Non-Native Plant Surveys on Public Lands Affected by Forest Fires 2009-2010

Prepared by Casey Greenstein and Brian Heitz

Alaska Natural Heritage Program
University of Alaska Anchorage

The Alaska Natural Heritage Program – University of Alaska Anchorage
707 A Street
Anchorage, AK 99501

Prepared for

Bureau of Land Management
Alaska State Office
222 W 7th Avenue #13
Anchorage, AK 99513

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Contents

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Introduction

The establishment, growth, and persistence of non-native[1] plant species pose a serious threat to natural ecosystems. Even though not all non-native species cause significant economic or ecological harm, a smaller proportion of these plants may be invasive[2] and may significantly alter community composition, successional pathways, nutrient cycling, hydrology, and fire regimes. Invasive plants can also reduce or eliminate threatened and endangered native species populations (U.S. Congress 1993, Busch 1995, Myers 1997, Brooks 1999, Stein et al. 2000).

While invasive plants constitute a major problem in the lower 48 states (Randall 1996), Alaska has remained much less affected. However, over the last ten years there has been a marked acceleration in the rate of introduction of non-native plants to the state, probably driven by movement of goods and people (Carlson and Shephard 2007). Invasive species management has become costly in Alaska, with an annual average of $5.8 million spent between 2007 and 2011 (Schwörer et al. 2012).

The susceptibility of native plant communities to invasion is largely a function of the degree of natural or anthropogenic disturbance (Hobbs and Huenneke 1992). In Alaska, non-native plant occurrence is most strongly correlated with high-use, and therefore highly disturbed, areas such as urban centers and transportation routes. Invasive plants are able to establish in these types of areas because there are more opportunities for introduction, less competition from native plants, and an abundance of disturbed substrates on which invasive species thrive. However, in some cases invasive weeds have been documented moving off the human footprint into natural ecosystems. In interior boreal Alaska, these species include, but are not limited to, *Caragana arborescens* (Siberian peashrub[3]), *Crepis tectorum* (narrowleaf hawksbeard), *Hieracium umbellatum* (narrowleaf hawkweed), *Melilotus albus* (white sweetclover), and *Vicia cracca* (bird vetch; Lapina et al. 2007; Cortés-Burns et al. 2007, 2008; Conn et al. 2008; Villano and Mulder 2008).

In addition to direct anthropogenic factors, climate change may also affect non-native plant establishment. At higher latitudes climate change is more pronounced (Holland and Bitz 2003), which may lead to a higher rate of non-native species establishment and accelerated population growth in the future. Non-native species are often better adapted and more competitive (Prentis et al. 2008) than native species, so they may be at an advantage with changing weather and temperature patterns. Native species often have slower migration rates (Malcolm et al. 2002, van Grunsven et al. 2007) and thus are likely to lag behind invasive species in their response to environmental changes. The compounding impacts of climate change on invasive species augments the need to prevent and manage non-native species in Alaska.

In Alaska's boreal forests 169 non-native plant species were present as of 2013. Many native species of the boreal forest are stress tolerant, but are slow to reestablish once they are removed (Grime 1979, Haeussler et al. 2002). If the native stress-tolerant species are eliminated from an area by disturbance (e.g. by fire, clear cut logging, roads, resource extraction, pipelines) habitats become more available for opportunistic species, including non-native plants. Consequently, as the frequency and scale of these

[1] Non-native plants are those whose presence in a given area is due to the accidental or intentional introduction by humans.

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

[3] Common names are derived from the PLANTS Database, plants.usda.gov

types of disturbances increase, so does the chance that invasive species will be introduced and successfully establish (Byers 2002).

Burned areas in Alaska are a special case for non-native plant management. In the conterminous United States land is highly susceptible to non-native plant invasions after a forest fire, due to the increase of disturbed habitat and unintentional dispersal by firefighting activities (Hobbs and Huenneke 1992, Brooks 2001, Harrod and Reichard 2001). Exposed soil, increased light and nutrient availability, and reduced interspecific competition create ideal conditions for opportunistic invasive species to thrive. Forest fires also create a complex matrix of disturbed and undisturbed plant communities that can provide a transitional foothold habitat for non-native species to invade more intact areas (Rejmánek 1989, Harrod and Reichard 2001). Alaska has one advantage over the conterminous United States, in that most of the areas burned by forest fire are far away from anthropogenic disturbance and consequently have few vectors for invasive propagule introductions.

In Alaska, research has previously been conducted regarding the likelihood of plant invasion in burned landscapes. Burned habitats most likely to be invaded were mixed conifer-deciduous woodland or open forest prior to burns (Villano and Mulder 2008). Furthermore, in a greenhouse setting, invasive species germinate better in interior Alaska soils from low severity burns relative to high severity burns (Villano 2008). While the scope and severity of burns are one predictor of habitat invasibility, invasion into this habitat requires a seed source of sufficient size to result in establishment. Consequently, the importance of propagule pressure from a nearby seed source is increasingly recognized as a critical element in invasions.

This project sought to determine if firefighters and their equipment have introduced non-native plants into remote areas during fire management efforts and whether burned areas in Alaska are susceptible to non-native plant invasion. Areas in Alaska affected by forest fires in 2009 and 2010 were visited the summers of 2012 and 2013 (Figure 1). Areas prioritized for surveys include known locations where firefighters were on the ground, the edges of private allotments where there was a likelihood of firefighter presence, and cabin sites where soil disturbance and foot traffic are probable. The Alaska Natural Heritage Program (AKNHP) at the University of Alaska Anchorage entered into an agreement with the Bureau of Land Management (BLM) State Office to conduct these surveys; funding is provided by the BLM while the field work, data synthesis, and report writing are carried out by AKNHP.

In total, nine burned areas were visited: Turquoise Lake, Katlitna, Big River, Cheeneetnuk, Wood River, Holonada, Paddle, Little Black, and Big Mountain. A total of 104 acres were surveyed, comprising 0.0126% of total burned areas in these nine burns. Here we describe the sites visited and presence or absence of non-native species (see Table 1). Only a few of these sites showed signs of obvious human influence. Unless otherwise stated under the “site notes” headings of each site description, it can be assumed that the areas surveyed were in a pristine setting. One site that had originally been on the itinerary to survey, the Titna burn located between McGrath and Fairbanks, was not visited due to dense fog. The total acreage burned in the 2009 and 2010 fires was gleaned from the Alaska Interagency Coordination Center’s Fire History in Alaska website, found at http://afsmaps.blm.gov/imf_firehistory/imf.jsp?site=firehistory.

In addition to documenting the presence and absence of non-native species, this study also identified two plants rare to Alaska: *Cicuta bulbifera* (bulblet-bearing water hemlock, G5S3[4]) at Big Mountain 1 and 2, and *Botrychium alaskense* (Alaska moonwort, G4S3) at Turquoise Lake 1.

[4] Conservation ranks: G = global rank assigned by NatureServe, represents the conservation status of a species within the entire range of the species; S = state rank assigned by the Alaska Natural Heritage Program.
G5 = Secure; common, widespread, and abundant
G4 = Apparently secure but uncommon; some cause for long-term concern because of declines or other factors
S3 = Rare within the state; at moderate risk of extirpation because of restricted range, narrow habitat specificity, recent population decline, small population sizes, a moderate number of occurrences

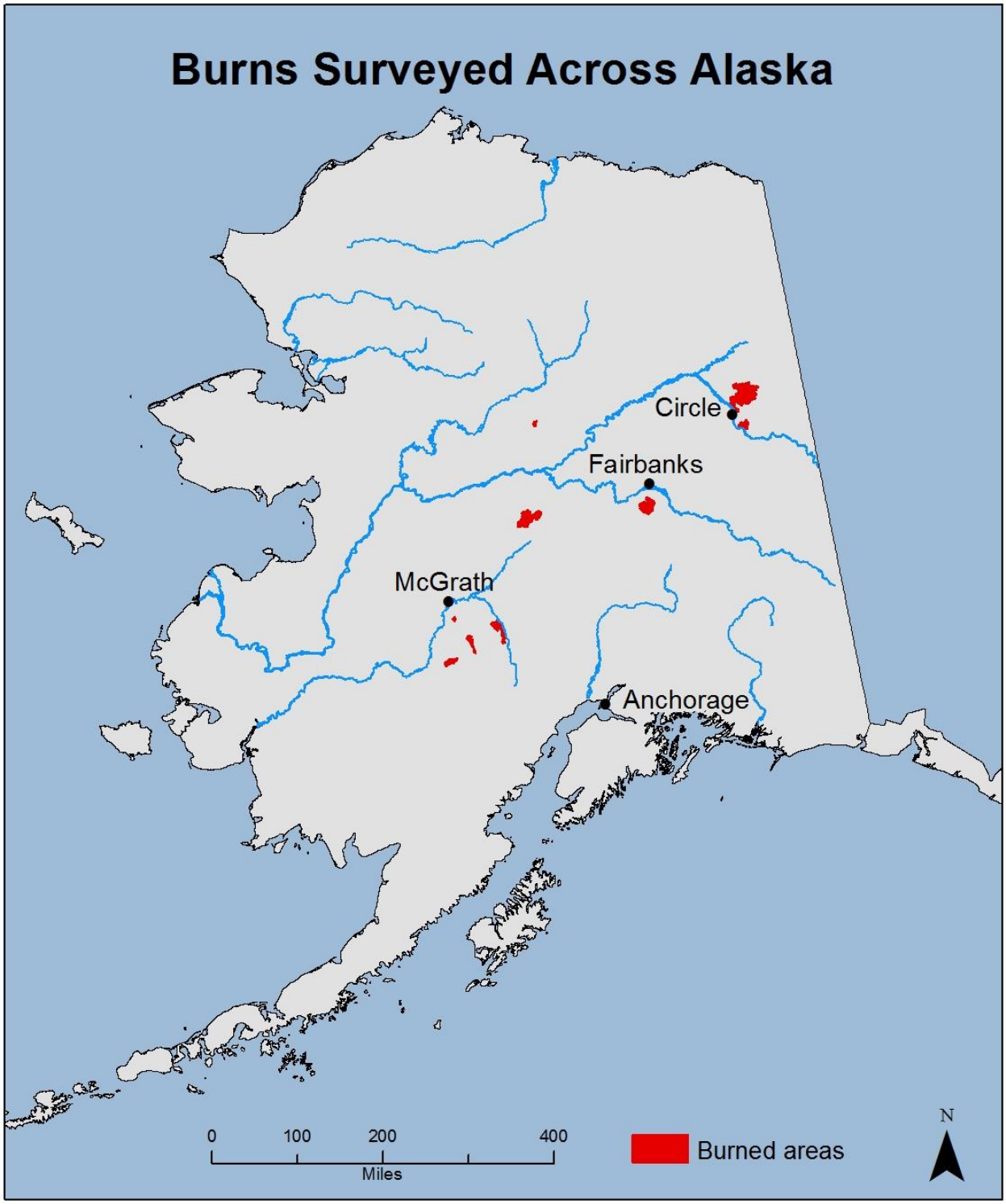

Figure 1 – Areas burned across Alaska in 2009 and 2010 that were surveyed in 2012 and 2013

Table 1 - Areas covered by burns and surveys

Burn	Number of sites surveyed	Total area of fire (acres)	Total area surveyed (acres)	Percent of burns surveyed	Infested area (acres)
Turquoise Lake	2	91885.4	18.9	0.0206	0.1
Adjacent to Turquoise Lake (Farewell Airstrip)	1	N/A	6	N/A	5
Katlitna	2	6569.7	7.1	0.1081	0
Big River	2	33261.9	9.3	0.0280	0
Cheeneetnuk	3	37527.4	11.2	0.0298	0
Wood River	1	125381.6	2.7	0.0022	0
Holonada	3	7909.5	15.2	0.1922	0.01
Paddle	1	41742.9	17.5	0.0419	0.1
Little Black	3	349449.9	4.6	0.0013	0.001
Big Mountain	2	83746	11.5	0.0137	0
Total	20	777474.3	104	0.0126	5.211

Methods

Prior to going into the field, maps of the burned areas and relative severity of the burns were reviewed. Areas were chosen for survey points based on the following criteria:

- Presence of known cabin, airstrip or other structure within or near the burn
- Areas with documented firefighter activity on the ground
- Edges of private allotments (presumably firefighters would try to protect the perimeter of private holdings, even if there is no documented record of activity)
- Areas along a dispersal corridor, such as the Iditarod Trail or a river
- Early seral habitats

Once in the field, actual survey sites were determined by where the helicopter could be safely landed. Where there was known anthropogenic disturbance on the ground, we tried to relocate the site as was practicable.

When surveying sites with clear human disturbance, we walked the area that was disturbed and most likely to harbor non-native species. For example, we surveyed an obvious fire line, four wheeler trail, airstrip margins, property boundaries, and the entire clearing around cabins. At undisturbed sites we tried to survey a circle of at least one acre.

For most sites photos were taken of the landscape and vegetation; at a minimum four photos were taken in the cardinal directions. A detailed list of all observed species was recorded, which can be found

in Appendix I. A score for burn severity was assigned to each site, based on protocols established by the Alaska Interagency Fire Effects Task Group (2007; see Appendix II). Where non-native plants were found, they were recorded with a Trimble Juno GPS unit provided by the BLM and subsequently uploaded into the BLM's National Invasive Species Information Management System (NISIMS). Data collected include species name, percent cover, size of infestation, phenology, and date. These records will also be entered into the Alaska Exotic Plants Information Clearinghouse (AKEPIC), Alaska's state-wide database. Tracks of surveyors were taken with Garmin GPS units, and will also be uploaded into the NISIMS and AKEPIC databases as absence records. Additionally, a paper datasheet (Appendix III) was filled out at each site, which included information on the locality, fire severity, and non-native species infestation size and control actions (where applicable). Alaska vegetation classifications (Viereck et al. 1992) were assigned to each area surveyed.

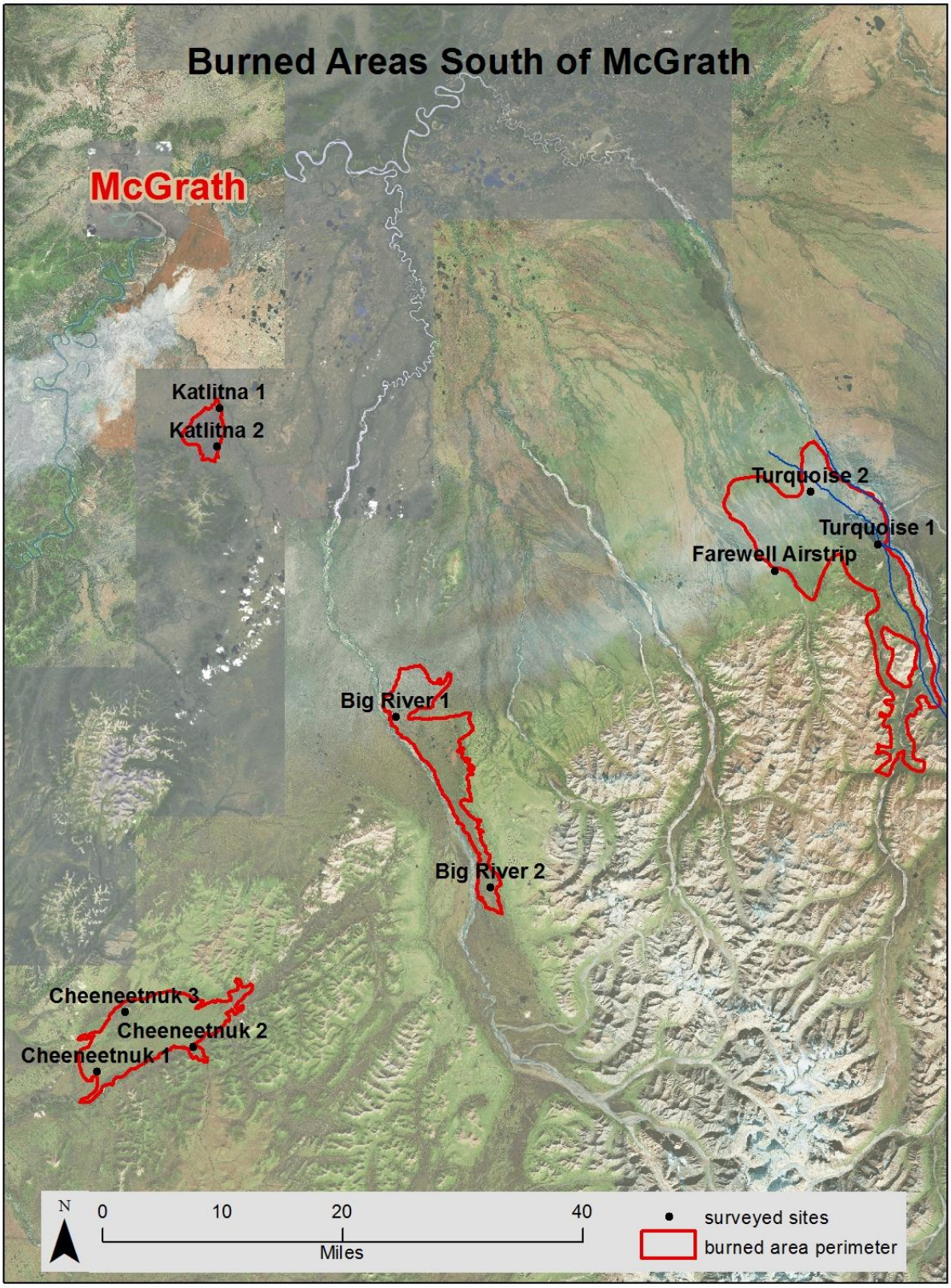

Figure 2 - Map of survey sites south of McGrath. Red polygons represent fire perimeters; black dots indicate locations of non-native plant surveys.

Site descriptions

Turquoise Lake 1

Total burned area: 91,885.4 acres
Burn severity: 2
Area surveyed: 17.8 acres
Non-native species found:
Plantago major (common plantain)
Infested area: 0.1 acres
Percent cover: 1%
Stem count: 26-50
Control actions: none
Taraxacum officinale (common dandelion)
Infested area: 0.1 acres
Percent cover: 1%
Stem count: 26-50
Control actions: none

Figure 3 - Turquoise Lake 1

Date surveyed: August 15, 2013
Coordinates of surveyed site: 62.54092, -153.61893
Land Status: State Patent or TA/State Selected
Landcover classification: I.A.1.j. Closed White Spruce Forest
Site notes: The non-native species found at this site were growing in a mowed lawn surrounding an occupied yurt. An old road leading from one airstrip to the yurt was surveyed, along with a fire line cut through the surrounding forest, and part of the airstrip. There is a second airstrip at this site, but it was not visited, because our helicopter pilot had previously encountered a hostile resident. The forest was predominantly a burned *Picea glauca* (white spruce) stand, with an average DBH of six inches. The shrub canopy included shoots of *Betula neoalaskana* (birch) that resprouted after the fire. Shrubs *Alnus viridis* (green alder), *Populus tremuloides* (quaking aspen), *Rosa acicularis* (prickly rose) and *Sanguisorba officinalis* (great burnet) were also present. *Chamerion latifolium* (dwarf fireweed) was common in the area. Colonies of bryophytes *Marchantia polymorpha* and *Ceratodon purpureus* were common on bare soil and burnt stumps. The rare plant *Botrychium alaskense* (Alaska moonwort) was found at this site.

Turquoise Lake 2

Total burned area: 91,885.4 acres
Burn severity: 5
Area surveyed: 1.1 acres
Non-native species found: none
Date surveyed: August 15, 2013
Coordinates of surveyed site: 62.60453, -153.79346
Land Status: State Patent or TA
Landcover classification: I.B.1.g. Closed Quaking Aspen – Balsam Poplar Forest
Site notes: This site appeared from the air as a scar on the landscape. It is also visible in Google Earth imagery from 2005 as either an old road or fire line. Several small trees of *Picea glauca* (white spruce) were present. Dominant species include *Populus balsamifera* (balsam poplar), *Populus tremuloides* (quaking aspen) and *Betula nana* (dwarf birch). Other species found include herbaceous plants *Chamerion angustifolium* (fireweed), *Lupinus arcticus* (arctic lupine), *Galium boreale* (northern bedstraw), and graminoids *Poa palustris* (fowl bluegrass), *Calamagrostis stricta* (slimstem reedgrass) and *Luzula multiflora* (common woodrush).

Figure 4 - Turquoise Lake 2

Farewell Airstrip

Total burned area: N/A (just outside of Turquoise Lake burn)
Burn severity: 5
Area surveyed: 6 acres
Non-native species found:
Crepis tectorum (narrowleaf hawsbeard)
Infested area: 5
Percent cover: 1
Stem count: 500+
Control actions: none
Hordeum jubatum (foxtail barley)
Infested area: 5
Percent cover: 5
Stem count: 500+
Control actions: none
Matricaria discoidea (pineappleweed)
Infested area: 1
Percent cover: 1
Stem count: 51-150
Control actions: none
Plantago major (common plantain)
Infested area: 2
Percent cover: 1
Stem count: 51-150
Control actions: none
Taraxacum officinale (common dandelion)
Infested area: 2
Percent cover: 1
Stem count: 51-150
Control actions: none
Trifolium repens (white clover)
Infested area: 0.01
Percent cover: 5
Stem count: 51-150
Control actions: none

Figure 5 - Farewell Airstrip

Date surveyed: August 15, 2013
Coordinates of surveyed site: 62.50974, -153.88828
Land Status: State Patent or TA/BLM
Landcover classification: III.G.4. Forb/Graminoid Roadside/Lot
Site notes: Although this site was not within the burned area, it was surveyed due to the high likelihood of non-native species being present. Areas surveyed included the FAA site, a portion of the airstrip, and a trail leading to the river. The riverbank was weed-free, but the edges of the airstrip and surrounding fields were heavily infested with non-native species. *Hordeum jubatum* (foxtail barley) is presumably native to the eastern interior of Alaska, but has expanded rapidly in association with human-modified landscapes, and is widely considered an introduced nuisance weed.

The presence of *Crepis tectorum* here is of concern because it produces wind-dispersed seeds that can travel long distances beyond the human footprint (Royer and Dickson 1999). Villano and Mulder (2008) documented this trend in a roadside survey of non-native species, which found that *Crepis tectorum* moved farther into burned areas than other target species (up to 50.5 m). Moreover, plants were found in burned area transects 200-400 m away from a seed source, indicating that even with low propagule pressure *Crepis tectorum* can establish in burns.

Katlitna 1

Total burned area: 6,569.7 acres
Burned severity: 3
Area surveyed: 1.7 acres
Non-native species found: none
Date surveyed: August 16, 2013
Coordinates of surveyed site: 62.69842, -155.34708
Land Status: BLM
Landcover classification: I.C.2.a. Open Spruce – Paper Birch Forest
Site notes: The area surveyed was a stand of burned *Picea glauca* (white spruce), *Picea mariana* (black spruce), *Betula neoalaskana* (birch), and *Larix laricina* (tamarack) forest and peatland. Tussocks of *Eriophorum vaginatum* (tussock cottongrass) were resprouting in moist areas within the site. High coverage of *Chamerion angustifolium* (fireweed) and *Calamagrostis canadensis* (bluejoint) were found throughout much of the area.

Figure 6 - Katlitna 1

Katlitna 2

Total burned area: 6,569.7 acres
Burn severity: 2
Area surveyed: 5.4 acres
Non-native species found: none
Date surveyed: August 16, 2013
Coordinates of surveyed site: 62.65193, -155.3532
Land Status: BLM
Landcover classification: I.C.2.a. Open Spruce – Paper Birch Forest
Site notes: The area surveyed was a heavily burned, upland *Picea glauca* (white spruce) - *P. mariana* (black spruce) stand. The site contained large amounts of course woody debris from fallen trees. Standing dead trees were sparse, with an average DBH of five inches or less. Herbaceous plants *Chamerion angustifolium* (fireweed) and *Equisetum sylvaticum* (woodland horsetail) provide high coverage on areas of disturbed soil.

Figure 7 - Katlitna 2

Big River 1

Total burned area: 33,261.9 acres
Burn severity: 3
Area surveyed: 2.1 acres
Non-native species found: none
Date surveyed: August 16, 2013
Coordinates of surveyed site: 62.33192,-154.87423
Land Status: BLM
Landcover classification: I.A.1.k. Closed Black Spruce Forest
Site notes: The boundaries of the private allotment at this site were clearly visible from the helicopter. We landed on the edge of a *Picea mariana* (black spruce) forest/Sphagnum peatland on the south side of the allotment and walked the eastern edge of the allotment. The site was extremely wet and partially inaccessible. Shrubs growing at this site include *Myrica gale* (sweetgale), *Chamaedaphne calyculata* (leatherleaf), *Rhododendron tomentosum* ssp. *decumbens* (marsh Labrador tea), *Betula nana* (dwarf birch), *Empetrum nigrum* (black crowberry), *Rubus chamaemorus* (cloudberry), and *Spiraea stevenii* (beauverd spirea). The wettest areas were dominated by members of the genus Carex - including *C. rariflora* (looseflower alpine sedge) and *C. rotundata* (round sedge) - Sphagnum mosses, and other bog-associated plants, e.g. *Drosera rotundifolia* (roundleaf sundew).

Figure 8 - Big River 1

Big River 2

Total burned area: 33,261.9 acres
Burn severity: 2
Area surveyed: 7.2 acres
Non-native species found: none
Date surveyed: August 16, 2013
Coordinates of surveyed site: 62.12821, -154.62262
Land Status: State Patent or TA
Landcover classification: I.A.3.c. White Spruce Woodland
Site notes: We surveyed the hilltop east of Big River. This site was severely burned with few dead standing *Picea glauca* (white spruce) trees and a dense cover of *Chamerion angustifolium* (fireweed). Shrubs *Salix bebbiana* (bebb willow) and *S. pulchra* (tealeaf willow) were growing as resprouts from burnt bases.

Figure 9 - Big River 2

Cheeneetnuk 1

Figure 10 - Cheeneetnuk 1

Total burned area: 37,527.4 acres
Burn severity: 3
Area surveyed: 3.1 acres
Non-native species found: none
Date surveyed: August 19, 2013
Coordinates of surveyed site: 61.89935, -155.62717
Land Status: BLM
Landcover classification: I.A.2.h. Open Black Spruce – Tamarack Forest
Site notes: Originally it was planned for this site to border a private allotment, but the there was no place to land near the allotment, no sign of human disturbance, and the site was unburned. Instead, the site surveyed was located near a small stream with tracts of unburned vegetation along the margins. *Drepanocladus* mosses grew in large patches along the stream margin, along with shrubs *Dasiphora fruticosa* (shrubby cinquefoil), *Myrica gale* (sweetgale), and herbaceous plants *Iris setosa* (beachhead iris), *Comarum palustre* (purple marshlocks), and *Parnassia palustris* (marsh grass of Parnassus). Areas further from the stream consisted of partially burned forest of *Picea glauca* (white spruce), *Picea mariana* (black spruce) and *Larix laricina* (tamarack). Seeds of Success collections were made here of *Chamerion angustifolium* (fireweed) and *Iris setosa* (beachhead iris).

Cheeneetnuk 2

Total burned area: 37,527.4 acres
Burn severity: 3
Area surveyed: 2.6 acres
Non-native species found: none
Date surveyed: August 19, 2013
Coordinates of surveyed site: 61.93182, -155.38263
Land Status: State Selected
Landcover classification: I.A.2.e. Open White Spruce Forest
Site notes: We surveyed a burned *Picea glauca* (white spruce) and *Betula neoalaskana* (birch) forest, which had a high cover of *Calamagrostis canadensis* (bluejoint) and resprouting shrubs such as *Vaccinium uliginosum* (bog blueberry), and *Rhododendron tomentosum* ssp. *decumbens* (marsh Labrador tea). We also surveyed river floodplain and a steep bank between the river and forest. The river bank vegetation included *Allium schoenoprasum* (wild chives), *Triglochin palustris* (marsh arrowgrass), *Carex aquatilis* (water sedge), *C. membranacea* (fragile sedge) and *Trichophorum alpinum* (alpine bulrush).

Figure 11 - Cheeneetnuk 2

Cheeneetnuk 3

Total burned area: 37,527.4 acres
Burn severity: 3
Area surveyed: 5.5 acres
Non-native species found: none
Date surveyed: August 19, 2013
Coordinates of surveyed site: 61.9721, -155.55872
Land Status: BLM
Landcover classification: II.D.3.a. Willow Dwarf Shrub Tundra
Site notes: We surveyed a hilltop and exposed rocky ridgeline on the west side of the Cheeneetnuk burn. The ridge was semi-barren, with remnants of 2-3 meter tall *Betula neoalaskana* (birch) trees, some of which were resprouting. Shrubs found at this site include *Salix arctica* (arctic willow), *S. bebbiana* (bebb willow), *S. phlebophylla* (skeletonleaf willow), and *S. reticulata* (netleaf willow). Herbaceous plants at the site include *Anthoxanthum monticola* (alpine sweetgrass), *Campanula lasiocarpa* (mountain harebell), and *Chamerion angustifolium* (fireweed).

Figure 12 - Cheeneetnuk 3

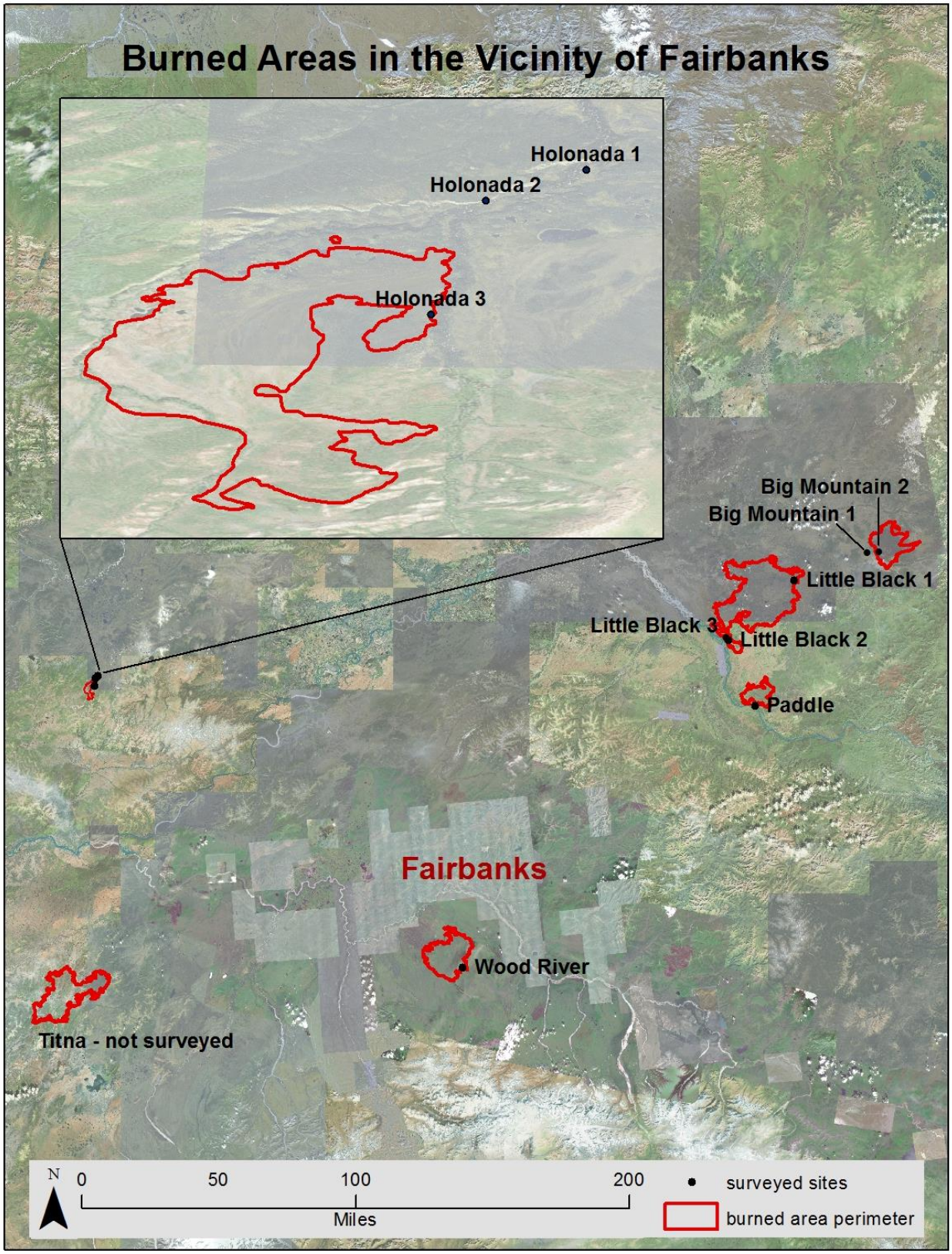

Figure 13 - Map of survey sites in the vicinity of Fairbanks. Red polygons represent fire perimeters; black dots indicate locations of non-native plant surveys

Wood River

Total burned area: 125,381.6 acres
Burn severity: 3
Area surveyed: 2.7 acres
Non-native species found: none
Date surveyed: August 20, 2013
Coordinates of surveyed site: 64.38719, -147.75348
Land Status: Military Withdrawn Lands
Landcover classification: I.A.2.f. Open Black Spruce Forest
Site notes: In order to survey this site, we obtained a military-issued permit to conduct a vegetation inventory here, as this site is located in the Tanana Flats Training Area of Fort Wainwright military land. The surveyed site was located in an area of high burn intensity west of the airstrip. Numerous small diameter spruce trees were killed by fire, and numerous *Populus tremuloides* (quaking aspen) resprouts were present. Much of the soil organic layer had been burned and *Ceratodon purpureus* moss was dominant on burnt mineral soil surfaces. Despite the proximity to human-modified landscapes, no non-native plants were encountered.

Figure 14 - Wood River

Holonada 1

Total burned area: 7,909.5 acres
Burn severity: 5
Area surveyed: 5 acres
Non-native species found: none
Date surveyed: August 21, 2013
Coordinates of surveyed site: 66.04009, -152.09952
Land Status: Fish and Wildlife Service
Landcover classification: I.C.1.a Closed Spruce – Paper Birch Forest
Site notes: We obtained a permit from the Kanuti National Wildlife Refuge to survey this site on Refuge land. We attempted to locate the site where smokejumpers were on the ground, and although we were able to survey the area around the given coordinates, there was no sign of human disturbance. Coordinates were located in an area of open fen near the forest edge. The area surveyed consisted of unburned riparian forest with large *Picea glauca* (white spruce) and *Betula neoalaskana* (birch) trees, and an open *Picea mariana* (black spruce) and *Eriophorum vaginatum* (tussock cottongrass) fen. Evidence of tree falling and stream alteration by beavers was significant.

Figure 15 - Holonada 1

Holonada 2

Total burned area: 7,909.5 acres
Burned severity: 5
Area surveyed: 3.2 acres
Non-native species found:
Chenopodium album (lambsquarters)
Infested area: 0.01
Percent cover: 1
Stem count: 151-500
Control actions: none

Date surveyed: August 21, 2013
Coordinates of surveyed site: 66.0288, -152.13612
Land Status: Fish and Wildlife Service
Landcover classification: I.B.1.f. Closed Paper Birch – Quaking Aspen Forest
Site notes: We obtained a permit from the Kanuti National Wildlife Refuge to survey this site on Refuge land. The area surveyed was the margin of a private inholding. The cabin is on a five acre patented site, owned by an Anchorage resident. However, the cabin owner has expressed interest in transferring the land back to the Kanuti Refuge in the future (J. Fox, pers. comm., 5 Dec. 2013). The area surveyed included the landing site on the river bank, and adjacent steep south-facing bluff. The south-facing bluff is habitat to several species of plants that were not found elsewhere in this study, including *Pseudoroegneria spicata* (bluebunch wheatgrass), *Androsace septentrionalis* (pygmyflower rockjasmine), *Cystopteris fragilis* (brittle bladderfern), and *Dryopteris fragrans* (fragrant woodfern). *Chenopodium album* (lambsquarters) was clearly visible among what appeared to be native grasses on the cabin's sod roof, but was not observed outside of the inholding.

Figure 16 - Holonada 2

Holonada 3

Total burned area: 7,909.5 acres
Burn severity: 3
Area surveyed: 7 acre
Non-native species found: none
Date surveyed: August 21, 2013
Coordinates of surveyed site: 65.98689, -152.15637
Land Status: BLM
Landcover classification: III.A.2.d Tussock Tundra
Site notes: This area, just south of the Kanuti National Wildlife Refuge, is an *Eriophorum vaginatum* (tussock cottongrass) – Sphagnum moss peatland with patches of low intensity burned areas and scattered dead *Picea mariana* (black spruce).

Figure 17 - Holonada 3

Paddle

Total burned area: 41,742.9 acres
Burn severity: 5
Area surveyed: 17.5 acres
Non-native species found:
Plantago major (common plantain)
Infested area: 0.1
Percent cover: 1
Stem count: 51-150
Control actions: none

Figure 18 - Paddle

Date surveyed: August 22, 2013
Coordinates of surveyed site: 65.56473, -143.74779
Land Status: State Patent or TA
Landcover classification: II.B.1.a. Closed Tall Willow Shrub
Site notes: The private inholding associated with this site has several modern buildings. *Plantago major* (common plantain) was found growing along a four-wheeler trail that leads from the cabins to a boat moored at the river's edge. The sandbar north of the homestead was also surveyed, and hosted primarily *Salix alaxensis* var. *longistylis* (feltleaf willow), *Salix arbusculoides* (littletree willow), and early seral riverbank species such as *Juncus alpinoarticulatus* (northern green rush)*, Rorippa palustris* (bog yellowcress)*, and Equisetum* species (horsetails).

Little Black 1

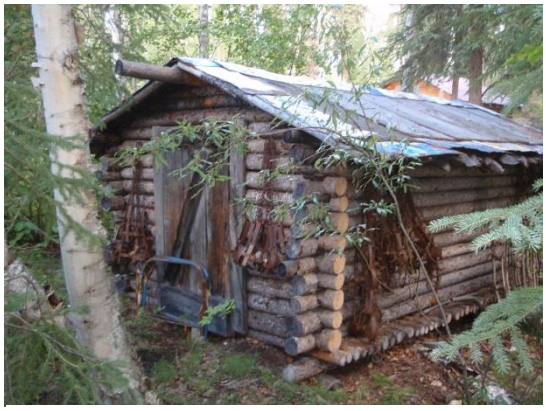

Figure 19 - Little Black 1

Total burned area: 349,449.9 acres
Burn severity: 5
Area surveyed: 1.4 acres
Non-native species found:
Chenopodium album (lambsquarters)
Infested area: 0.001
Percent cover: 1
Stem count: 26-50
Control actions: pulled and removed from site

Date surveyed: August 22, 2013
Coordinates of surveyed site: 66.1853, -142.98506
Land Status: Fish and Wildlife Service
Landcover classification: I.C.1.a Closed Spruce – Paper Birch Forest
Site notes: We obtained a permit from the Yukon Flats National Wildlife Refuge to survey this site on Refuge land. This cabin site is located between the Little Black river and an oxbow lake in a densely forested area. Although the cabin is on Refuge land, it is privately owned and permitted to an individual until the summer of 2014. It was built some time before 1980, and to the best of our knowledge, the cabin has no name, but is identified as BR-09 (N. Hawkaluk, pers. comm., 5 Sept. 2013). The area surveyed included the river bank, clearing surrounding the man-made structures, and the foot paths leading from the clearing to two different river and lake access points. The cabin, outbuildings, and surrounding *Picea glauca* (white spruce) – *Betula neoalaskana* (birch) forest along the creek appear unaffected by forest fires in recent years, but burned areas are very close by. A relatively small number of the non-native plant *Chenopodium album* (lambsquarters) was found growing in the area; it was collected in plastic bags and removed from the site.

Little Black 2

Total burned area: 349,449.9 acres
Burn severity: 3
Area surveyed: 0.8 acre
Non-native species found: none
Date surveyed: August 22, 2013
Coordinates of surveyed site: 65.92767, -143.95343
Land Status: State Selected
Landcover classification: III.A.2.h. Sedge – Willow Tundra
Site notes: This is a *Picea mariana* (black spruce) – Sphagnum peatland on the east side of the Yukon River. The vegetation consists of sparse patches of young *Picea mariana* (black spruce) and *Betula neoalaskana* (birch) trees, some of which had been burnt, and several small ponds with *Eriophorum angustifolium* (tall cottongrass), *E. chamissonis* (Chamisso's cottongrass), *E. vaginatum* (tussock cottongrass), *Ranunculus gmelinii* (Gmelin's buttercup), and *Typha latifolia* (broadleaf cattail).

Figure 20 - Little Black 2

Little Black 3

Total burned area: 349,449.9 acres
Burn severity: 2
Area surveyed: 2.4 acres
Non-native species found: none
Date surveyed: July 20, 2012
Coordinates of surveyed site: 65.9453, -143.97134
Land Status: State Selected
Landcover classification: I.C.2.a. Open Spruce – Paper Birch Forest
Site notes: Within the burned area surveyed there were two distinct landcover types. One portion had been a mature birch-white spruce forest with 50% total canopy cover, of which 95% had burned down. Ground cover is now dense *Chamerion angustifolium* (fireweed) and *Betula neoalaskana* (birch) seedlings. The other section of this site was predominately a mature spruce forest, with 50% total canopy cover, of which 80% of trees were left standing but severely burned, with a few birch interspersed. The understory here is mostly *Calamagrostis canadensis* (bluejoint), *Chamerion angustifolium* (fireweed), *Rosa acicularis* (prickly rose), and *Betula neoalaskana* (birch) seedlings.

Figure 21 – Little Black 3

Big Mountain 1

Figure 22 – Big Mountain 1

Total burned area: 83,746 acres
Burn severity: 5
Area surveyed: 6.6 acres
Non-native species found: none
Date surveyed: July 18, 2012
Coordinates of surveyed site: 66.26068, -141.98314
Land Status: BLM
Landcover classification: I.A.3.d. Black Spruce Woodland
Site notes: The site surveyed was on the edge of an allotment located between two oxbow lakes of the Black River. Given the current vegetation, this area appears to have been outside the 2009-2010 burns being studied but experienced a severe burn prior to this timeframe; there were few mature standing spruces, but many burned on the ground with an average of 4-10 inches in diameter. The area was previously a *Picea mariana* (black spruce) bog, but now supports a dense layer of *Chamerion angustifolium* (fireweed), *Calamagrostis canadensis* (bluejoint), *Alnus* sp. (alders), and a variety of *Salix* species (willows), with a bryophyte layer of abundant *Marchantia polymorpha.* A small patch of *Persicaria lapathifolia* (= *Polygonum pensylvanicum* ssp. *oneillii* sensu Hultén 1968, curlytop knotweed) was found growing here. This population appears to be a native North American genotype; current taxonomic treatments now merge a number of previously recognized taxa into a large, widespread, and highly variable species that includes clearly native elements as well as introduced genotypes.

Big Mountain 2

Total burned area: 83,746 acres
Burn severity: 3
Area surveyed: 4.9 acres
Non-native species found: none
Date surveyed: July 18, 2012
Coordinates of surveyed site: 66.25497, -141.83311
Land Status: BLM
Landcover classification: I.A.2.f. Open Black Spruce Forest
Site notes: This area was mostly a hummocky black spruce bog with a 20% cover of standing mature trees, of which about 10% had some green leaves remaining. There was approximately 20% cover of new spruce and birch trees up to one meter tall. We surveyed along the edge of the Black River, which supported a steep riparian corridor populated by *Betula neoalaskana* (birch), *Aconogonon alaskanum* (Alaska wild rhubarb), and *Calamagrostis canadensis* (bluejoint). A fire line had been cut in at the top of the river bank, running parallel to the river; many birch seedlings were emerging throughout the fire line. There was a dense groundcover throughout the burned area, which was predominantly comprised of *Sphagnum fuscum* (sphagnum moss). A native population of *Persicaria lapathifolia* (curlytop knotweed) was found at this site.

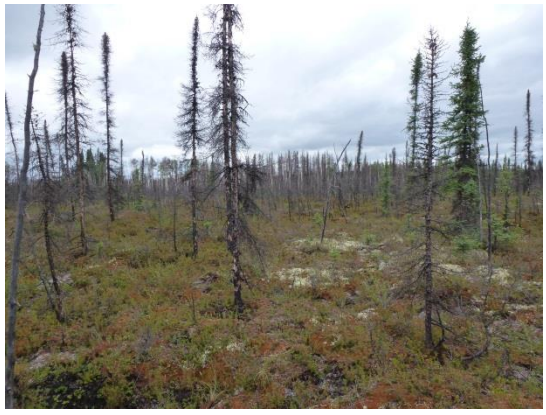

Figure 23 – Big Mountain 2

Conclusions

These surveys indicate a paucity of non-native species in remote parts of Alaska. In our surveys, non-native plants were only found at sites with cabins and airstrips, and in these instances plants were of moderate invasiveness rank[5] and relatively low management priority, as they are widespread throughout Alaska. Where property boundaries were visible in the form of a cleared corridor, and where fire lines were present, no non-native species were observed. Furthermore, the non-native plant populations found are unlikely to persist without continued disturbance and we expect that it is unlikely for these species to spread into surrounding intact forest.

Excluding the Farewell Airstrip, which was a highly disturbed site outside of a burned area, only three non-native species were found: *Plantago major* (common plantain, invasiveness rank 44[5]), *Taraxacum officinale* (common dandelion, 58), and *Chenopodium album* (lambsquarters, 37). If including the Farewell Airstrip in this assessment, four additional non-native species were present: *Crepis tectorum* (narrowleaf hawksbeard, 56), *Hordeum jubatum* (foxtail barley, 63), *Matricaria discoidea* (pineappleweed, 32), and *Trifolium repens* (white clover, 59). Photos and descriptions of these species can be found in Appendix IV. *Chenopodium album* was occasionally found at remote sites devoid of any other non-native species or recent disturbance; it is likely a poor competitor and more drought tolerant than many other non-native species.

Overall, it appears that burned areas in remote parts Alaska are less susceptible to plant invasions than burned areas in the contiguous United States, likely due to a much smaller weed seed source (lower propagule pressure). While the probability of establishment of non-native species in remote burned areas is low, it still remains possible, and if an infestation does establish, early detection is very unlikely to occur. Undoubtedly some viable weed seeds are being transported to remote burned areas in Alaska where fire fighters and equipment are present on the ground. These crews and their equipment are often mobilized quickly and over large geographic areas, including elsewhere in the western states, so some contamination by non-native weed seeds is probable. Often repeated introductions of large numbers of seeds are required for establishment even in suitable habitats. Thus any effort that reduces the number and diversity of weed seeds transported into burns should be encouraged, such as thoroughly washing clothing, boots, and equipment; quarantining of equipment originating from highly infested areas; maintaining weed-free heliports; etc. Additionally, aggressive control measures of known infestations bordering burns would reduce the likelihood of invasion into the burned area. Last, broader efforts directed towards increasing education, outreach, and prevention measures are likely to result in benefits to all habitats, including burned areas.

[5] Invasiveness Rank is calculated based on a species' ecological impacts, biological attributes, distribution, and response to control measures. The ranks are scaled from 0 to 100, with 0 representing a plant that poses no threat to natural ecosystems and 100 representing a species that poses a major threat to natural ecosystems (see Carlson et al. 2008 for more information).

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Appendix I – Species list of all vascular plants found at each survey site

Scientific name	Common name	Turquoise 1	Turquoise 2	Farewell Airstrip	Katlitna 1	Katlitna 2	Big River 1	Big River 2	Cheeneetnuk 1	Chee neetnuk 2	Cheeneetnuk 3	Wood River	Holonada 1	Holonada 2	Holonada 3	Paddle	Little Black 1	Little Black 2	Little Black 3	Big Mountain 1	Big Mountain 2
Achillea millefolium	common yarrow	x	x	x					x	x						x	x				
Aconogonon alaskanum	Alaska wild rhubarb								x				x		x		x			x	x
Aconitum delphinifolium	larkspurleaf monkshood	x	x										x				x				
Agrostis scabra	rough bentgrass			x									x	x							
Allium schoenoprasum	wild chives									x											
Alnus incana ssp. tenuifolia	thinleaf alder					x				x			x	x		x	x	x			
Alnus viridis	green alder	x		x		x				x			x		x			x			x
Alnus viridis ssp. *crispa*	mountain alder									x											
Andromeda polifolia	bog rosemary								x											x	
Androsace septentrionalis	pygmyflower rockjasmine												x	x							
Anemone narcissiflora	narcissus anemone	x					x														
Antennaria friesiana	Fries' pussytoes		x								x										
Anthoxanthum monticola	alpine sweetgrass										x										
Anticlea elegans	deathcamas			x																	
Arabidopsis lyrata	lyrate rockcress															x					
Arctagrostis latifolia	wideleaf polargrass			x						x											
Arctophila fulva	pendantgrass								x												
Arctostaphylos uva-ursi	kinnikinnick		x											x							
Arctous rubra	red fruit bearberry	x				x			x		x	x			x			x			

Scientific name	Common name	Turquoise 1	Turquoise 2	Farewell Airstrip	Katlitna 1	Katlitna 2	Big River 1	Big River 2	Cheeneetnuk 1	Chee neetnuk 2	Cheeneetnuk 3	Wood River	Holonada 1	Holonada 2	Holonada 3	Paddle	Little Black 1	Little Black 2	Little Black 3	Big Mountain 1	Big Mountain 2
Arnica angustifolia	narrowleaf arnica														x						
Arnica frigida	snow arnica										x										
Arnica lessingii	nodding arnica																				x
Artemisia frigida	prairie sagewort													x							
Artemisia tilesii	Tilesius' wormwood												x			x	x				
Astragalus alpinus	Alpine milkvetch													x							
Beckmannia syzigachne	American sloughgrass												x	x		x					
Betula glandulosa	resin birch				x				x												
Betula nana	dwarf birch		x				x	x	x	x	x	x	x		x			x			
Betula neoalaskana	birch	x			x	x				x	x	x	x	x	x		x	x	x	x	x
Bistorta vivipara	alpine bistort			x						x											
Boechera holboellii	Holboell's rockcress													x							
Boschniakia rossica	northern groundcone												x	x			x				
Botrychium alaskense	Alaska moonwort	x																			
Botrychium lunaria	common moonwort	x																			
Botrychium minganense	Mingan moonwort	x																			
Bromopsis pumpelliana	Pumpelly's brome			x													x				
Calamagrostis canadensis	bluejoint				x	x	x			x		x		x		x	x	x	x		x
Calamagrostis stricta	slimstem reedgrass		x	x				x		x					x	x					
Calla palustris	water arum																				x
Campanula lasiocarpa	mountain harebell		x								x										

Scientific name	Common name	Turquoise 1	Turquoise 2	Farewell Airstrip	Katlitna 1	Katlitna 2	Big River 1	Big River 2	Cheeneetnuk 1	Chee neetnuk 2	Cheeneetnuk 3	Wood River	Holonada 1	Holonada 2	Holonada 3	Paddle	Little Black 1	Little Black 2	Little Black 3	Big Mountain 1	Big Mountain 2
Carex aquatilis	water sedge					x	x			x			x		x	x		x			x
Carex bigelowii	Bigelow's sedge					x	x	x		x					x			x			
Carex canescens	silvery sedge							x	x												
Carex limosa	mud sedge																				x
Carex membranacea	fragile sedge									x			x	x		x					
Carex microchaeta	smallawned sedge										x										
Carex rariflora	looseflower alpine sedge						x														
Carex rotundata	round sedge						x			x											
Carex saxatilis	rock sedge												x	x							
Carex sp.	sedge				x														x	x	
Castilleja caudata	Port Clarence Indian paintbrush			x																	
Chamaedaphne calyculata	leatherleaf				x		x						x		x			x		x	
Chamaepericlymenum canadense	bunchberry dogwood	x						x	x	x			x								
Chamerion angustifolium	fireweed	x	x		x	x		x	x	x	x	x			x		x	x	x	x	x
Chamerion latifolium	dwarf fireweed	x					x			x			x								
Chenopodium album	lambsquarters												x	x			x				
Cicuta bulbifera	bulblet-bearing water hemlock																			x	
Cicuta virosa	Mackenzie's water hemlock																	x		x	
Cnidium cnidiifolium	Jakutsk snowparsley	x		x										x							

Scientific name	Common name	Turquoise 1	Turquoise 2	Farewell Airstrip	Katlitna 1	Katlitna 2	Big River 1	Big River 2	Cheeneetnuk 1	Chee neetnuk 2	Cheeneetnuk 3	Wood River	Holonada 1	Holonada 2	Holonada 3	Paddle	Little Black 1	Little Black 2	Little Black 3	Big Mountain 1	Big Mountain 2
Comarum palustre	purple marshlocks					x			x				x	x				x		x	
Cornus sericea ssp. *sericea*	redosier dogwood															x					
Crepis tectorum	narrowleaf hawksbeard			x																	
Cystopteris fragilis	brittle bladderfern												x	x							
Dasiphora fruticosa	shrubby cinquefoil			x		x			x	x		x						x			
Descurainia sophioides	northern tansymustard																x				
Dianthus repens	boreal carnation													x							
Diapensia lapponica	pincushion plant										x										
Draba stenopetala	Anadyr draba										x										
Drosera rotundifolia	roundleaf sundew						x													x	
Dryas octopetala	eightpetal mountain-avens	x		x																	
Dryopteris fragrans	fragrant woodfern												x	x							
Elymus macrourus	tufted wheatgrass																				
Elymus sp.	wildrye													x							
Elymus trachycaulus	slender wheatgrass	x											x				x				
Empetrum nigrum	black crowberry		x				x		x						x						
Epilobium ciliatum	fringed willowherb																		x		
Epilobium palustre	marsh willowherb																				x
Equisetum arvense	field horsetail			x					x			x	x	x		x					
Equisetum fluviatile	water horsetail																		x		x
Equisetum hyemale	scouringrush horsetail																				x

Scientific name	Common name	Turquoise 1	Turquoise 2	Farewell Airstrip	Katlitna 1	Katlitna 2	Big River 1	Big River 2	Cheeneetnuk 1	Chee neetnuk 2	Cheeneetnuk 3	Wood River	Holonada 1	Holonada 2	Holonada 3	Paddle	Little Black 1	Little Black 2	Little Black 3	Big Mountain 1	Big Mountain 2
Equisetum palustre	marsh horsetail												x			x					
Equisetum pratense	meadow horsetail															x					
Equisetum scirpoides	dwarf scouringrush								x					x							
Equisetum sylvaticum	woodland horsetail					x				x											x
Equisetum sp.	horsetail	x			x		x	x									x	x			
Equisetum variegatum	variegated scouringrush									x											
Erigeron acris	bitter fleabane			x					x	x			x	x					x		
Eriophorum angustifolium	tall cottongrass					x	x											x			
Eriophorum chamissonis	Chamisso's cottongrass					x	x											x			
Eriophorum vaginatum	tussock cottongrass				x	x	x						x		x			x			
Erysimum cheiranthoides	wormseed wallflower																x				
Euphrasia disjuncta	polar eyebright	x																			
Eurybia sibirica	arctic aster	x		x						x				x		x					
Festuca altaica	Altai fescue	x	x						x						x						
Galium boreale	northern bedstraw	x	x						x	x			x	x		x	x			x	
Galium trifidum	threepetal bedstraw																				x
Gentiana prostrata	pygmy gentian			x																	
Gentianella propinqua	fourpart dwarf gentian			x																	
Geocaulon lividum	false toadflax	x											x	x			x			x	
Geranium erianthum	woolly geranium									x											
Goodyera repens	lesser rattlesnake plantain												x								

Scientific name	Common name	Turquoise 1	Turquoise 2	Farewell Airstrip	Katlitna 1	Katlitna 2	Big River 1	Big River 2	Cheeneetnuk 1	Chee neetnuk 2	Cheeneetnuk 3	Wood River	Holonada 1	Holonada 2	Holonada 3	Paddle	Little Black 1	Little Black 2	Little Black 3	Big Mountain 1	Big Mountain 2
Hedysarum alpinum	alpine sweetvetch	x	x							x			x	x		x	x				
Hordeum jubatum	foxtail barley			x																	
Iris setosa	beachhead iris								x												
Juncus alpinoarticulatus	northern green rush															x					
Juncus castaneus	chestnut rush												x								
Juniperus communis	common juniper												x	x							
Larix laricina	tamarack				x		x		x			x									
Lemna minor	common duckweed																				x
Leymus innovatus	downy ryegrass	x		x																	
Linnaea borealis	twinflower	x											x						x		
Lomatogonium rotatum	marsh felwort			x																	
Lupinus arcticus	arctic lupine		x										x	x							
Luzula confusa	northern woodrush										x										
Luzula multiflora	common woodrush	x	x																		
Luzula rufescens	rufous woodrush																		x		
Matricaria discoidea	pineappleweed			x																	
Menyanthes trifoliata	buckbean						x														
Mertensia paniculata	tall bluebells	x										x	x				x				
Micranthes reflexa	reflexed saxifrage													x							
Minuartia rubella	beautiful sandwort	x																			
Minuartia stricta	bog stitchwort			x																	

Scientific name	Common name	Turquoise 1	Turquoise 2	Farewell Airstrip	Katlitna 1	Katlitna 2	Big River 1	Big River 2	Cheeneetnuk 1	Chee neetnuk 2	Cheeneetnuk 3	Wood River	Holonada 1	Holonada 2	Holonada 3	Paddle	Little Black 1	Little Black 2	Little Black 3	Big Mountain 1	Big Mountain 2
Myrica gale	sweetgale						x		x												
Oxycoccus microcarpus	small cranberry																			x	
Oxycoccus palustris	small cranberry				x		x														
Oxytropis campestris	field locoweed	x		x																	
Packera contermina	northwestern groundsel	x																			
Packera indecora	elegant groundsel																			x	x
Packera paupercula	balsam groundsel	x	x	x																	
Parnassia palustris	marsh grass of Parnassus	x		x					x	x						x					
Pedicularis labradorica	Labrador lousewort								x												x
Pedicularis lapponica	Lapland lousewort						x														
Pedicularis oederi	Oeder's lousewort										x										
Pedicularis parviflora	smallflower lousewort			x																	
Pedicularis sp.	lousewort		x																		
Pedicularis verticillata	whorled lousewort			x																	
Persicaria lapathifolia	curlytop knotweed															x	x			x	x
Petasites frigidus	arctic sweet coltsfoot								x					x	x					x	
Picea glauca	white spruce	x	x	x	x	x		x	x	x			x	x			x		x		
Picea mariana	black spruce				x	x	x		x	x		x	x		x			x		x	x
Plantago major	common plantain	x		x												x					
Platanthera obtusata	bluntleaved orchid												x								
Poa alpina	alpine bluegrass			x						x						x					

Scientific name	Common name	Turquoise 1	Turquoise 2	Farewell Airstrip	Katlitna 1	Katlitna 2	Big River 1	Big River 2	Cheeneetnuk 1	Chee neetnuk 2	Cheeneetnuk 3	Wood River	Holonada 1	Holonada 2	Holonada 3	Paddle	Little Black 1	Little Black 2	Little Black 3	Big Mountain 1	Big Mountain 2
Poa palustris	fowl bluegrass	x	x							x	x			x							
Poa pratensis	Kentucky bluegrass												x	x							
Polemonium acutiflorum	tall Jacob's ladder		x	x						x			x								
Populus balsamifera	balsam poplar		x									x									
Populus tremuloides	quaking aspen	x	x		x					x		x		x			x				
Populus trichocarpa	black cottonwood		x	x						x											
Potentilla anserina	silverweed cinquefoil															x					
Potentilla bimundorum	staghorn cinquefoil	x		x																	
Potentilla norvegica	Norwegian cinquefoil	x																			x
Potentilla pensylvanica	Pennsylvania cinquefoil													x							
Potentilla rubricaulis	Rocky Mountain cinquefoil													x							
Pseudoroegneria spicata	bluebunch wheatgrass												x	x							
Ranunculus gmelinii	Gmelin's buttercup					x							x			x		x			
Ranunculus sceleratus	cursed buttercup															x					
Ranunculus sp.	buttercup									x				x							
Rhinanthus minor	little yellow rattle			x			x														
Rhododendron tomentosum ssp. *decumbens*	marsh Labrador tea	x			x		x	x	x	x		x			x		x			x	
Ribes triste	red currant								x				x				x				
Rorippa barbareifolia	hoary yellowcress												x	x		x				x	
Rorippa islandica	northern marsh yellowcress															x	x				
Rorippa palustris	bog yellowcress																			x	

Scientific name	Common name	Turquoise 1	Turquoise 2	Farewell Airstrip	Katlitna 1	Katlitna 2	Big River 1	Big River 2	Cheeneetnuk 1	Chee neetnuk 2	Cheeneetnuk 3	Wood River	Holonada 1	Holonada 2	Holonada 3	Paddle	Little Black 1	Little Black 2	Little Black 3	Big Mountain 1	Big Mountain 2
Rosa acicularis	prickly rose	x		x					x	x		x	x	x			x		x	x	
Rubus arcticus	arctic raspberry							x		x			x								
Rubus chamaemorus	cloudberry					x	x	x		x					x						
Rubus idaeus	American red raspberry												x								
Rumex arcticus	arctic dock								x								x				
Salix alaxensis	feltleaf willow									x						x			x	x	x
Salix alaxensis ssp. *longistylis*	feltleaf willow												x	x		x	x				
Salix arbusculoides	littletree willow				x					x			x		x	x	x	x			x
Salix arctica	arctic willow								x		x										
Salix barclayi	Barclay's willow								x												
Salix barrattiana	Barratt's willow	x																			
Salix bebbiana	Bebb willow	x	x					x	x	x	x	x		x			x		x		
Salix fuscescens	Alaska bog willow																	x			
Salix glauca	grayleaf willow																	x			
Salix hastata	halberd willow																				x
Salix interior	sandbar willow															x					
Salix phlebophylla	skeletonleaf willow										x										
Salix pseudomonticola	false mountain willow											x				x					
Salix pulchra	tealeaf willow							x							x			x			x
Salix reticulata	netleaf willow								x		x										
Sanguisorba officinalis	great burnet	x	x	x						x						x					

Scientific name	Common name	Turquoise 1	Turquoise 2	Farewell Airstrip	Katlitna 1	Katlitna 2	Big River 1	Big River 2	Cheeneetnuk 1	Chee neetnuk 2	Cheeneetnuk 3	Wood River	Holonada 1	Holonada 2	Holonada 3	Paddle	Little Black 1	Little Black 2	Little Black 3	Big Mountain 1	Big Mountain 2
Saussurea angustifolia	narrowleaf saw-wort											x									
Saxifraga hirculus	yellow marsh saxifrage								x												
Shepherdia canadensis	russet buffaloberry			x					x					x			x				
Solidago multiradiata	Rocky Mountain goldenrod	x	x	x					x				x	x							
Spiraea stevenii	beauverd spirea				x		x	x		x				x	x						
Spiranthes romanzoffia	hooded lady's tresses												x							x	
Stellaria longipes	longstalk starwort	x			x													x			
Stellaria sp.	starwort												x								
Taraxacum officinale	common dandelion	x		x																	
Tephroseris palustris	marsh fleabane																		x		x
Thalictrum sparsiflorum	fewflower meadow-rue									x			x								
Tofieldia pusilla	Scotch false asphodel																			x	
Trichophorum alpinum	alpine bulrush									x											
Trichophorum cespitosum	tufted bulrush								x	x											
Trifolium repens	white clover			x																	
Triglochin palustris	marsh arrowgrass									x											
Trisetum spicatum	spike trisetum		x	x																	
Typha latifolia	broadleaf cattail																	x			
Utricularia intermedia	flatleaf bladderwort																			x	
Vaccinium uliginosum	bog blueberry				x		x	x		x		x	x		x		x				
Vaccinium vitis-idaea	lingonberry	x			x		x			x			x	x	x		x				

Scientific name	Common name	Turquoise 1	Turquoise 2	Farewell Airstrip	Katlitna 1	Katlitna 2	Big River 1	Big River 2	Cheeneetnuk 1	Chee neetnuk 2	Cheeneetnuk 3	Wood River	Holonada 1	Holonada 2	Holonada 3	Paddle	Little Black 1	Little Black 2	Little Black 3	Big Mountain 1	Big Mountain 2
Valeriana capitata	capitate valerian												x								
Viburnum edule	squashberry												x				x				
Wilhelmsia physodes	merckia												x	x							

Appendix II – Burn severity code matrix

Table 2 - This matrix was adapted from Alaska Interagency Fire Effects Task Group (2007), which in turn was modified from USDI National Park Service Fire Monitoring Handbook (2003). This matrix was used to assign fire severity codes in the field.

Code	Substrate	Vegetation
5 Unburned	Not burned	Not burned
4 Scorched	Litter partially blackened; duff nearly unchanged; wood/leaf structures unchanged.	Foliage scorched and attached to supporting twigs (red needles may have dropped and can be found at base of trunks).
3 Lightly burned	Litter charred to partially consumed; upper duff layer may be partially consumed but not altered over the entire depth; surface appears black; small woody debris is partially burned.	Foliage and smaller twigs partially to completely consumed; branches mostly intact; less than 40% of the shrub canopy is commonly consumed.
2 Moderately burned	Litter mostly to entirely consumed, leaving coarse, light colored ash; duff deeply charred to lower duff or upper/lower duff interface, but underlying mineral soil is not exposed; small woody debris is mostly consumed.	Foliage, twigs, and small stems consumed; some branches (>.5-2.5 cm in diameter) still present; 40-80% of the shrub canopy is commonly consumed.
1 Heavily burned	Litter and duff completely consumed, or within 1 cm of mineral soil, sometimes leaving fine white ash; mineral soil may be visibly altered, sometimes reddish. *Marchantia* and fire mosses may be present.	All plant parts less than 2.5 cm (1 in) in diameter are consumed, only leaving deeply charred major stems or trunks.

Appendix III – Field data sheet

Date _____ Observers & affiliations _____

Project name _____ County/region _____

Study type (circle): exhaustive highest priority species single species

Visit type (circle): control monitoring recon research

Site Code _____ Original Site Code (revisit) _____ Area surveyed (acres) _____

Viereck code/land cover type _____

_____

Disturbance type _____

Years since last disturbance _____ Photo numbers/camera name _____

Location notes (used to help relocate site in future) _____

_____

_____

Dominant/associated species _____

_____

_____

Slope (0-100°) _____ Aspect (NESW or 0-360°) _____ Soil (circle): sand silt lay loam Moisture (circle): dry mesic wet

Other locality remarks _____

_____

(NAD83) Lat _____ Lon _____ Elev (circle: ft m) _____ Precision (circle): 0-5 0-30 0-100

.001 ac = 3.7 ft radius .01 ac = 12 ft radius .1 ac = 37 ft radius .5 ac= 83 ft radius 1 acre ~ football field

Percent cover: 0, 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, 100 Stem count: 1-5, 6-25, 26-50, 51-150, 151-500, 500+

Species/USDA code	Acres infested	Percent cover	Stem count	Collected?	Control actions? (manual, mechanical, chemical, etc.)	Notes / photo #

Appendix IV – Non-native species descriptions and photos

Sunflower Family (Asteraceae)

Common dandelion • *Taraxacum officinale*

Invasiveness Rank: 58 points — Species Code: TAOF

Description:

Stems

- Unbranched
- Flowering stalks are leafless and hollow
- All leaves are basal and lobed

Inflorescence

- Single flower per stem
- NOT distinctly horned (unlike some native dandelions)
- Outer rows are reflexed or spreading (unlike most native dandelions)
- NOT blackish-green (unlike some native dandelions)

Fruits

- Straw-colored achenes
- White pappus

Habitat: disturbed areas

Burned area survey sites where present:
Turquoise Lake 1, Farewell Airstrip

Sunflower Family (Asteraceae)

Narrowleaf hawksbeard • *Crepis tectorum*

Invasiveness Rank: 56 points | Species Code: CRTE3

Description:

Winter annual, 0.3-0.9 m tall

Leaves

- Some form a basal rosette
- Stem leaves have extensions at the base that appear to clasp the stem

Inflorescence

- Involucral bracts arranged in two rows
- Involucral bracts are densely hairy on the inside

Habitat: disturbed sites including forest clearings, abandoned fields, agricultural fields, pastures and roadsides

Burned area survey sites where present:

Farewell Airstrip

Sunflower Family (Asteraceae)

Pineappleweed • *Matricaria discoidea*

Invasiveness Rank: 32 points | Species Code: MADI6

Description:
Annual, <30 cm tall
Leaves

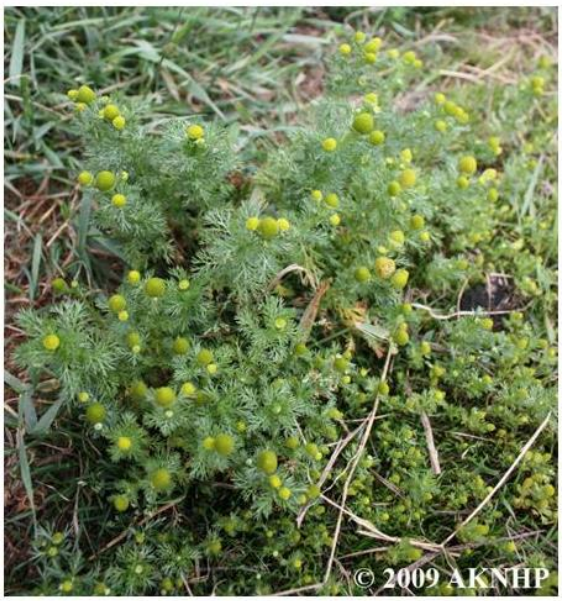
- Divided several times into narrow segments
- Strong odor when crushed, similar to chamomile
- Similar in appearance to native yarrow (*Achillea*) but leaves are less feathery and produce a different scent

Inflorescence

- Cone-shaped flowers
- Greenish-yellow

Habitat: compacted soils of roadsides, farmyards and waste areas

Burned area survey sites where present:
Farewell Airstrip



Goosefoot Family (Chenopodiaceae)

Lambsquarters • *Chenopodium album ssp. album*

Invasiveness Rank: 37 points | Species Code: CHALA

Description:

Annual

Stems

- Often turn reddish as the plant matures

Leaves

- Triangular with irregular lobes
- Green on top and white-mealy on the bottom
- Taste like spinach

Inflorescence

- Clustered in panicles
- Five tiny, greenish sepals

Fruits

- Seeds are black, shiny, circular, flattened, and enclosed in a thin, white, papery envelope

Habitat: disturbed soils in clearings, burns, river bars, waste places, and cultivated soil

Burned area survey sites where present:
Holonada 2, Little Black 1

Plantain Family (Plantaginaceae)

Common plantain • *Plantago major*

Invasiveness Rank: 44 points | Species Code: PLMA2

Description:
Annual, biennial or perennial
Leaves
- Ovate
- 3-5 prominent ribs
- Smooth margins
- Basal rosette only

Inflorescence
- Small and clustered in spikes
- Greenish-white, turning brown

Fruits
- Ovate capsule that splits around the middle
- >6 seeds per capsule

Habitat: cultivated fields, lawns, roadsides, waste areas, open woods and valleys; mid-montane locations

Burned area survey sites where present:
Turquoise Lake 1, Farewell Airstrip, Paddle

Most botanists specializing in northern floras think there were, or still are, native populations of *Plantago major*

Grass Family (Poaceae)

Traits of *Hordeum* species in Alaska:

- 3 spikelets per node but the two lateral ones are often reduced to awns
- Each spikelet has one flower
- All spikelets have 2 glumes

Foxtail barley • *Hordeum jubatum*

Invasiveness Rank: 63 points | Species Code: HOJU

Nativity of this species is disputed. Foxtail barley is most likely to have been present in eastern interior Alaska prior to European contact. However, it appears to have spread dramatically in the last half century. It is considered a nuisance weed due to the ability of awns to become lodged in the noses and mouths of animals.

Description:
Perennial
Leaves

- No auricles

Inflorescence

- Turn purple to tawny and disarticulate (come apart) at maturity
- Awns of lemmas are 1-6 cm long

Habitat: waste places, roadsides, river banks, lake shores, wetlands

Burned area survey sites where present:
Farewell Airstrip

White clover • *Trifolium repens*

Invasiveness Rank: 59 points | Species Code: TRRE3

Description:

Stems
- Creeping and rooting at nodes

Leaves
- Leaflets often have v-shaped marks, but not always

Inflorescence
- White to pinkish-white

Habitat: waste areas, lawns, ditches, disturbed sites

Burned area survey sites where present:
Farewell Airstrip