

# Monitoring & Controlling Invasive Plants at Rohn Cabin: 2014 Update

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## Summary

The Alaska Natural Heritage Program (AKNHP), University of Alaska Anchorage, visited Rohn Cabin August 26, 2014 to inventory and remove non-native plant species from Bureau of Land Management (BLM) property at the site. This is the fifth year in which AKNHP has surveyed and/or treated non-native plants at Rohn Cabin. The ongoing treatment and survey activities occur for several reasons. First, this remote location is a hub of activity during the Iditarod Trail Sled Dog Race; many people and large amount of materials are introduced to the site, including straw for sled dog bedding, which is a known vector for invasive plant propagules. This is a relatively well-known stop along the Iditarod Trail, and successful weed treatment here may encourage invasive plant management at other checkpoints along the trail. Second, the site is surrounded by undisturbed spruce forest and thus acts as a natural laboratory to study whether the non-native species known to occur at the site are able to move into nearby pristine areas. Third, and most importantly, control actions at Rohn Cabin are intended to prevent the spread of invasive species into adjacent natural areas. Fourth, since the area receives follow-up treatments on a fairly regular basis, weed management activities can be evaluated for efficacy and consequently improve the knowledge base for weed management in remote areas. For example, mustard species (*Brassica rapa* and *B. napus*), chickweed (*Cerastium fontanum* ssp. *vulgare*), common plantain (*Plantago major*), timothy (*Phleum pratense*), and non-native bluegrasses (*Poa annua* and *P. pratensis*) have been eliminated from the site, showing a positive response to hand pulling, while foxtail barley (*Hordeum jubatum*) continues to spread despite manual control efforts.

Early surveys confused two yellow flowered mustards: native *Descurainia sophioides* (northern tansymustard) and non-native *Descurainia sophia* (herb sophia). It was previously believed that the non-native herb sophia was found at Rohn Cabin, but this was determined in 2013 to be the native northern tansymustard. Given its nativity and non-aggressive behavior on previous site visits, it was made less of a priority in 2013's survey and control effort and has not been included in the 2013 or 2014 reports. Native yellow flowered mustards were not previously observed in the Rohn Cabin area and although northern tansymustard is native to Alaska, it was likely introduced through human activity at this site. On the 2014 site visit, this species appeared to be spreading and growing in numbers, so it was removed. Problem populations were located at the clearing around the outhouse and on the margin of the cabin entrance clearing and meadow. A few scattered stems were found throughout the meadow and forested areas north and west of the cabin.

The 2014 survey targeted the airstrip, FAA site, the area surrounding the cabin and outhouse, the meadow in front of the cabin, and neighboring forested areas (Figure 1). Overall, the 2014 survey found the number of non-native plant species and their abundances were similar to values in previous years. No new species were encountered. Non-native species richness declined after 2009, but has remained similar from 2011 to 2014. Areas that hotspots for invasive species have remained consistent across years: the cabin, meadow, and their immediate surroundings. In the last four years, species composition has changed only slightly (Table 1).

Data from 2009, 2011, and 2012 can be accessed through the Alaska Exotic Plants Information Clearinghouse (AKEPIC) data portal, available at <http://aknhp.uaa.alaska.edu/maps/akepic/>. Data

collected in 2013 was submitted directly to the BLM's National Invasive Species Information Management System (NISIMS) database, and will be available through AKEPIC, along with this year's data. Additionally, a report including management recommendations for Rohn Cabin was written after both the 2012 and 2013 visits (Greenstein and Carlson 2013, Greenstein 2013) and can be found on AKNHP's publications page at <http://aknhp.uaa.alaska.edu/botany/akepic/publications/>.

This document summarizes current populations, most recent control actions, and recommendations for future management. Specifically, we compare data collected July 2-3 and August 27-28, 2012; July 31, 2013; and August 26, 2014 but omit earlier data. Records collected prior to 2012 are not included because (a) earlier surveys only looked at two to three sites (cabin and end(s) of airstrip), and (b) species recognition and estimation of percent cover and population size is somewhat subjective and is dependent on level of expertise; consequently, data collected by different people across years can be somewhat inconsistent. By contrast, 2012, 2013, and 2014 data were collected, entered, and summarized by the same person (CG). The data are used here to describe current trends and inform management recommendations. For reference, Appendix I includes recommendations from Monitoring & Controlling Invasive Plants at Rohn Cabin: 2012 Update (Greenstein and Carlson 2013), which was previously submitted to the Bureau of Land Management.

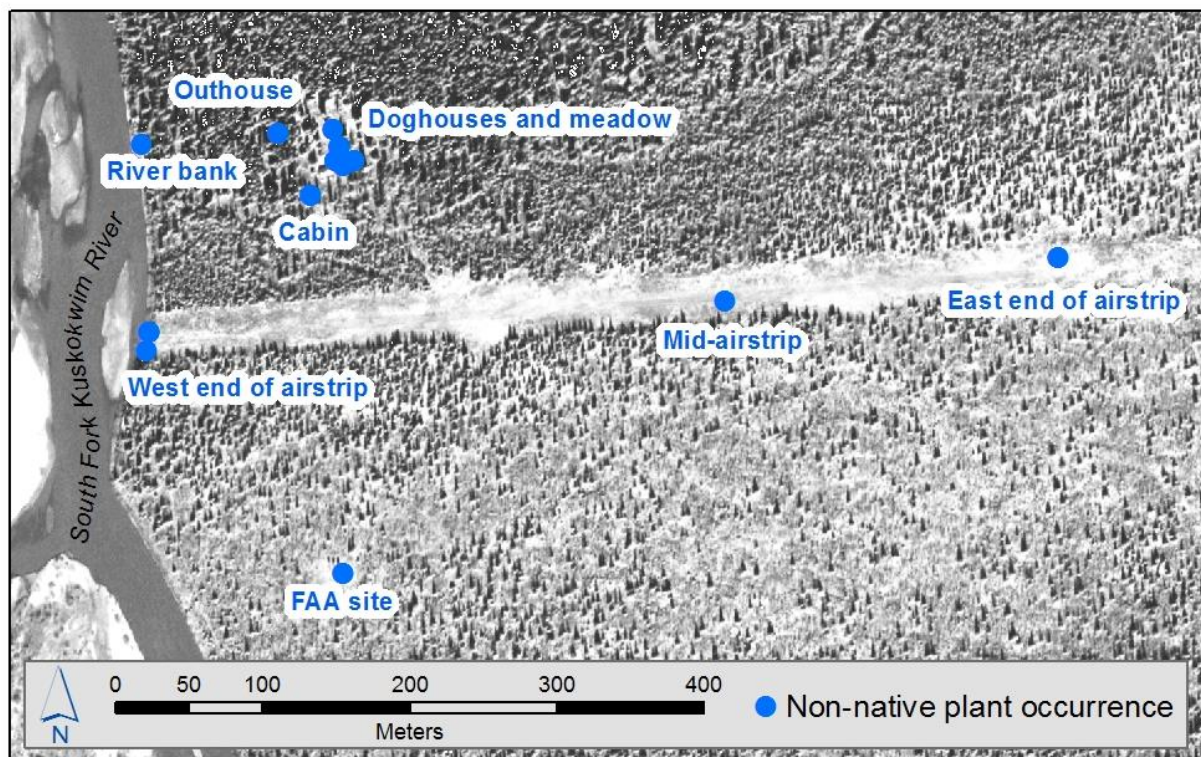


Figure 1 - Rohn Cabin site overview with non-native plant occurrences documented between 2009-2014.

Table 1 - Species presence at Rohn Cabin across years.

| Scientific name                               | Common name            | Invasiveness rank <sup>1</sup> | 2009 | 2011 | 2012 | 2013 | 2014 |
|-----------------------------------------------|------------------------|--------------------------------|------|------|------|------|------|
| <i>Brassica napus</i>                         | rapeseed mustard       | 47                             | x    |      |      |      |      |
| <i>Brassica rapa</i>                          | birdsrape mustard      | 50                             | x    | x    |      |      |      |
| <i>Bromus inermis</i> ssp. <i>inermis</i>     | smooth brome           | 62                             |      |      | x    |      | x    |
| <i>Capsella bursa-pastoris</i>                | shepherd's purse       | 40                             | x    |      |      | x    | x    |
| <i>Cerastium fontanum</i> ssp. <i>vulgare</i> | big chickweed          | 36                             | x    |      |      |      |      |
| <i>Chenopodium album</i>                      | lambsquarters          | 37                             | x    | x    | x    | x    | x    |
| <i>Crepis tectorum</i>                        | narrowleaf hawksbeard  | 56                             | x    | x    | x    | x    | x    |
| <i>Galeopsis tetrahit</i>                     | brittlestem hempnettle | 50                             | x    | x    | x    | x    | x    |
| <i>Hordeum jubatum</i> <sup>2</sup>           | foxtail barley         | 63                             | x    | x    | x    | x    | x    |
| <i>Hordeum vulgare</i>                        | common barley          | 39                             |      |      | x    |      |      |
| <i>Matricaria discoidea</i>                   | pineappleweed          | 32                             | x    | x    | x    | x    | x    |
| <i>Phleum pratense</i>                        | timothy                | 54                             | x    |      |      |      |      |
| <i>Plantago major</i>                         | common plantain        | 44                             | x    |      |      |      |      |
| <i>Poa annua</i>                              | annual bluegrass       | 46                             | x    |      |      |      |      |
| <i>Poa pratensis</i> <sup>3</sup>             | bluegrass              | 52                             | x    |      |      |      |      |
| <i>Polygonum aviculare</i>                    | prostrate knotweed     | 45                             | x    |      | x    | x    |      |
| <i>Taraxacum officinale</i>                   | common dandelion       | 58                             |      |      | x    | x    | x    |

Records from 2009 and 2011 were taken from AKEPIC, records from 2012, 2013, and 2014 were observed in surveys. The native species *Descurainia sophioides* and *Erysimum cheiranthoides* were previously considered to be nuisance species and were controlled by the BLM. However, given their nativity, we did not include them in our survey results for 2013 and 2014.

<sup>1</sup> The 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 native ecosystems and 100 representing a plant that poses a major threat to native ecosystems. For more information see Carlson et al. 2008.

<sup>2</sup> *Hordeum jubatum* is generally considered native to Alaska and the Yukon, but its distribution and abundance has increased dramatically in the last 100 years and it occupies many new areas due to importation by people and goods. We include *H. jubatum* here and elsewhere in the report with non-native species.

<sup>3</sup> AKEPIC records indicate this is either *Poa pratensis* subspecies *pratensis* or subspecies *irrigata*. Both are non-native.

## Site Descriptions and Recommendations

The following site descriptions provide overall biomass for each species recorded, which is calculated by multiplying infestation size by percent cover. It provides a simple comparison between the relative abundance of different species and across years. See Appendix II for a detail description of infestation size, percent cover, and stem count for each species at each site.

### Rohn Cabin Entrance

Last year's attempt to control weeds at the cabin entrance by tarping and applying moss sod had appeared successful in the short term, but this year a carpet of pineappleweed was found at the cabin entrance. Figures 2-5 show changes in ground cover at this site over time. The area that was previously covered in a dense mat of foxtail barley and pineappleweed had been converted to mostly bare ground, with two small patches of pineappleweed growing in it as of 2013, and subsequently transitioned to

mostly pineappleweed as of 2014. A few stems of foxtail barley were still growing around the sides of the cabin, but less so than previous years. Additionally, a few stems of lambsquarters and shepherd's purse were found around the cabin. Several stems of narrowleaf hawksbeard were growing along the margins of the clearing and meadow. It is worth noting that foxtail barley was definitely growing here in July 2012, but was not documented because it was not flowering at that time and could not be identified. Similarly, narrowleaf hawksbeard was not documented here in 2013, although it was likely present, as these plant are very inconspicuous when not in flower.

Treatment in 2014 consisted of weedwhacking remaining stems in the clearing – primarily pineappleweed – and raking and bagging cut material, then laying down landscaping fabric, which was secured with landscape staples. The fabric was buried under two to three inches of a locally sourced mulch of spruce needles, collected from weed-free areas beneath mature spruce trees in the surrounding forest. This site will need to be monitored in the future to assess the efficacy of this treatment.

Although past evidence shows that tarping can be successful in the short-term, there is a good chance that foxtail barley and pineappleweed will continue to be a problem here in the future, given the large seed bank in the area and continued soil disturbance at the cabin entrance.

No new recommendations for 2014 for the cabin entrance area, see Greenstein (2013) for general recommendations for this site.

Table 2 – Biomass of non-native species found at Rohn Cabin entrance, calculated by multiplying infestation size by percent cover

| Species                                           | July 2012 | August 2012 | July 2013 | August 2014 |
|---------------------------------------------------|-----------|-------------|-----------|-------------|
| <i>Capsella bursa-pastoris</i> (shepherd's purse) |           |             | 0.001     | 0.00001     |
| <i>Chenopodium album</i> (lambsquarters)          |           | 0.0001      | 0.001     | 0.01        |
| <i>Crepis tectorum</i> (narrowleaf hawksbeard)    |           | 0.0001      |           | 0.00001     |
| <i>Hordeum jubatum</i> (foxtail barley)           |           | 0.15        | 1         | 0.3         |
| <i>Matricaria discoidea</i> (pineappleweed)       | 0.5       | 0.05        | 0.01      | 0.1         |
| <i>Polygonum aviculare</i> (prostrate knotweed)   | 0.0001    | 0.0001      | 0.0001    |             |



Figure 2 - Cabin entrance July 2012, before (left) laying tarp and after (right). Pineappleweed is outlined in yellow, foxtail barley is outlined in red, and the native fireweed meadow is outlined in blue.



Figure 3 - Cabin entrance August 2012 before (left) and after (right) the tarp was relocated and exposed soil covered with moss sod. Remaining foxtail barley is outlined in red.

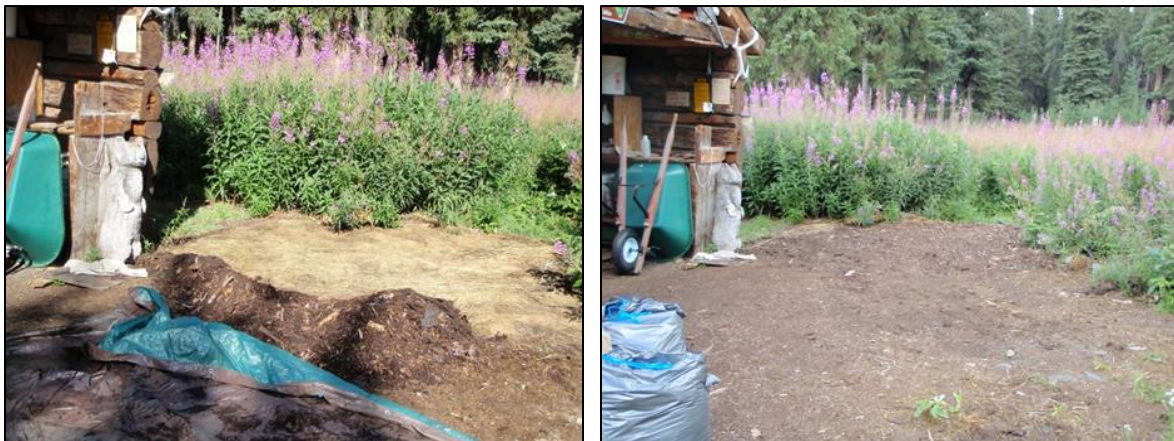


Figure 4 - July 2013 follow-up treatment; exposed mat of dead foxtail barley (left), and weed-free cabin entrance (right).



Figure 5 - August 2014, clock wise from top left: pineappleweed outlined in yellow, before area was treated; landscaping fabric being stapled down; covering landscaping fabric with spruce needles; final result.

### *Doghouses and meadow*

This year the area around the doghouses was not accessible because it was covered with a large tarp (Figure 6 and 7), which was presumably covering up the 2014 Iditarod Race leftover straw, as it couldn't be burned due to dry, snow-free conditions. However, the rest of the meadow was surveyed. A large amount of hempnettle was growing around the edges of the tarp. Similar to previous years, a layer of countless hempnettle stems less than 10 inches tall were growing beneath the dense cover of mature plants. This plant is biennial, and these will be the mature stems of 2015. Lambsquarters was found in patches throughout the meadow and was dropping seeds as we tried to carefully remove as much of the plant and seed as possible. For this reason, it is likely that the meadow will not see a decrease in lambsquarters this year; the 2015 site visit should take place earlier in the season, to avoid a repeat of this problem. A few stems of narrowleaf hawksbeard were also present. Although much foxtail barley was found in the meadow and expanding into the surrounded forest in 2013, this year this trend was not observed. This may be attributed to the timing of our survey, as foxtail barley that has already dropped seed is reasonably inconspicuous. This was likely also the case during July 2012 surveys. All weeds found were pulled by hand.

Table 3 – Biomass of non-native species found around the doghouses and in the meadow, calculated by multiplying infestation size by percent cover.

| Species                                            | Biomass   |             |           |             |
|----------------------------------------------------|-----------|-------------|-----------|-------------|
|                                                    | July 2012 | August 2012 | July 2013 | August 2014 |
| <i>Chenopodium album</i> (lambsquarters)           | 0.5       | 0.01        | 1         | 0.2         |
| <i>Crepis tectorum</i> (narrowleaf hawksbeard)     |           |             | 0.001     | 0.0001      |
| <i>Galeopsis tetrahit</i> (brittlestem hempnettle) | 0.1       | 1           | 1         | 0.5         |
| <i>Hordeum jubatum</i> (foxtail barley)            |           | 1           | 1         |             |
| <i>Hordeum vulgare</i> (common barley)             |           | 0.001       |           |             |
| <i>Matricaria discoidea</i> (pineappleweed)        |           | 0.001       | 1         |             |

#### New recommendations for 2014:

It was difficult to assess changes in the meadow weed populations this year due to a large tarp covering the area around the doghouses, and because it was too late in the season to observe foxtail barley. However, the infestations of lambsquarters and hempnettle appear similar, with a slight decline in numbers. No common barley or pineappleweed were observed in 2014. Follow up work next year will be helpful to determine if the tarp laid down by Iditarod workers will have the dual effect of covering up last year's straw and smothering invasive species.



Figure 6 - Photos from 2014. Blue tarp was in place prior to our visit (left), but numerous stems of mature hempnettle were growing up along its edges (right).

#### Outhouse and vicinity

The distribution of foxtail barley and narrowleaf hawksbeard scattered throughout the forest surrounding the outhouse (Figure 8) appears to have decreased since last year, although this again may be due to the late timing of the survey.

Table 4 – Biomass of non-native species found in the vicinity of the outhouse, calculated by multiplying infestation size by percent cover

| Species                                        | Biomass    |             |           |             |
|------------------------------------------------|------------|-------------|-----------|-------------|
|                                                | July 2012* | August 2012 | July 2013 | August 2014 |
| <i>Crepis tectorum</i> (narrowleaf hawksbeard) |            | 0.001       | 0.001     | 0.0001      |
| <i>Hordeum jubatum</i> (foxtail barley)        |            | 0.5         | 1         | 0.0001      |

\*The outhouse area was not specifically surveyed on the July 2012 site visit.

#### **New recommendations for 2014**

Continue monitoring this site, and try to survey earlier in August next year. Previous recommendations for this site still apply: the scattered stems of foxtail barley could be most effectively controlled with herbicides, and the few stems of narrowleaf hawksbeard can be hand-pulled, as it is easily removed with minimal soil disturbance.



Figure 7 – Outhouse within a white spruce forest. Ground cover consists mostly of fireweed, with scattered stems of foxtail barley and narrowleaf hawksbeard.

#### ***South Fork of the Kuskokwim River***

The forest behind the cabin extending to the river bank (Figure 9) was surveyed again in 2014. No weeds have been observed here since surveys began in 2012. Future establishment of non-native species in this area is unlikely and it should be considered a lower priority area.

No new recommendations for 2014 for this site.



Figure 8 - South Fork of the Kuskokwim River bank (photo from 2013).

#### ***East end of airstrip***

No weeds were found here in 2012 or 2013. However, this area should continue to be a priority for surveying as it sees a lot of human traffic.

No new recommendations for 2014 for this site.

#### ***West end of airstrip***

As in 2013, two stems of foxtail barley were found at the bottom of the river bank, about one foot from the river. These were removed. On the west end of the airstrip itself, no weeds were found in 2012, 2013, or 2014. However, this area should continue to be a priority for surveying as it sees a lot of human traffic.

No new plant management recommendations for 2014.

### *Mid-airstrip, south side*

A small cluster of smooth brome was found near the middle of the airstrip, on the north edge (Figure 11), in 2012 and 2014, but was not observed in 2013. The population of approximately 30 stems in a two foot radius was hand-pulled both years. This area should continue to be a priority for surveying as it sees a lot of human traffic and associated gear and goods.

No new recommendations for 2014 for this site.



Figure 9 – Airstrip, removing smooth brome and looking west (left) and looking east (right).

### *FAA site*

Only a few basal rosettes of common dandelion were found in 2013 and 2014. These can be distinguished from the widely distributed and abundant native horned dandelion by the presence of wider leaves, which are less deeply lobed and are more robust in appearance. About nine stems of common dandelion were found and all were pulled in 2013, and only one cluster of several stems was found in 2014. Dandelion has stout roots that are difficult to dig out their entirety. Plants are likely resprouting from root fragments left in the ground.

Table 5 – Biomass of non-native species found at the FAA site, calculated by multiplying infestation size by percent cover.

| Species                                        | Biomass    |             |           |             |
|------------------------------------------------|------------|-------------|-----------|-------------|
|                                                | July 2012* | August 2012 | July 2013 | August 2014 |
| <i>Crepis tectorum</i> (narrowleaf hawksbeard) |            | 0.001       |           |             |
| <i>Taraxacum officinale</i> (common dandelion) |            | 0.001       | 0.0001    | .000001     |

\*The FAA area was not specifically surveyed on the July 2012 site visit.

### **New recommendations for 2014**

Rather than trying to dig up dandelion with a hand trowel or hori hori, use a full-size shovel and dig one foot around and below plants, to ensure the entire root is removed.



Figure 10 - FAA site (left) and few remaining stems of common dandelion (right).

## Conclusions and recommendations

General recommendations for continued surveys and treatment at Rohn Cabin were provided in the 2012 summary report. These are still valid and remain as our best suggestions for management. They are as follows:

- Upon visiting the Rohn Cabin site, begin monitoring and treatment activities at areas with the least abundance or likelihood of finding weeds. Start with the FAA site, airstrip, and survey areas behind the cabin and elsewhere where weeds have not yet been reported. Next, move into areas with known, dense populations, including the cabin entrance, outhouse, and doghouses. This will help avoid unintentionally spreading seeds into uninfested areas.
- A thorough accounting and accurate identification of species around Rohn Cabin is necessary to track progress between years. All non-native plant populations should be documented in detail to ensure effective monitoring, assess the efficacy of control over time, and allow for changes to treatment approaches where appropriate. A change of three sampling locations in 2009, two in 2011, and six in 2012 reflects the survey strategies of different botanist involved on each trip. It would be beneficial to have the same botanist do surveys each year.
- All weeds should be collected (prior to fruiting) in contractor bags or doubled-up garbage bags and flown off site for disposal. On site disposal by burning bags of weeds in a contained unit, such as a burn barrel may be an acceptable alternative if transportation costs and volume of weeds are too high.
- BLM staff and volunteers visiting Rohn Cabin in the summer should take care to clean boots, gear, and equipment before leaving Anchorage or other cities, to avoid transporting weed seeds from the urban center to the site<sup>1</sup>.

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<sup>1</sup> If weedwhackers are used, they should be cleaned in Anchorage prior to use at Rohn.

- Timing a weed collection trip for late July or early August would be ideal. The first week of July is too early to scout for invasive species. By the last week of August some species have already set seed<sup>2</sup>, while other species can still be managed. Treatment of some species may require springtime tillage, so a trip may also be necessary in late May or June.
- Iditarod Trail Race considerations
  - ♦ Certified weed-free straw is currently required for special use permits at Rohn Cabin. It is recommended that this should be a permanent requirement and should continue to be enforced.
  - ♦ Offer dog team owners in the area information on where weed-free straw for dog bedding is available.
  - ♦ Encourage those using snow machines on-site to inspect and clean their machines before bringing them to the cabin.
  - ♦ Encourage those working in support of the Iditarod Race to clean their boots and gear before leaving for Rohn Cabin; seeds can be transported even in winter.
- Provide training and educational materials regarding plant identification, impacts, and preventative actions to the public, and to those involved with Rohn Cabin activities. Update educational materials in the Rohn Cabin binder regularly<sup>3</sup>, including plant identification and prevention practices.
- Although the yellow-flowered mustards *Descurainia sophioides*, *Erysimum cheiranthoides*, and *Erysimum inconspicuum* are considered introduced to the Rohn Cabin site, they are native to Alaska and found in habitats similar to Rohn Cabin. *Descurainia sophioides* and *Erysimum cheiranthoides* can form high-density weedy patches on disturbed substrates that can be counter to management goals. *Erysimum inconspicuum*, on the other hand, is not known to us to form dense patches and is unlikely to interfere with management goals. We recognize that the first two species may be targeted for control, but we recommend that clearly non-native taxa are higher priorities.

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<sup>2</sup> As of August 26, 2014, lambsquarters could not be effectively controlled, given the amount of seed it was dropping. Northern tansymustard and foxtail barley had also dropped most of its seed.

<sup>3</sup> The Rohn Cabin binder educational materials were updated July 2013 and may need updating in the future if new species or infestations are discovered, or new management techniques are implemented.

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## Appendix I – Management recommendations by site from Greenstein and Carlson 2013 (Monitoring & Controlling Plants at Rohn Cabin: 2012 update)

### *Rohn Cabin entrance*

- *Brassica napus*, *Brassica rapa*, *Capsella bursa-pastoris*, *Cerastium fontanum* ssp. *vulgare*, *Chenopodium album*, *Crepis tectorum*, *Galeopsis tetrahit*, *Phleum pratense*, *Plantago major*, *Poa pratensis* ssp. *pratensis* or ssp. *irrigata*, *Polygonum aviculare*

These species were either not present at the cabin entrance on the 2012 visits, or were present in low numbers that could be easily hand pulled. Future control efforts should be on the lookout for these species, and should remove them by digging the plant and roots out by hand. If they are not eradicated from the cabin entrance by 2015, a new approach should be considered.

- *Descurainia* cf. *sophioides*, *Erysimum cheiranthoides*

These species were present in somewhat larger numbers, but consensus of their nativity is lacking. The *Descurainia* present at Rohn appears to be the native *Descurainia sophioides*. These plants have a pubescence that some authors (Hultén 1968) consider consistent with the non-native *D. sophia*. The total constellation of traits, however, is a good fit for more recent treatments of the native *D. sophioides*. This native species can behave in a very weedy manner and often reaches very high densities following fire and in human-disturbed areas. *Erysimum cheiranthoides* is generally considered to include native and non-native genotypes in Alaska, and because of the species' widespread nature and presence in undisturbed areas it is not included on AKNHP's non-native species list. Regardless of its statewide rarity, *E. cheiranthoides* is often introduced into new areas by human activity. Assuming removal of weedy regionally introduced species such as these is a BLM goal, we recommend hand pulling prior to flowering over multiple years. These species behave primarily as biennials and are easily pulled by hand; if they are removed prior to seed drop, control of populations should be attainable. Additionally, reducing open mineral soil by encouraging other plant establishment will limit recruitment of the seed bank. Overall, because these species are native to the state and widespread, we place a low priority on their control and elimination.

- *Hordeum jubatum*, *Matricaria discoidea*

These form a dense mat in front of the cabin. *Matricaria discoidea* is only weakly invasive, having little documented negative effects on ecosystems (see Carlson et al. 2008), and does not persist without disturbance and/or trampling. It is included here because it forms a near continuous mat with *Hordeum jubatum* at the cabin entrance.

*Hordeum jubatum* is native to Alaska, but has spread dramatically in recent decades due to anthropogenic disturbance. It is a perennial weed and difficult to control. It has fibrous, shallow roots

that form dense mats but do not penetrate very deep. Tarping this population was tried on the August 2012 visit to Rohn Cabin, but there is no literature suggesting this is an effective method. If the method is successful, then we recommend that it should be implemented in the future, until the seed bank is depleted. Seeds remain viable for only a short period of time, with viability quickly decreasing after three years (Conn and Deck 1995).

Tarping perhaps slowed down the reproduction and spread of *Hordeum jubatum*, but more than likely additional control measures will be needed. Spring tillage can control this plant, due to the absence of rhizomes or stolons (Conn and Deck 1995). Tilling will increase weed seed germination and emergence, so all weeds at the site will need to be removed before setting seed. However, as weed emergence increases, the longevity of the seed bank decreases (Roberts and Feast 1972, 1973). Consequently, the long-term benefits should outweigh the short-term costs of necessary follow-up treatments in the same growing season after tillage (Conn 2006).

Species growing in the vicinity of the *Hordeum jubatum* mat at the cabin entrance and in the meadow that would be affected by tilling include *Chenopodium album*, *Descurainia sophioides*, *Erysimum cheiranthoides*, and *Galeopsis tetrahit*. These are all annuals that reproduce by seed only. Therefore tilling any or all of these species will have roughly the same outcome; seed emergence will initially increase, but the seed bank will be exhausted more quickly. The duration of seed viability varies between species (AKEPIC Species Biographies), but all favor disturbed areas and are unlikely to persist after native plants reclaim sites.

If tarping and tillage are not effective, it may be necessary to use herbicide. The most effective method for controlling *Hordeum jubatum* in Alaska, as determined by Conn and Deck (1995), is to use a combination of 1.1 kg/ha glyphosate, 2.2 kg/ha ammonium sulfate, and 0.5% nonionic surfactant, applied between early August and mid-September. Timing is important, as efficacy greatly increases after plants flower and seeds mature; herbicides are least effective while stems are undergoing seed fill. As previously mentioned, seeds remain viable for up to three years, so follow up treatments will be needed for at least that long, or until the population is contained or eradicated.

Given the abundance of native plants in the surrounding area, there should be enough dispersal to reestablish native vegetation on disturbed sites without human intervention. However, if it is observed that this is not occurring, areas disturbed by weed removal could be reseeded manually. Ideally, seeds of native *Calamagrostis canadensis* should be collected at Rohn Cabin the summer of 2013 and stored for future use.

### *Doghouses and meadow*

- *Chenopodium album*, *Descurainia cf. sophioides*, *Galeopsis tetrahit*, *Hordeum jubatum*

These species are found in the greatest numbers and density immediately surrounding the middle and northernmost doghouses. Densities decrease farther away from the doghouses, but stems can still be

found reaching into the surrounding meadow. The recommendations provided for *Hordeum jubatum* at the cabin entrance apply to the central dense patch of weeds in the meadow. If tarping, tilling, or herbicide use takes place, this central patch can be delineated by where the ratio of non-native to native plants is 50:50. Areas with less than 50% non-native plants should be hand pulled, and the central patch of dense weeds should be treated with one or more of the aforementioned methods.

- *Erysimum cheiranthoides* , *Hordeum vulgare*, *Matricaria discoidea*

Few stems of these species were found around the doghouses in the meadow. The stems found within the central dense patch discusses above would be treated along with the aforementioned species. Those solitary stems creeping into the meadow should be hand pulled.

### *Outhouse and vicinity*

- *Descurainia* cf. *sophioides*

This weedy species native to Alaska, yet locally introduced, is also found immediately around the outhouse, along the front and sides. This and other unwanted plants will likely continue to be a modest problem at this site, due to frequent disturbance and trampling. For now, we recommend implementing hand pulling to keep weeds in check. Should the abundance or diversity of unwanted plants increase in the future, more aggressive management strategies may be needed.

- *Crepis tectorum*, *Hordeum jubatum*

These were found scattered throughout the undergrowth in the vicinity of the outhouse. The best approach for removing these dispersed stems is to pull each out by the roots. However, this is a time consuming process, and plenty of time should be allowed to completely survey the area. The density, infested area, and number of stems should be documented on each visit; if it appears this method is not effective, more aggressive management strategies may be needed in the future.

- *Elymus trachycaulus*

There is a dense patch of grass behind the outhouse, which at first glance may resemble non-native *Elymus repens* (quackgrass). However, this is the native *Elymus trachycaulus*, which is unusually wide-leaved and robust, and should not be removed.

### *South Fork of the Kuskokwim River*

- *Erysimum inconspicuum*

Although the BLM has requested removing all yellow-flowered mustards from the vicinity of Rohn Cabin, this is a native and non-weedy species. The river bank is the only place this plant was found; it was

nowhere near disturbed sites or other weedy mustards. It is recommended that *Erysimum inconspicuum* is not removed.

### *East end of airstrip*

- *Crepis tectorum*, *Descurainia* cf. *sophioides*

These two species were not found on the 2012 site visit (although they were noted on earlier visits) and may have been eradicated from this location. The east end of the airstrip should be monitored on each visit, and if weeds reappear, they should be hand pulled. We recommend collecting *Descurainia* specimens in late flower to fruit to confirm that they are not the species alien to Alaska.

### *West end of airstrip*

- *Poa annua*, *Poa pratensis*

These grasses were not found on the 2012 site visit (although they were noted on earlier visits), and may have been eradicated from this location. The west end of the airstrip should be monitored on each visit, and if weeds reappear, they should be hand pulled. If *Poa pratensis* is relocated, we recommend collection of material for identification as the subspecies identity is unclear for this site.

### *Mid-airstrip, south side*

- *Bromus inermis* ssp. *inermis*

Only found in 2012, this young population was discovered and pulled early enough that it may not reappear in 2013. If it does, hand-pulling is recommended, ensuring all roots are removed. A 20 m radius around the population should be carefully surveyed to look for any outlying stems.

### *FAA site*

- *Crepis tectorum*, *Descurainia* cf. *sophioides*, *Taraxacum officinale*

On the 2012 visit there were extremely few stems of each of these species. Monitoring and hand pulling at this site should continue until no weeds are found for three consecutive years. There is relatively little traffic at this site and therefore little opportunity for reintroduction of weed seeds or propagules.

## Appendix II – Infestation size, percent cover, and stem count at each site

### *Cabin entrance*

| Species                                           | July 2012 | August 2012 | July 2013 | August 2014 |
|---------------------------------------------------|-----------|-------------|-----------|-------------|
| <i>Capsella bursa-pastoris</i> (shepherd's purse) |           |             |           |             |
| infestation size (acres)                          | -         | -           | 0.001     | 0.01        |
| percent cover                                     | -         | -           | 1         | 0.001       |
| stem count                                        | -         | -           | 6-25      | 1-5         |
| <i>Chenopodium album</i> (lambsquarters)          |           |             |           |             |
| infestation size (acres)                          | -         | 0.01        | 0.001     | 0.01        |
| percent cover                                     | -         | 0.01        | 1         | 1           |
| stem count                                        | -         | 1-5         | 6-25      | 51-150      |
| <i>Crepis tectorum</i> (narrowleaf hawksbeard)    |           |             |           |             |
| infestation size (acres)                          | -         | 0.01        | -         | 0.01        |
| percent cover                                     | -         | 0.01        | -         | 0.001       |
| stem count                                        | -         | 1           | -         | 1-5         |
| <i>Hordeum jubatum</i> (foxtail barley)           |           |             |           |             |
| infestation size (acres)                          | -         | 0.01        | 1         | 0.01        |
| percent cover                                     | -         | 15          | 1         | 3           |
| stem count                                        | -         | 500+        | 500+      | 26-50       |
| <i>Matricaria discoidea</i> (pineappleweed)       |           |             |           |             |
| infestation size (acres)                          | 0.01      | 0.01        | 0.01      | 0.01        |
| percent cover                                     | 50        | 5           | 1         | 10          |
| stem count                                        | 151-500   | 51-150      | 151-500   | 500+        |
| <i>Polygonum aviculare</i> (prostrate knotweed)   |           |             |           |             |
| infestation size (acres)                          | 0.01      | 0.01        | 0.001     | -           |
| percent cover                                     | 0.01      | 0.01        | 1         | -           |
| stem count                                        | 1-5       | 1           | 1         | -           |

### *Doghouses and meadow*

| Species                                            | July 2012 | August 2012 | July 2013 | August 2014 |
|----------------------------------------------------|-----------|-------------|-----------|-------------|
| <i>Chenopodium album</i> (lambquarters)            |           |             |           |             |
| infestation size (acres)                           | 0.01      | 0.1         | 1         | 0.1         |
| percent cover                                      | 50        | 0.01        | 1         | 2           |
| stem count                                         | 151-500   | 1-5         | 500+      | 151-500     |
| <i>Crepis tectorum</i> (narrowleaf hawksbeard)     |           |             |           |             |
| infestation size (acres)                           | -         | -           | 0.001     | 0.1         |
| percent cover                                      | -         | -           | 1         | 0.001       |
| stem count                                         | -         | -           | 1-6       | 6-25        |
| <i>Galeopsis tetrahit</i> (brittlestem hempnettle) |           |             |           |             |
| infestation size (acres)                           | 0.01      | 0.1         | 1         | 0.1         |
| percent cover                                      | 10        | 10          | 1         | 5           |
| stem count                                         | 1-5       | 500+        | 500+      | 500+        |
| <i>Hordeum jubatum</i> (foxtail barley)            |           |             |           |             |
| infestation size (acres)                           | -         | 0.1         | 1         | -           |
| percent cover                                      | -         | 20          | 1         | -           |
| stem count                                         | -         | 500+        | 500+      | -           |
| <i>Hordeum vulgare</i> (common barley)             |           |             |           |             |
| infestation size (acres)                           | -         | 0.1         | -         | -           |
| percent cover                                      | -         | 0.01        | -         | -           |
| stem count                                         | -         | 1-5         | -         | -           |
| <i>Matricaria discoidea</i> (pineappleweed)        |           |             |           |             |
| infestation size (acres)                           | -         | 0.1         | 1         | -           |
| percent cover                                      | -         | 0.01        | 1         | -           |
| stem count                                         | -         | 1-5         | 500+      | -           |

### *Outhouse and vicinity*

| Species                                        | July 2012 | August 2012 | July 2013 | August 2014 |
|------------------------------------------------|-----------|-------------|-----------|-------------|
| <i>Crepis tectorum</i> (narrowleaf hawksbeard) |           |             |           |             |
| infestation size (acres)                       | N/A*      | 0.1         | 0.001     | 0.1         |
| percent cover                                  | N/A       | 0.01        | 1         | 0.001       |
| stem count                                     | N/A       | 6-25        | 1-5       | 1-5         |
| <i>Hordeum jubatum</i> (foxtail barley)        |           |             |           |             |
| infestation size (acres)                       | N/A       | 0.1         | 1         | 0.1         |
| percent cover                                  | N/A       | 5           | 1         | 0.001       |
| stem count                                     | N/A       | 51-150      | 51-150    | 26-50       |

### *West end of airstrip*

| Species                                 | July 2012 | August 2012 | July 2013 | August 2014 |
|-----------------------------------------|-----------|-------------|-----------|-------------|
| <i>Hordeum jubatum</i> (foxtail barley) |           |             |           |             |
| infestation size (acres)                | -         | -           | 0.001     | 0.001       |
| percent cover                           | -         | -           | 1         | 0.001       |
| stem count                              | -         | -           | 1-5       | 1-5         |

### *Mid-airstrip, south side*

| Species                                                  | July 2012 | August 2012 | July 2013 | August 2014 |
|----------------------------------------------------------|-----------|-------------|-----------|-------------|
| <i>Bromus inermis</i> ssp. <i>inermis</i> (smooth brome) |           |             |           |             |
| infestation size (acres)                                 | -         | 0.001       | -         | 0.001       |
| percent cover                                            | -         | 1           | -         | 0.001       |
| stem count                                               | -         | 26-50       | -         | 51-150      |

### *FAA site*

| Species                                        | July 2012 | August 2012 | July 2013 | August 2014 |
|------------------------------------------------|-----------|-------------|-----------|-------------|
| <i>Crepis tectorum</i> (narrowleaf hawksbeard) |           |             |           |             |
| infestation size (acres)                       | N/A*      | 0.1         | -         | -           |
| percent cover                                  | N/A       | 0.01        | -         | -           |
| stem count                                     | N/A       | 1           | -         | -           |
| <i>Taraxacum officinale</i> (common dandelion) |           |             |           |             |
| infestation size (acres)                       | N/A       | 0.1         | 0.001     | 0.001       |
| percent cover                                  | N/A       | 0.01        | 0.001     | 0.001       |
| stem count                                     | N/A       | 1           | 6-25      | 1-5         |