and long awns; © missouriplants.com

Where found:

White Mountain Beach (Site 5.1), Nome (Site 7.0), Unalakleet Checkpoint (Site 12), Old Woman Cabin (Site 13.0), Galena (Sites 20.0 and 20.1), Innoko River crossing (Site 28.0), Ophir (Site 29.0), McGrath Checkpoint (Site 33.1), Bear Creek Cabin (Site 36.0), Rohn Cabin (Site 38.2), see Appendix X for distribution map

Species biographies

Three species of *Hordeum* occur in Alaska; both *Hordeum jubatum* and *H. vulgare* are non-native and are usually recognizable by their long awns; although an unawned, infertile form of *H. vulgare* exists (von Bothmer et al. 2007); all specimens encountered in this study were awned. The two non-native species of *Hordeum* are further distinguished by the presence or absence of auricles (small, clasping outgrowths present on the leaf collar, Figure 16) and awn length. The auricles in *Hordeum jubatum* are negligible (Hitchcock et al. 1984) to absent and awns are 1.5-8.5 cm long, whereas *H. vulgare* has auricles to 0.6 cm long and when present, awns are 3-18 cm long. In addition, awns of *Hordeum jubatum* become divergent and red at maturity (Figure 14) whereas *H. vulgare* awns remain green and the florets of *H. vulgare* are comparatively inflated (Figure 15). The only species in this genus that is native to Alaska, *Hordeum brachyantherum* lacks auricles and has awns 0.7-1.9 cm long, which are noticeably shorter than the long awns characteristic of the introduced species (von Bothmer et al. 2007)[13].

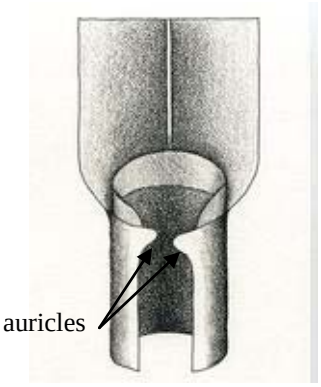


Figure 16: Schematic drawing of auricles; small, clasping outgrowths that may or may not be present on the leaf collar. © 2009 The Regents of the University of California

Although *Hordeum jubatum* is moderately invasive and a nuisance weed, this species is not usually considered a high-priority for control in developed areas as its distribution is largely restricted to areas of medium to high disturbance (e.g. this species does not easily invade late-seral, native plant communities). In addition, its taxonomy and nativity have yet to be adequately determined. It is currently accepted that native and non-native genotypes of *Hordeum jubatum* exist in Alaska,

[13] The treatment of the *Hordeum* genus in The Flora of Alaska (Hulten 1968) and the Invasive Plants of Alaska (AKEPIC 2005) guidebook is confusing. In both cases *Hordeum vulgare* is described as awnless. According to the Flora of North America (von Bothmer et al. 2007) an awnless, infertile form does exist, however the presumably more common fertile forms are characterized by long (3-18 cm) awns.

but these cannot be distinguished phenotypically. Furthermore, hybridization between the native and non-native genotypes is possible, further blurring the distinction between these two (potential) taxa. However, its occurrence along the Iditarod Trail is problematic as *Hordeum jubatum* is a known associate of straw (Aiken et al. 1995) and its barbed awns can burrow into an animal's mouth or skin causing infected sores (USFS 1937).

Control and management recommendations

Because *Hordeum jubatum* typically occurs in human-disturbed or early-seral habitats, it is expected that their populations will be reduced where natural succession is allowed to proceed. As an extension of this natural control process, *Hordeum jubatum* can be controlled by seeding high-use or frequently disturbed areas with fast-growing native grass species (e.g. Canada Bluejoint [*Calamagrostis canadensis*]) that are able to out-compete the introduced grass (Tesky 1992). Herbicide applications have not been field tested in Alaska, but control with dalapon (2,2-dichloropropionic acid) has been shown to completely kill or reduce the occurrence of *Hordeum jubatum* in Lower 48 rangelands. Mefluidide, an herbicide that suppresses seedhead formation, has also proved effective when applied at the initiation of flowering (Tesky 1992).

Common timothy (*Phleum pratense*)

Invasiveness Rank = **56** points

Where found: Rohn Cabin (Site 38.2), see Appendix XII for distribution map

Figure 17: *Phleum pratense* Inflorescence showing long, cylindrical panicle. © James R. Johnson. USDA NRCS. 1992

Species biography

Phleum pratense is a short-lived perennial bunch grass (Figure 17) that is grown in Alaska for hay, and as such is suspected to be introduced to Iditarod NHT sites as a component of straw. It is distinguished from our one native species of *Phleum* (*P. alpinum*) by the shape of its panicle. Non-native *Phleum pratense* has a long cylindrical panicle (more than four times long as broad), whereas the native species, *Phleum alpinum*, has a short (less than four times long as broad) oblong panicle, an inflated uppermost leaf sheath, and typically occurs at higher elevations (Hulten 1968).

Control and management recommendations

Mechanical control methods are recommended for *Phleum pratense*. Hand-pulling and frequent cutting or mowing can weaken overall plant health (AKEPIC 2005)

Summary

The majority of the Iditarod NHT is routed through pristine areas of interior and coastal Alaska and thus is largely weed-free. The non-native plant populations that are present along the trail tend to be concentrated in developed or high-use areas such as villages and remote cabins.

Non-native plant species of concern that were recorded on BLM-managed land along the Iditarod NHT (listed in decreasing order of threat) are: narrow leaf hawk's beard (*Crepis tectorum*), field mustard (*Brassica rapa*), hempnettle (*Galeopsis tetrahit* s.l.), flixweed (*Descurainia sophia*), common timothy (*Phleum pratense*), and foxtail barley (*Hordeum jubatum*). The non-native grass, *Hordeum jubatum*, is strongly associated with the presence of straw. Populations of all species of concern should be controlled following the recommendations in this report. Remote locations prioritized for control (listed in decreasing order of priority) are the Rohn Checkpoint, and the Old Woman and Bear Creek BLM shelter cabins. This study also indicates that the landcover types most susceptible to invasion tend to be early-seral (e.g. mesic forb and open shrub) or disturbed (e.g. roadsides/lot) habitats.

Based on the distribution of non-native species along the trail, we suspect that historically, most plants were introduced by the movement of people and goods between villages and cabins. At present, however, non-native plants are likely being introduced to the trail with bedding straw, construction materials, machinery, and aircraft. More critically, the exposure of mineral soil resulting from human or natural disturbances appears to facilitate the establishment of weed propagules introduced along the trail.

Consequently, best management practices should aim to reduce propagule introductions as well as mitigate the impacts of activities that result in soil disturbance. Specific recommendations include; enforcing the use of weed-free certified straw of local origin (and perhaps testing the straw to evaluate levels of contamination), appropriately disposing of straw (preferably burning at site of use), encouraging natural successional processes at early-seral and disturbed sites, and diminishing (or preventing) disturbance of the vegetated organic soil surface mat and subsequent exposure of mineral soil during construction and maintenance activity on BLM-managed land. If soil disturbance cannot be avoided, we recommend revegetating with native plant species.

Finally, we propose the development of an invasive species management plan for the Iditarod NHT and outreach materials for trail users and local residents, as this would help protect this remarkable trail, the pristine ecosystems it passes through, and the subsistence resources these systems support.

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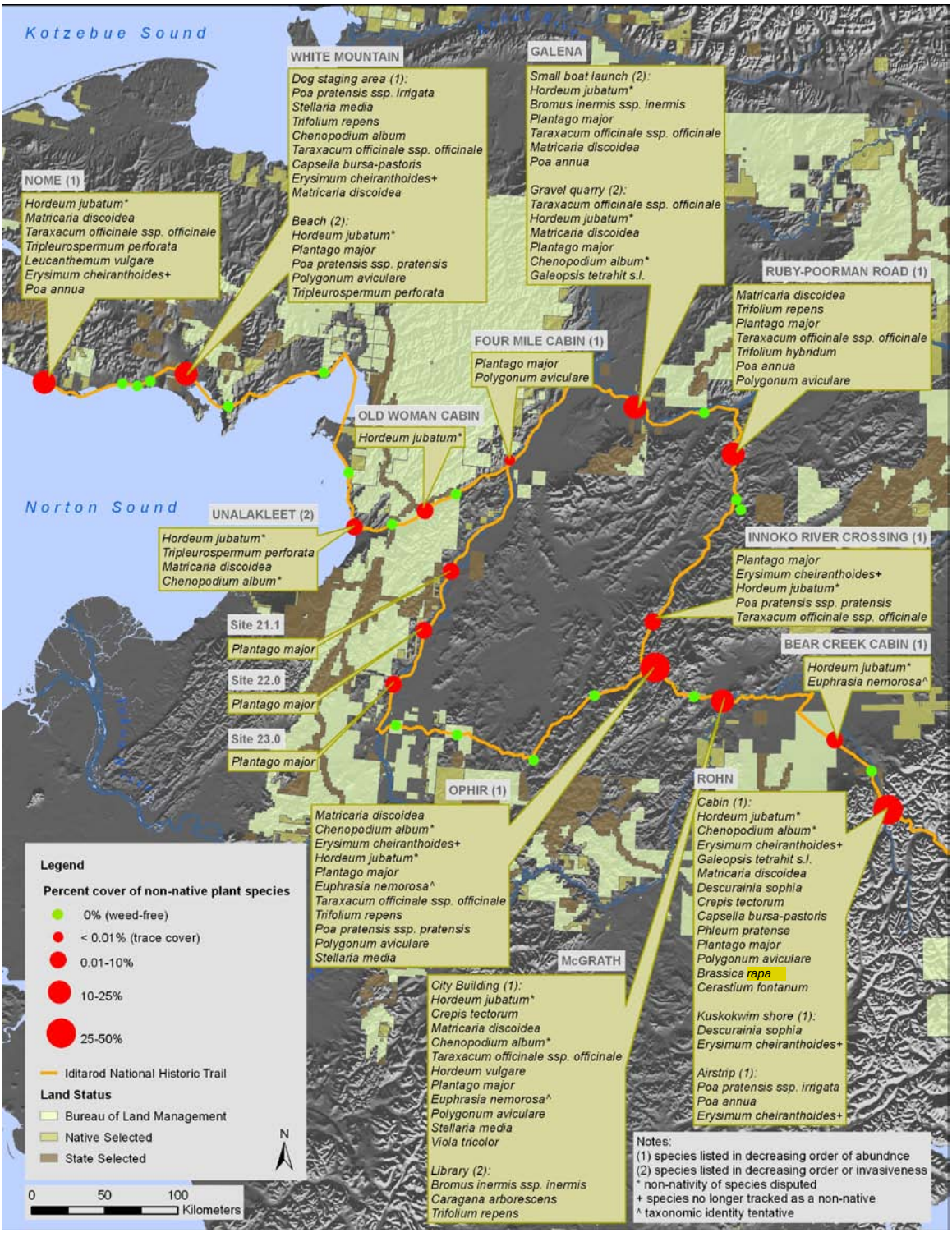
Appendix I. Map of survey area



Appendix II. Percent covers and locations of non-native species detected along the Iditarod National Historic Trail

(page 1 of 2) USDA code is taken from the PLANTS database. Invasiveness rank scores species on a scale from 1 (very weakly invasive) to 100 (extremely invasive; Carlson et al. 2005).

Site	Scientific Name	USDA code	Invasivness Rank	Percent cover	Latitude (NAD83)	Longitude (NAD83)
5.0	*Stellaria media*	STME2	42	5	64.68130267	-163.41197591
5.0	*Poa pratensis* ssp. *irrigata*	POPRI	52	5	64.68130267	-163.41197591
5.0	*Trifolium repens*	TRRE3	59	5	64.68130267	-163.41197591
5.0	*Taraxacum officinale* ssp. *officinale*	TAOFO	58	3	64.68130267	-163.41197591
5.0	*Chenopodium album*	CHAL7	37	3	64.68130267	-163.41197591
5.0	*Capsella bursa-pastoris*	CABU2	40	2	64.68130267	-163.41197591
5.0	*Erysimum cheiranthoides*	ERCH9	NR	1	64.68130267	-163.41197591
5.0	*Matricaria discoidea*	MADI6	32	1	64.68130267	-163.41197591
5.1	*Hordeum jubatum*	HOJU	63	NR	64.68107800	-163.41100200
5.1	*Plantago major*	PLMA2	44	NR	64.68107800	-163.41100200
5.1	*Poa pratensis* ssp. *pratensis*	POPRP2	52	NR	64.68107800	-163.41100200
5.1	*Polygonum aviculare*	POAV	45	NR	64.68107800	-163.41100200
5.1	*Tripleurospermum perforatum*	TRPE21	48	NR	64.68107800	-163.41100200
7.0	*Erysimum cheiranthoides*	ERCH9	NR	NR	64.49547227	-165.39388815
7.0	*Hordeum jubatum*	HOJU	63	NR	64.49547227	-165.39388815
7.0	*Leucanthemum vulgare*	LEVU	61	NR	64.49547227	-165.39388815
7.0	*Matricaria discoidea*	MADI6	32	NR	64.49547227	-165.39388815
7.0	*Papaver* sp.	PAPAV	NR	NR	64.49547227	-165.39388815
7.0	*Poa annua*	POAN	46	NR	64.49547227	-165.39388815
7.0	*Silene* sp.	SILEN	NR	NR	64.49547227	-165.39388815
7.0	*Taraxacum officinale* ssp. *officinale*	TAOFO	58	NR	64.49547227	-165.39388815
7.0	*Tripleurospermum perforatum*	TRPE21	48	NR	64.49547227	-165.39388815
12.0	*Matricaria discoidea*	MADI6	32	2	63.87479159	-160.78839269
12.0	*Chenopodium album*	CHALA	37	1	63.87479159	-160.78839269
12.0	*Hordeum jubatum*	HOJU	63	NR	63.87479159	-160.78839269
12.0	*Tripleurospermum perforatum*	TRPE21	48	NR	63.87479159	-160.78839269
13.0	*Hordeum jubatum*	HOJU	63	2	64.01413017	-159.82496467
15.0	*Plantago major*	PLMA2	44	T	64.36517140	-158.69198232
15.0	*Polygonum aviculare*	POAV	45	T	64.36517140	-158.69198232
17.0	*Trifolium repens*	TRRE3	59	3	64.46846670	-155.52596943
17.0	*Matricaria discoidea*	MADI6	32	3	64.46846670	-155.52596943
17.0	*Taraxacum officinale* ssp. *officinale*	TAOFO	58	2	64.46846670	-155.52596943
17.0	*Plantago major*	PLMA2	44	2	64.46846670	-155.52596943
17.0	*Trifolium hybridum*	TRHY	57	2	64.46846670	-155.52596943
17.0	*Polygonum aviculare*	POAV	45	T	64.46846670	-155.52596943
17.0	*Poa annua*	POAN	46	T	64.46846670	-155.52596943
20.0	*Hordeum jubatum*	HOJU	63	3	64.73234855	-156.93559516
20.0	*Plantago major*	PLMA2	44	2	64.73234855	-156.93559516
20.0	*Taraxacum officinale* ssp. *officinale*	TAOFO	58	2	64.73234855	-156.93559516
20.0	*Bromus inermis* ssp. *inermis*	BRINI	62	2	64.73234855	-156.93559516
20.0	*Matricaria discoidea*	MADI6	32	T	64.73234855	-156.93559516
20.0	*Poa annua*	POAN	46	T	64.73234855	-156.93559516
20.1	*Chenopodium album*	CHALA	37	NR	64.73353090	-156.95058184
20.1	*Galeopsis tetrahit*	GATE2	40	NR	64.73353090	-156.95058184
20.1	*Hordeum jubatum*	HOJU	63	NR	64.73353090	-156.95058184
20.1	*Matricaria discoidea*	MADI6	32	NR	64.73353090	-156.95058184
20.1	*Plantago major*	PLMA2	44	NR	64.73353090	-156.95058184
20.1	*Taraxacum officinale* ssp. *officinale*	TAOFO	58	NR	64.73353090	-156.95058184
21.1	*Plantago major*	PLMA2	44	3	63.65845668	-159.39531653
22.0	*Plantago major*	PLMA2	44	2	63.28540072	-159.69890513
23.0	*Plantago major*	PLMA2	44	2	62.93934681	-160.04482350

Notes:
*non-nativity of species disputed
+species no longer tracked as non-native
^taxonomic identity tentative

Appendix II. Percent covers and locations of non-native species detected along the Iditarod National Historic Trail

Site	Scientific Name	USDA code	Invasivness Rank	Percent cover	Latitude (NAD83)	Longitude (NAD83)
28.0	*Plantago major*	PLMA2	44	2	63.42469697	-156.57928113
28.0	*Erysimum cheiranthoides+*	ERCH9	NR	T	63.42469697	-156.57928113
28.0	*Hordeum jubatum**	HOJU	63	T	63.42469697	-156.57928113
28.0	*Poa pratensis* ssp. *pratensis*	POPRP2	52	T	63.42469697	-156.57928113
28.0	*Taraxacum officinale* ssp. *officinale*	TAOFO	58	T	63.42469697	-156.57928113
29.0	*Matricaria discoidea*	MADI6	32	10	63.14457611	-156.52437086
29.0	*Chenopodium album**	CHALA	37	4	63.14457611	-156.52437086
29.0	*Hordeum jubatum**	HOJU	63	4	63.14457611	-156.52437086
29.0	*Plantago major*	PLMA2	44	4	63.14457611	-156.52437086
29.0	*Erysimum cheiranthoides+*	ERCH9	NR	4	63.14457611	-156.52437086
29.0	*Taraxacum officinale* ssp. *officinale*	TAOFO	58	2	63.14457611	-156.52437086
29.0	*Trifolium repens*	TRRE3	59	2	63.14457611	-156.52437086
29.0	*Euphrasia nemorosa^*	EUNE3	NR	2	63.14457611	-156.52437086
29.0	*Polygonum aviculare*	POAV	45	1	63.14457611	-156.52437086
29.0	*Poa pratensis* ssp. *pratensis*	POPRP2	52	1	63.14457611	-156.52437086
29.0	*Stellaria media*	STME2	42	T	63.14457611	-156.52437086
33.0	*Bromus inermis* ssp. *inermis*	BRINI	62	NR	62.95453180	-155.59531200
33.0	*Caragana arborescens*	CAAR18	66	NR	62.95453180	-155.59531200
33.0	*Trifolium repens*	TRRE3	59	NR	62.95453180	-155.59531200
33.1	*Hordeum jubatum**	HOJU	63	12	62.95015477	-155.58790474
33.1	*Crepis tectorum*	CRTE3	54	6	62.95015477	-155.58790474
33.1	*Matricaria discoidea*	MADI6	32	6	62.95015477	-155.58790474
33.1	*Chenopodium album**	CHALA	37	4	62.95015477	-155.58790474
33.1	*Taraxacum officinale* ssp. *officinale*	TAOFO	58	2	62.95015477	-155.58790474
33.1	*Plantago major*	PLMA2	44	1	62.95015477	-155.58790474
33.1	*Hordeum vulgare*	HOVU	NR	1	62.95015477	-155.58790474
33.1	*Polygonum aviculare*	POAV	45	T	62.95015477	-155.58790474
33.1	*Viola tricolor*	VITR	NR	T	62.95015477	-155.58790474
33.1	*Euphrasia nemorosa^*	EUNE3	NR	T	62.95015477	-155.58790474
33.1	*Stellaria media*	STME2	42	T	62.95015477	-155.58790474
36.0	*Hordeum jubatum**	HOJU	63	5	62.72338456	-154.07624812
36.0	*Euphrasia nemorosa^*	EUNE3	NR	T	62.72338456	-154.07624812
38.0	*Descurainia sophia*	DESO2	41	5	62.29351667	-153.37605000
38.0	*Erysimum cheiranthoides+*	ERCH9	NR	T	62.29351667	-153.37605000
38.1	*Poa pratensis* ssp. *irrigata*	POPRI	52	5	62.29403333	-153.36403333
38.1	*Erysimum cheiranthoides+*	ERCH9	NR	1	62.29403333	-153.36403333
38.1	*Poa annua*	POAN	46	1	62.29403333	-153.36403333
38.2	*Hordeum jubatum**	HOJU	63	10	62.29466667	-153.37353333
38.2	*Chenopodium album**	CHALA	37	8	62.29466667	-153.37353333
38.2	*Erysimum cheiranthoides+*	ERCH9	NR	8	62.29466667	-153.37353333
38.2	*Galeopsis tetrahit* s.l.	GATE2	40	5	62.29466667	-153.37353333
38.2	*Matricaria discoidea*	MADI6	32	5	62.29466667	-153.37353333
38.2	*Descurainia sophia*	DESO2	41	4	62.29466667	-153.37353333
38.2	*Crepis tectorum*	CRTE3	54	2	62.29466667	-153.37353333
38.2	*Capsella bursa-pastoris*	CABU2	40	T	62.29466667	-153.37353333
38.2	*Phleum pratense*	PHPR3	54	T	62.29466667	-153.37353333
38.2	*Plantago major*	PLMA2	44	T	62.29466667	-153.37353333
38.2	*Polygonum aviculare*	POAV	45	T	62.29466667	-153.37353333
38.2	*Brassica raoa*	BRRA	NR	NR	62.29466667	-153.37353333
38.2	*Cerastium fontanum*	CEFO2	36	NR	62.29466667	-153.37353333
38.2	*Poa pratensis* ssp. *irrigata*	POPRI	52	NR	62.29466667	-153.37353333

Notes:

*non-nativity of species disputed

+species no longer tracked as non-native

^taxonomic identity tentative

Appendix III. Example field datasheet used for the 2009 Iditarod National Historic Trail non-native plant survey

BLM Iditarod Trail Non-native Plant Survey

Plot #	Surveyors:	Date:	Landcover class name:
GPS used:		WP:	
Lat:		Elevation (ft):	
Long:		Error ±	Slope (0-100°):
Camera used:	Photos taken:		Aspect (0-360°): true magnetic
	Air Photo #		Plot Size: ______ x ______ (ft)

Vegetated	% Cover	Height (ft)	**Unvegetated**	% Cover	**Draw schematic below:**
Needleleaf			Litter, duff		
Broadleaf			Wood (>0.4")		
Tall shrub (>5 ft)			Silt (feel on tongue)		
Low (8" > 5 ft)			Sand (feel b/w fingers)		
Dwarf (<8")			Small rocks (gravel <3")		
Forb			Large rocks		
Grass			(cobbles 3-8", boulders >8")		
Sedge			Bedrock		
Moss			Trunks of trees		
Lichen			(basal area)		
Unvegetated			Other (describe):		
Water					
Other					

Biome:	**Hydrologic Regime:**	**Landform**
Alpine	Dry	
Subalpine	Mesic	
Forest	Wet	**Notes:**
Bog	Aquatic - FW	
Herb meadow	Aquatic - brackish	
Riparian	Aquatic - SW	

AKEPIC Site Info:

Area Surveyed ____________ acres

Disturbance type ____________

Species	% Cover	Height (ft)	collected?	**Species**	% Cover	Height (ft)	collected?

Appendix IV. List of voucher specimens collected along the Iditarod National Historic Trail

Scientific Name	Family	Collection Date	Latitude (NAD83)	Longitude (NAD83)	Site
Brassica rapa	Brassicaceae	7/20/2009	62.29466667	-153.3735333	38.2
Bromus inermis ssp. *inermis*	Poaceae	8/7/2009	64.73234855	-156.9355952	20.0
Bromus inermis ssp. *inermis*	Poaceae	8/7/2009	64.73234855	-156.9355952	20.0
Cerastium beeringianum ssp. *beeringianum* var. *grandiflorum*	Caryophyllaceae	8/6/2009	63.87479159	-160.7883927	12.0
Chrysanthemum arcticum	Asteraceae	8/6/2009	64.53713913	-161.0861633	12.0
Crepis tectorum	Asteraceae	8/10/2009	62.89170524	-154.5759186	33.1
Descurainia sophia	Brassicaceae	7/20/2009	62.29351667	-153.37605	38.0
Descurainia sophioides	Brassicaceae	8/6/2009	63.87479159	-160.7883927	5.0
Descurainia sophioides	Brassicaceae	8/5/2009	64.68130267	-163.4119759	12.0
Elymus repens	Poaceae	8/10/2009	62.95015477	-155.5879047	33.1
Elymus repens	Poaceae	8/10/2009	62.95015477	-155.5879047	33.1
Elymus trachycaulus ssp. *trachycaulus*	Poaceae	8/7/2009	64.01413017	-159.8249647	13.0
Elymus trachycaulus ssp. *trachycaulus*	Poaceae	8/7/2009	64.01413017	-159.8249647	13.0
Erigeron acris ssp. *politus*	Asteraceae	7/20/2009	62.29351667	-153.37605	38.0
Erigeron lonchophyllus	Asteraceae	8/10/2009	62.95015477	-155.5879047	33.1
Erigeron lonchophyllus	Asteraceae	8/7/2009	64.73234855	-156.9355952	20.0
Erysimum cheiranthoides	Brassicaceae	8/5/2009	64.68130267	-163.4119759	38.2
Erysimum cheiranthoides	Brassicaceae	8/9/2009	63.42469697	-156.5792811	5.0
Erysimum cheiranthoides	Brassicaceae	8/10/2009	62.89170524	-154.5759186	28.0
Galeopsis tetrahit s.l.	Lamiaceae	7/20/2009	62.29466667	-153.3735333	38.2
Galeopsis tetrahit s.l.	Lamiaceae	7/20/2009	62.29466667	-153.3735333	38.2
Hedysarum alpinum var. *americanum*	Fabaceae	7/20/2009	62.29466667	-153.3735333	38.2
Hordeum vulgare	Poaceae	8/6/2009	64.53774917	-161.0860972	33.1
Lactuca tatarica	Asteraceae	8/7/2009	64.73234855	-156.9355952	20.0
Lomatogonium rotatum	Gentianaceae	8/9/2009	63.14457611	-156.5243709	29.0
Polygonum alpinum	Polygonaceae	8/5/2009	64.70847362	-163.4995516	4.0
Rorippa barbareifolia	Brassicaceae	8/9/2009	63.42469697	-156.5792811	20.1
Rorippa barbareifolia	Brassicaceae	8/7/2009	64.7335309	-156.9505818	28.0
Rorippa palustris ssp. *fernaldiana*	Brassicaceae	8/6/2009	64.20281234	-160.9480786	10.0
Rorippa palustris ssp. *hispida*	Brassicaceae	8/6/2009	64.20281234	-160.9480786	10.0
Rosa acicularis	Rosaceae	8/10/2009	62.95015477	-155.5879047	33.1
Saussurea angustifolia	Asteraceae	7/20/2009	62.29351667	-153.37605	38.0
Stachys pilosa var. *pilosa*	Lamiaceae	8/7/2009	64.3651714	-158.6919823	15.0
Tanacetum bipinnatum	Asteraceae	8/7/2009	64.73234855	-156.9355952	20.0
Taraxacum officinale ssp. *ceratophorum*	Asteraceae	7/20/2009	62.29403333	-153.3640333	38.2

Appendix V. Iditarod National Historic Trail site attributes

(page 1 of 3) Land Status: TC indicates Tentative Approval; IC indicates Interim Conveyed.

Site	Location description	Latitude (NAD83)	Longitude (NAD83)	Land status	Surveyors	Survey date	Elevation (m)	Slope (degrees)	Aspect (degrees)	Plot size (m2)	Area surveyed (acres)
1.0	Tommy Johnsons cabin	64.56435811	-164.29428966	State Patent or TA	Flagstad, L.; Wright, C.	8/5/2009	3	3	320	100	1.5
2.0	Topkok Mushers cabin	64.56349812	-164.07971076	State Patent or TA	Flagstad, L.; Wright, C.	8/5/2009	5	3	200	100	1.5
3.0	Suprize Creek cabin	64.60534520	-163.90432589	State Patent or TA	Flagstad, L.; Wright, C.	8/5/2009	12	2	160	100	1
4.0	West bank of Mudyutok River	64.70847362	-163.49955155	Native Patent or IC	Flagstad, L.; Wright, C.	8/5/2009	6	10	80	100	1
5.0	White Mountain dog staging area	64.68130267	-163.41197591	Native Patent or IC	Flagstad, L.; Wright, C.	8/5/2009	12	2		100	
5.1	White Mountain beach	64.68107800	-163.41100200	Native Patent or IC	Flagstad, L.; Wright, C.	8/5/2009	12	2		NA	
6.0	Divide Elim Portage	64.51804264	-162.75276932	Bureau of Land Management	Flagstad, L.; Wright, C.	8/5/2009	177	5		100	1.5
7.0	Front Street, Nome	64.49547227	-165.39388815	Native Patent or IC	Flagstad, L.; Wright, C.	8/5/2009	10	0	NA	NA	
8.0	lowland; broad, sloping drainage	64.79480000	-161.45563000	Native Patent or IC	Flagstad, L.; Wright, C.	8/6/2009	17	3	330	100	1
10.0	South End Besson Slough	64.20281234	-160.94807860	Native Selected	Flagstad, L.; Wright, C.	8/6/2009	11	8	288	100	
11.0	flat plain near Unalakleet River	63.91488240	-160.27230249	State Selected	Flagstad, L.; Wright, C.	8/6/2009	19	0	NA	100	1
12.0	Unalakleet Checkpoint	63.87479159	-160.78839269	Native Patent or IC	Flagstad, L.; Wright, C.	8/6/2009	3	10	90	400	1.5
13.0	Old Woman Cabin	64.01413017	-159.82496467	Native Selected	Flagstad, L.; Wright, C.	8/7/2009	61	2	10	100	2
14.0	Tripod Flats Cabin	64.13423765	-159.41455962	Bureau of Land Management	Flagstad, L.; Wright, C.	8/7/2009	156	12	180	100	2
15.0	Four-mile Cabin	64.36517140	-158.69198232	Native Patent or IC	Flagstad, L.; Wright, C.	8/7/2009	38	6	76	100	1
16.0	Yukon River bank between Galena and Ruby	64.71635160	-155.95964734	Bureau of Land Management	Flagstad, L.; Wright, C.	8/7/2009	45	3	315	100	1
17.0	Ruby-Poorman Road	64.46846670	-155.52596943	State Selected	Flagstad, L.; Wright, C.	8/7/2009	223	2	232	100	1
18.0	Sulatna River crossing/bridge	64.18898488	-155.46699705	State Patent or TA	Flagstad, L.; Wright, C.	8/7/2009	120	0	NA	100	1
19.0	unnamed cabin	64.12671656	-155.40369767	State Patent or TA	Flagstad, L.; Wright, C.	8/7/2009	132			100	1
20.0	Galena small boat launch to Yukon River	64.73234855	-156.93559516	Native Patent or IC	Flagstad, L.	8/7/2009	39	8	240	200	1
20.1	Galena gravel quary, Yukon River bank	64.73353090	-156.95058184	Native Patent or IC	Flagstad, L.	8/7/2009	41			NA	1
21.0	Eagle Island Checkpoint	63.65847814	-159.39611231	State Patent or TA	Flagstad, L.; Wright, C.	8/8/2009	43	30	50	100	1.5
21.1	downstream on Yukon from Eagle Island	63.65845668	-159.39531653	State Patent or TA	Flagstad, L.; Wright, C.	8/8/2009	26	5	50	100	1
22.0	collapsed cabin on Yukon River	63.28540072	-159.69890513	Native Patent or IC	Flagstad, L.; Wright, C.	8/8/2009	33	12	90	100	1
23.0	abandoned cabin on West bank of Yukon River	62.93934681	-160.04482350	Native Patent or IC	Flagstad, L.; Wright, C.	8/8/2009	27	10	88	100	1
24.0	bog between Anvik and Shaktoolik	62.69285465	-159.96868640	Bureau of Land Management	Flagstad, L.; Wright, C.	8/8/2009	29	0		100	1
25.0	lowland bog	62.66567892	-159.13695811	Bureau of Land Management	Flagstad, L.; Wright, C.	8/9/2009	76	8	150	100	1
26.0	Town of Iditarod, abandoned mine	62.54422456	-158.09524119	State Patent or TA	Flagstad, L.; Wright, C.	8/9/2009	49	0		100	5
27.0	Don's cabin	62.95809494	-157.32864196	State Patent or TA	Flagstad, L.; Wright, C.	8/9/2009	155	2	300	100	1.5
28.0	Innoko River crossing	63.42469697	-156.57928113	State Patent or TA	Flagstad, L.; Wright, C.	8/9/2009	110	2	60	100	1.5
29.0	Ophir runway	63.14457611	-156.52437086	State Patent or TA	Flagstad, L.; Wright, C.	8/9/2009	181	0		100	1
30.0	bog	62.97645274	-155.98344642	Native Selected	Flagstad, L.; Wright, C.	8/9/2009	116	0		100	1
31.0	McGrath-Takotna Trail crossing	62.98272626	-155.65158918	Native Selected	Flagstad, L.; Wright, C.	8/9/2009	110	2	90	100	1
33.0	McGrath Library	62.95453180	-155.59531200	Native Patent or IC	Flagstad, L.; Wright, C.	8/10/2009	108	0		NA	
33.1	McGrath Checkpoint, City Building	62.95015477	-155.58790474	Native Patent or IC	Flagstad, L.; Wright, C.	8/10/2009	101	5	90	900	2.5
35.0	Sullivan Creek bridge	62.77520584	-154.27109501	Bureau of Land Management	Flagstad, L.; Wright, C.	8/10/2009	160	1	340	100	1
36.0	Bear Creek Cabin	62.72338456	-154.07624812	Bureau of Land Management	Flagstad, L.; Wright, C.	8/10/2009	226	2	225	225	2
37.0	cabin ruin East of Fairwell Lake	62.53501637	-153.59052546	State Selected	Flagstad, L.; Wright, C.	8/10/2009	313	2	90	100	1
38.0	Kuskokwim River shore	62.29351667	-153.37605000	State Patent or TA	Cortes-Burns, H.; Roberts, T.; Thorpe, L.	7/20/2009	417	36			
38.1	Rohn Airstrip	62.29403333	-153.36403333	State Patent or TA	Cortes-Burns, H.; Roberts, T.; Thorpe, L.	7/20/2009	434				
38.2	Rohn Cabin	62.29466667	-153.37353333	State Patent or TA	Cortes-Burns, H.; Roberts, T.; Thorpe, L.	7/20/2009	433				

Appendix V. Iditarod National Historic Trail site attributes

(page 2 of 3) Landcover class is in accordance with Viereck et al. 1992. Hydrologic regime: Aquatic - FW indicates a freshwater aquatic habitat.

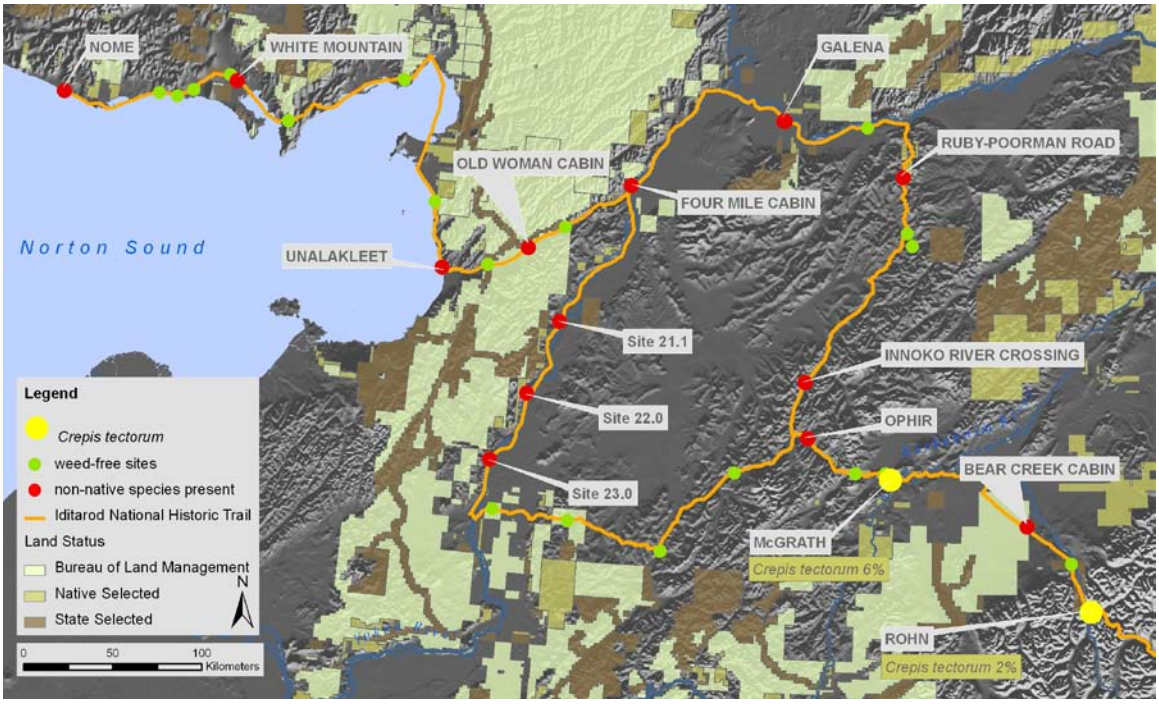
Site	Landcover class	Disturbance type	Biome	Hydrologic Regime
1.0	II.D.2.c-C2 Crowberry Dwarf Shrub Tundra	Mechanical Substrate Alteration or Removal, Cabin	Subalpine	Mesic
2.0	II.C.2.-C2 Open Low Scrub	Mechanical Substrate Alteration or Removal, Cabin	Subalpine	Mesic
3.0	II.C.2.-C2 Open Low Scrub	Mechanical Substrate Alteration or Removal, Cabin	Subalpine	Mesic
4.0	II.B.2.d-C2 Open Tall Alder-Willow Shrub	Mechanical Substrate Alteration or Removal, Trail	Forest	Mesic
5.0	III.B.2.-C2 Mesic Forb Herbaceous	River Action (i.e., Flooding/Erosion-Ice Scour/Deposition of New Substrates)	Riparian	Mesic
5.1	III.B.2.-C2 Mesic Forb Herbaceous	River Action (i.e., Flooding/Erosion-Ice Scour/Deposition of New Substrates)	Riparian	Mesic
6.0	II.D.2.b-C2 Vaccinium Dwarf Shrub Tundra	Animal related disturbed site	Subalpine	Mesic
7.0	Sparsely vegetated	Fill Importation (e.g., Road or Railroad Grade), Town	Developed	Mesic
8.0	II.C.2.f-C2 Open Low Shrub Birch-Willow Shrub	Mechanical Substrate Alteration or Removal, Trail	Subalpine	Mesic
10.0	III.A.2.a-C2 Bluejoint Meadow	Mechanical Substrate Alteration or Removal, Outhouse	Herb Meadow	Mesic
11.0	III.A.2.d-C2 Tussock Tundra	Animal related disturbed site	Subalpine	Mesic
12.0	III.G.2-C2 Graminoid Roadside/Lot	Fill Importation (e.g., Road or Railroad Grade), Town	Subalpine	Mesic
13.0	I.C.2.b.-C2 Open Quaking Aspen-Spruce Forest	Mechanical Substrate Alteration or Removal, Cabin	Forest	Mesic
14.0	I.C.2.b.-C2 Open Quaking Aspen-Spruce Forest	Mechanical Substrate Alteration or Removal, Cabin	Forest	Mesic
15.0	III.A.2.b-C2 Bluejoint-Herb	Mechanical Substrate Alteration or Removal, Cabin	Herb Meadow	Mesic
16.0	II.C.1.b-C2 Closed Low Willow Shrub	River Action (i.e., Flooding/Erosion-Ice Scour/Deposition of New Substrates)	Riparian	Mesic
17.0	II.C.2.-C2 Open Low Scrub	Fill Importation (e.g., Road or Railroad Grade), Dirt Road	Forest	Mesic
18.0	I.C.2.a.-C2 Open Spruce-Paper Birch Forest	Fill Importation (e.g., Road or Railroad Grade), Road Bridge	Forest, Bog	Mesic
19.0	I.A.2.h.-C2 Open Black Spruce-Tamarack Forest	Mechanical Substrate Alteration or Removal, Cabin	Forest, Herb Meadow	Mesic
20.0	II.B.2.a-C2 Open Tall Willow Shrub	Mechanical Substrate Alteration or Removal, Boat Launch	Riparian	Mesic
20.1	Sparsely vegetated	Material Extraction (e.g., Rock Quarry or Gravel Pit)	Riparian	Mesic
21.0	I.C.2.b.-C2 Open Quaking Aspen-Spruce Forest	Mechanical Substrate Alteration or Removal, Cabin	Forest	Mesic
21.1	II.C.2.g-C2 Open Low Willow Shrub	River Action (i.e., Flooding/Erosion-Ice Scour/Deposition of New Substrates)	Riparian	Mesic
22.0	III.A.2.b-C2 Bluejoint-Herb	Mechanical Substrate Alteration or Removal, Cabin	Riparian	Mesic
23.0	II.B.2.a-C2 Open Tall Willow Shrub	Mechanical Substrate Alteration or Removal, Cabin	Riparian	Mesic
24.0	II.C.2.-C2 Open Low Scrub	Animal related disturbed site	Bog	Wet
25.0	I.A.3.d.-C2 Black Spruce Woodland	Mechanical Substrate Alteration or Removal, Trail	Forest	Mesic
26.0	I.C.3.a.-C2 Spruce-Paper Birch Woodland	Mechanical Substrate Alteration or Removal, Abandoned Mine	Bog	Wet
27.0	II.C.2.f-C2 Open Low Shrub Birch-Willow Shrub	Mechanical Substrate Alteration or Removal, Cabin	Forest	Mesic
28.0	II.B.2.a-C2 Open Tall Willow Shrub	Mechanical Substrate Alteration or Removal, Cabin Construction	Riparian	Mesic
29.0	III.B.2.-C2 Mesic Forb Herbaceous	Fill Importation (e.g., Road or Railroad Grade), Runway	Herb Meadow	Mesic
30.0	III.A.3.j-C2 Subarctic Lowland Sedge-Bog Meadow	Mechanical Substrate Alteration or Removal, Trail	Bog	Wet
31.0	II.C.2.b-C2 Open Low Mixed Shrub-Sedge Tussock Bog	Mechanical Substrate Alteration or Removal, Trail	Bog	Wet
33.0	III.G.4-C2 Forb-Graminoid Roadside/Lot	Fill Importation (e.g., Road or Railroad Grade), Town	Developed	Mesic
33.1	III.G.6-C2 Mixed Herbaceous-Shrub Roadside/Lot	Fill Importation (e.g., Road or Railroad Grade), Road	Developed	Mesic
35.0	I.A.3.d.-C2 Black Spruce Woodland	Mechanical Substrate Alteration or Removal, Trail	Forest	Mesic
36.0	II.C.2.-C2 Open Low Scrub	Mechanical Substrate Alteration or Removal, Cabin and Trail and Mechanical Clearing	Herb Meadow	Mesic
37.0	I.C.2.d.-C2 Open Spruce-Balsam Poplar Forest	Mechanical Substrate Alteration or Removal, Cabin and Trail	Forest	Mesic
38.0	I.C.2.d.-C2 Open Spruce-Balsam Poplar Forest	River Action (i.e., Flooding/Erosion-Ice Scour/Deposition of New Substrates)	Herb Meadow	Mesic
38.1	III.G.6-C2 Mixed Herbaceous-Shrub Roadside/Lot	Fill Importation (e.g., Road or Railroad Grade), Runway	Developed	Mesic
38.2	I.A.2.e.-C2 Open White Spruce Forest	Mechanical Substrate Alteration or Removal, Cabin	Forest	Mesic

Appendix V. Iditarod National Historic Trail site attributes

(page 3 of 3) Tall shrubs are greater than 1.3 m in height, low shrubs are between 20 cm and 1.3 m in height, dwarf shrubs are less than 20 cm in height. Wood corresponds to woody debris greater than 1 cm diameter; silt is mineral material <0.05 mm maximum diameter, sand is between 0.05 mm and 2 mm and rock is between 2 mm and 20 cm.

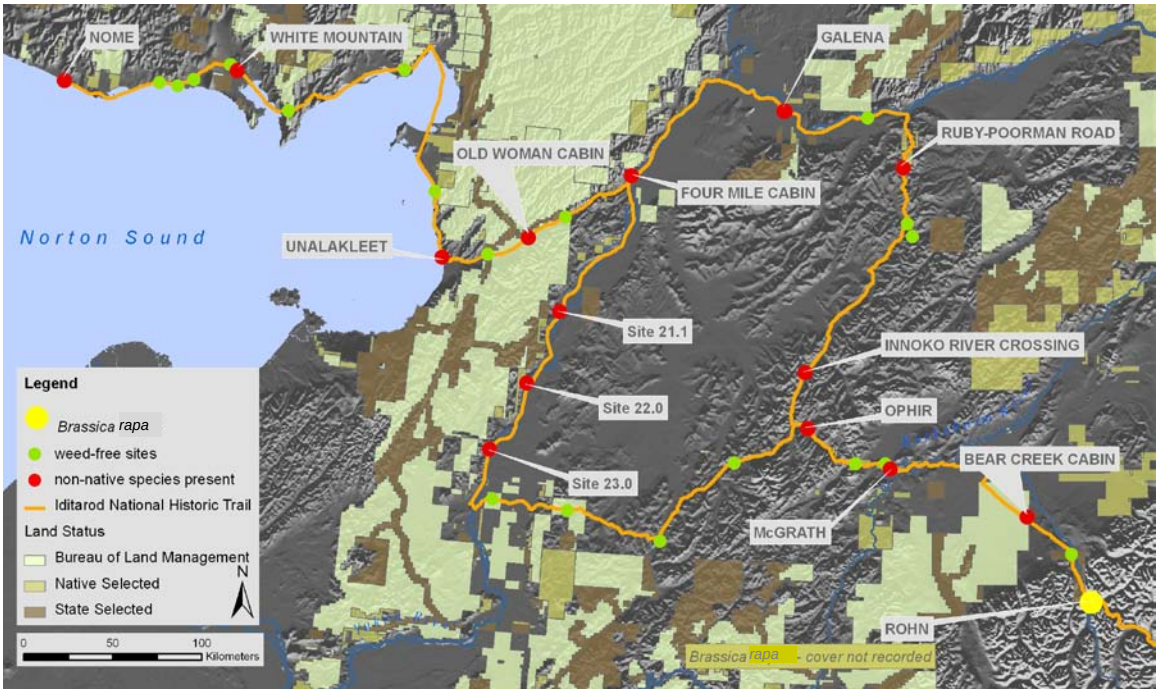
Site	Straw present	Mineral soil present	Needleleaf (% cover)	Broadleaf (% cover)	Tall shrub (% cover)	Low shrub (% cover)	Dwarf shrub (% cover)	Forb (% cover)	Grass (% cover)	Sedge (% cover)	Moss (% cover)	Lichen (% cover)	Unvegetated (% cover)	Litter (% cover)	Wood (% cover)	Silt (% cover)	Sand (% cover)	Rock (% cover)	Bedrock (% cover)
1.0			0	0	0	0	54	28	18	1	0	10	5	5	0	0	0	0	0
2.0			0	0	0	11	47	12	10	24	9	7	0	0	0	0	0	0	0
3.0			0	0	0	4	62	4	10	11	10	3	0	0	0	0	0	0	0
4.0			0	0	25	20	0	20	35	0	0	0	0	0	0	0	0	0	0
5.0		X	0	0	0	0	0	70	15	1	0	0	40	0	0	0	5	10	25
5.1		X	0	0	0	0	0	70	15	1	0	0	40	0	0	0	5	10	25
6.0			0	0	0	0	55	16	1	9	40	10	0	0	0	0	0	0	0
7.0		X																	
8.0			5	0	0	28	33	20	1	1	60	20	0	0	0	0	0	0	0
10.0			0	0	10	0	0	30	85	0	1	0	0	0	0	0	0	0	0
11.0			0	0	0	0	18	16	0	30	0	46	0	0	0	0	0	0	0
12.0		X	0	0	0	0	0	46	40	0	0	0	15	0	0	0	0	0	0
13.0	X	X	5	5	0	15	25	6	15	5	7	16	5	0	0	0	0	0	0
14.0			10	10	0	21	11	19	15	2	20	7	5	5	0	0	0	0	0
15.0		X	1	4	20	16	0	44	65	1	0	0	0	0	0	0	0	0	0
16.0		X	0	0	20	70	0	5	0	0	0	0	0	0	0	0	0	0	0
17.0		X	5	5	8	1	0	26	10	2	1	0	50	0	0	15	20	15	0
18.0		X	5	8	10	8	0	32	10	0	0	0	10	10	0	0	0	0	0
19.0			13	0	10	14	8	8	35	2	11	2	0	0	0	0	0	0	0
20.0		X	0	0	45	2	0	30	11	0	0	0	20	0	8	0	8	4	0
20.1		X																	
21.0	X		10	30	15	19	6	31	60	0	10	0	10	8	0	0	0	0	0
21.1		X	0	5	0	30	0	32	8	0	0	0	40	5	5	0	25	5	0
22.0		X	0	1	0	10	0	79	60	0	0	0	10	0	0	0	0	0	0
23.0		X	0	5	25	5	0	45	10	0	0	0	10	0	0	0	10	0	0
24.0			0	0	0	55	5	18	2	1	75	2	5	5	0	0	0	0	0
25.0			10	0	0	40	21	5	2	15	32	18	0	0	0	0	0	0	0
26.0			6	12	8	13	8	8	10	11	26	5	2	0	0	0	0	0	0
27.0	X	X	7	0	10	32	2	15	30	1	6	0	5	3	0	0	0	0	0
28.0		X	0	6	20	8	0	15	14	2	0	0	25	0	1	5	10	9	
29.0		X	0	0	0	14	0	51	15	4	0	0	20	0	0	0	10	10	0
30.0			0	0	0	8	6	19	12	18	20	0	0	0	0	0	0	0	0
31.0			3	0	0	13	12	1	5	5	30	5	0	0	0	0	0	0	0
33.0		X																	
33.1		X	5	4	8	12	0	40	37	0	0	0	30	0	0	10	0	20	0
35.0		X	10	3	6	26	5	10	4	3	6	1	0	0	0	0	0	0	0
36.0			4	10	0	24	20	32	20	1	5	1	0	0	0	0	0	0	0
37.0			40	25	10	19	0	20	4	0	50	5	30	30	0	0	0	0	0
38.0		X	10	10	0	0	0	25	20	0	5	3	40	0	0	10	0	80	0
38.1			5	40	3	25	0	50	15	0	0	5	40	0	0	0	0	90	0
38.2	X																		

Appendix VI. Distribution of narrowleaf hawks beard (*Crepis tectorum*; 54[14]) along the Iditarod National Historic Trail



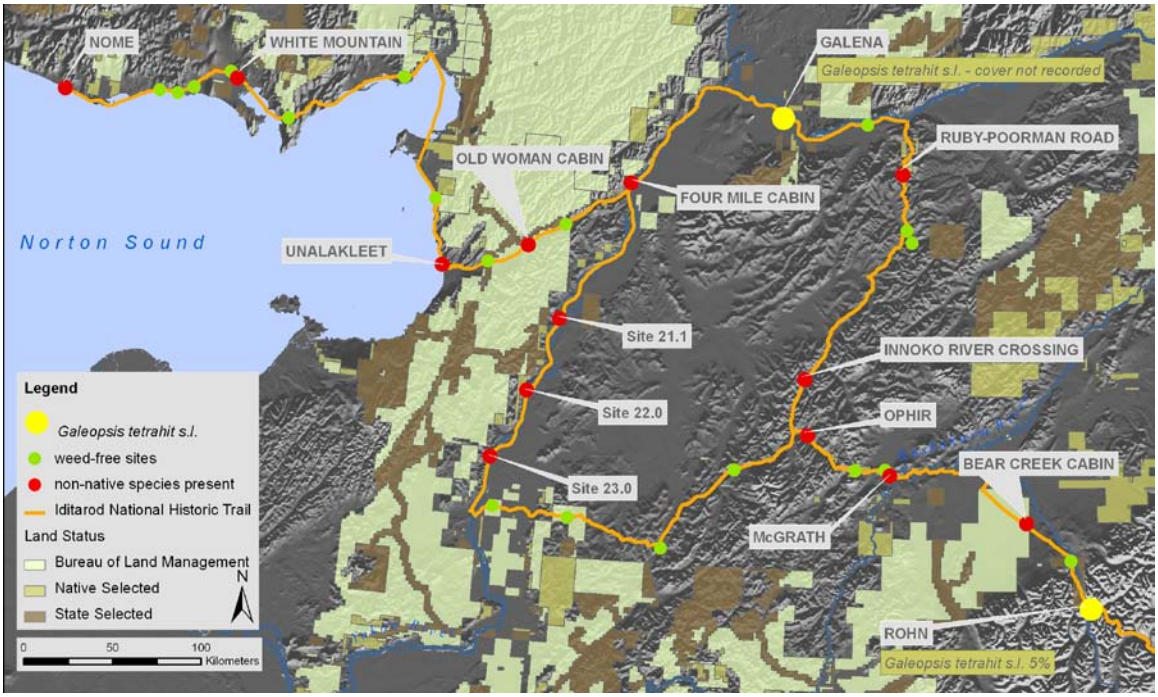
[14] Invasiveness Rank refers to the points assigned to a given species by the Invasiveness Ranking System for Non-native Plants of Alaska (Carlson et al. 2008). Species are ranked on a scale of 0 to 100 with 100 being an extremely invasive species. Species that were not ranked in this publication (Carlson et al. 2008) are designated as 'NR', not ranked.

Appendix VII. Distribution of rapeseed (*Brassica rapa*; NR[15]) along the Iditarod National Historic Trail



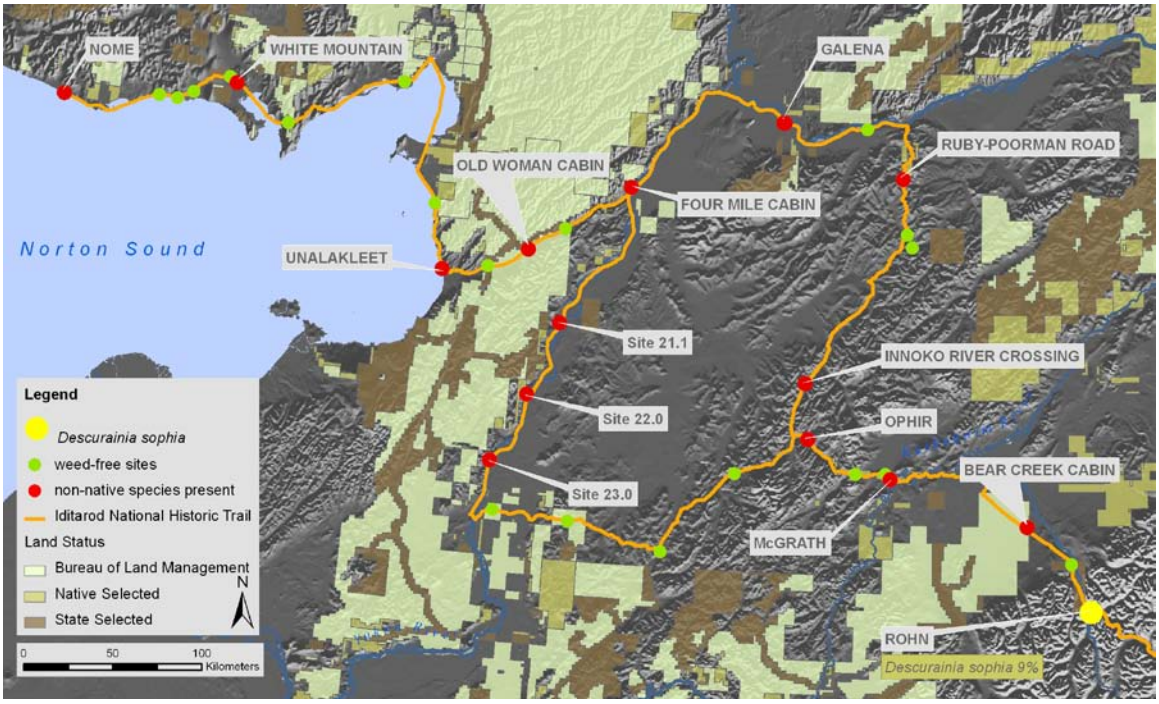
[15] Invasiveness Rank refers to the points assigned to a given species by the Invasiveness Ranking System for Non-native Plants of Alaska (Carlson et al. 2008). Species are ranked on a scale of 0 to 100 with 100 being an extremely invasive species. Species that were not ranked in this publication (Carlson et al. 2008) are designated as 'NR', not ranked.

Appendix VIII. Distribution of hempnettle (*Galeopsis tetrahit* s.l.; 40[16]) along the Iditarod National Historic Trail



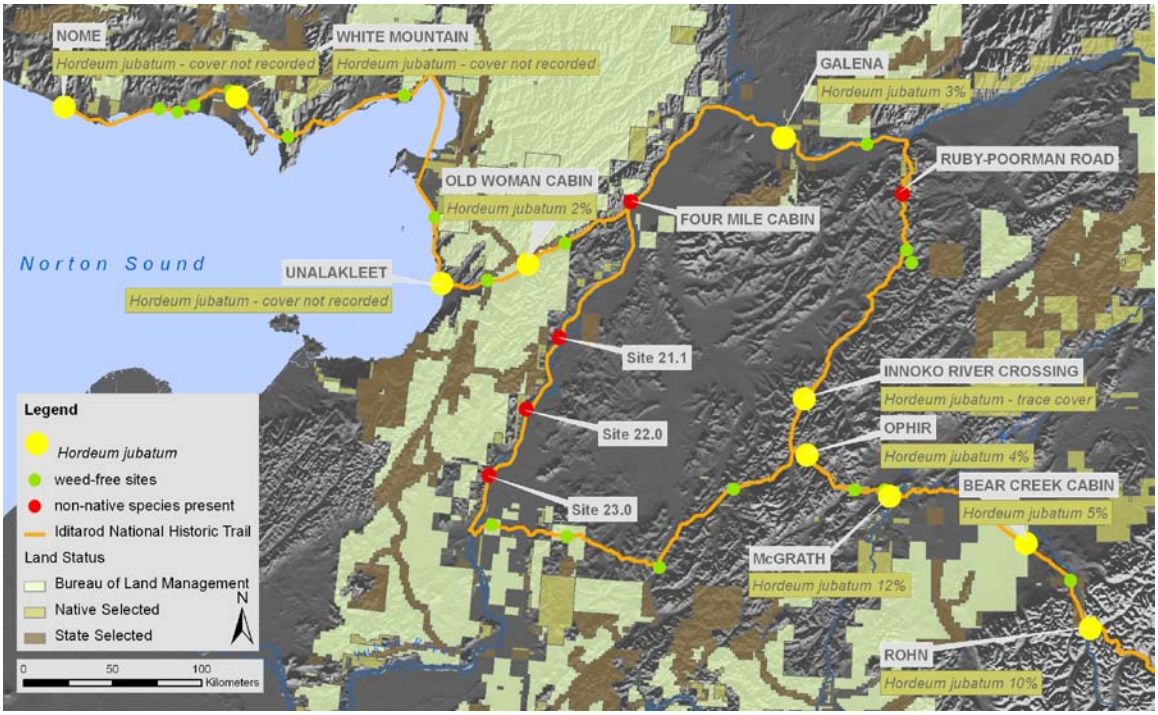
[16] Invasiveness Rank refers to the points assigned to a given species by the Invasiveness Ranking System for Non-native Plants of Alaska (Carlson et al. 2008). Species are ranked on a scale of 0 to 100 with 100 being an extremely invasive species. Species that were not ranked in this publication (Carlson et al. 2008) are designated as 'NR', not ranked.

Appendix IX. Distribution of flixweed (*Descurainia sophia*; 41[17]) along the Iditarod National Historic Trail



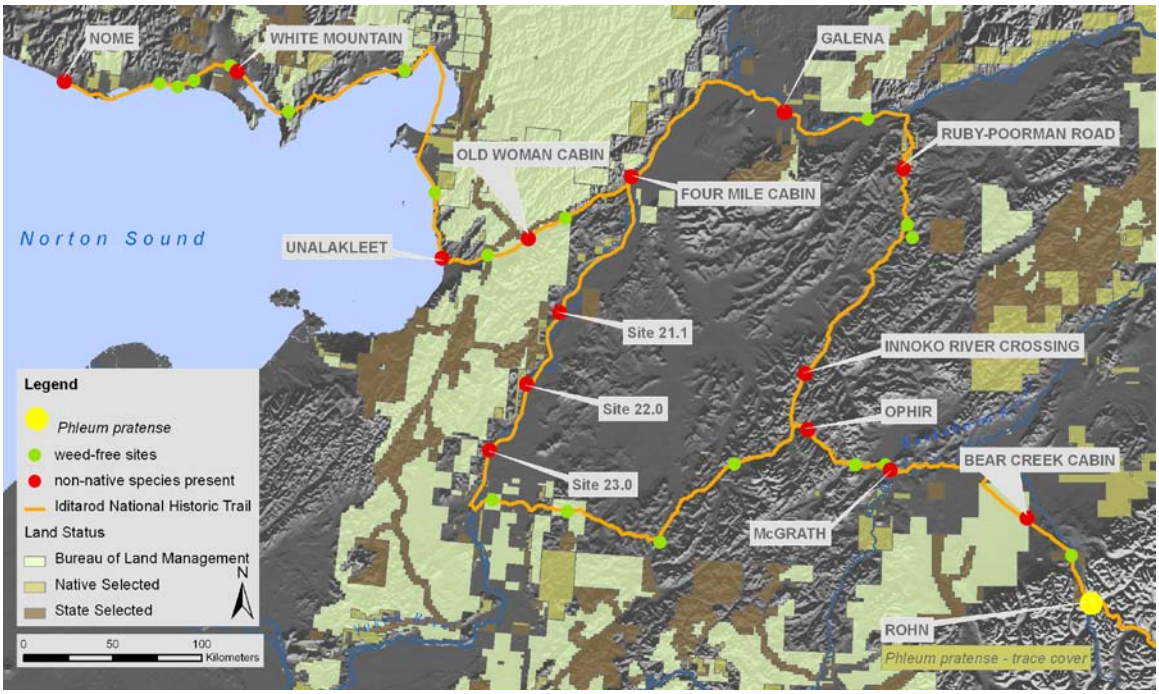
[17] Invasiveness Rank refers to the points assigned to a given species by the Invasiveness Ranking System for Non-native Plants of Alaska (Carlson et al. 2008). Species are ranked on a scale of 0 to 100 with 100 being an extremely invasive species. Species that were not ranked in this publication (Carlson et al. 2008) are designated as 'NR', not ranked.

Appendix X. Distribution of foxtail barley (*Hordeum jubatum*; 63[18]) along the Iditarod National Historic Trail



[18] Invasiveness 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). Species are ranked on a scale of 0 to 100 with 100 being an extremely invasive species. Species that were not ranked in this publication (Carlson et al. 2008) are designated as 'NR', not ranked.

Appendix XI. Distribution of common timothy (*Phleum pratense*; 56[19]) along the Iditarod National Historic Trail



[19] Invasiveness 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). Species are ranked on a scale of 0 to 100 with 100 being an extremely invasive species. Species that were not ranked in this publication (Carlson et al. 2008) are designated as 'NR', not ranked.