INVASIVE PLANT INVENTORY AND BIRD CHERRY CONTROL TRIALS

Phase I: Non-native plants recorded along four Anchorage Municipality trail systems

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Abstract

To assess the impacts of non-native plant species to Municipality of Anchorage lands, Alaska Natural Heritage Program staff conducted systematic surveys for non-native vascular plants species during the 2008 and 2009 field seasons. This work was conducted for the Municipality of Anchorage and the Anchorage Parks Foundation and is comprised of two phases. Phase I documents the extent and locations of highly-invasive plant species along the Campbell Creek and Chester Creek Greenbelts, Tony Knowles Coastal Trail and select trails in the Kincaid Park system. Phase II investigates the current and potential ecological impacts of a single invasive tree species, *Prunus padus* (European bird cherry), the results of which are presented in a separate report. This report summarizes Phase I of the project. Species of concern and areas of high-infestation are identified and methods for their control are recommended.

Non-native invasive plant species are abundant and widespread across Municipal Park lands. A total of 56 non-native taxa were documented within the study area; 13 of these species are considered high-priority (those with an invasiveness ranking greater than or equal to 60[*]), additional taxa are included as species of concern based on their apparent invasiveness. High-priority species were detected in over 50% of the 92 plots surveyed. Multiyear control and follow-up monitoring of small, outlying populations could successfully eradicate discrete infestations. Eradication of several invasive species present within the study area, however, will be difficult due to their abundance. We recommend that control efforts for such species be initially aimed at containing the infestations. A long-term weed management plan that includes a range of control methods and that identifies a suite of best management practices, such as the use of weed-free materials in trail construction and revegetation projects, should minimize the further introduction and dispersal of invasive species to Municipal Park lands in the future.

[*] The Invasiveness Ranking System for Non-Native Plants of Alaska (Appendix I, Carlson *et al.* 2008) was developed to aid in identifying problematic non-native plants and for prioritizing control efforts in the state of Alaska. The ranking system evaluates a given species with respect to potential ecosystem impacts, biological attributes, known distribution, efficacy of control measures, and the potential for establishment in the different ecogeographic regions of Alaska (south coastal, interior boreal, and arctic alpine). Based on this evaluation, species are ranked between zero and 100, where zero indicates low invasiveness and 100 indicates high aggressiveness (see http://akweeds.uaa.alaska.edu/akweeds_ranking_page.htm for further information on the invasiveness ranking system).

Acknowledgements

This project was funded by The Municipality of Anchorage and Anchorage Parks Foundation. We gratefully acknowledge their support. We would also like to thank the following Alaska Natural Heritage Program staff: Susan Klein for directing and conducting all the fieldwork on the Chester and Campbell Creek trails, Lorae' Simpson for conducting some of the fieldwork on the Coastal trail and in Kincaid Park, and field technician Kellee Hampy for assisting AKNHP staff in setting up many of the plots. We are grateful to Tina Boucher, AKNHP Ecologist, who helped us extensively in designing the methods for both Phases I and II of this project, and Matthew Carlson, AKNHP Program Botanist, for his thoughtful critiques and edits of the final report. Finally, we are especially grateful to Monique Anderson (Municipality of Anchorage), who provided us with invaluable guidance and support throughout the first year of work.

Introduction

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

While invasive plants constitute a major problem in the Lower 48 states (*cf*. Randall 1996), Alaska has remained largely unaffected by non-native plants. However, over the last ten years there has been a marked acceleration in the rate of introduction of non-native plants to the state, presumably driven by increases in population, commerce, development, gardening, and outdoor recreation activities (Carlson and Shephard 2007). In several cases, invasive weeds have been documented moving off the human footprint into natural ecosystems (Cortés-Burns *et al*. 2007, 2008; Lapina *et al*. 2007; Villano and Mulder 2008).

The susceptibility of native plant communities to invasion is largely a function of the degree of natural or anthropogenic disturbance (Hobbs and Huenneke 1992). In Alaska, non-native plant occurrence is most strongly correlated with high-use (and therefore highly disturbed) areas such as transportation routes (trails, roads, and railways), urban centers and recreational areas. The Anchorage Bowl has the highest concentration of human-altered landscapes in the state and is likely the largest portal for non-native plant introductions. This renders our local park lands and the margins of the surrounding wilderness particularly vulnerable to infestation.

In response to this growing threat, The Municipality of Anchorage (MOA) Department of Parks & Recreation is in the early stages of developing an Invasive Plant Management Strategy for the lands under its stewardship. To facilitate this effort, the Alaska Natural Heritage Program (AKNHP) of the University of Alaska Anchorage was engaged to conduct a systematic survey of four trail systems owned and managed by the Municipality. The extent and distribution of problem non-native species that occur along these trails is summarized herein and will aid in the prioritization of species and locations for weed management activities in the future.

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

[†] 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.

Methods

Alaska Natural Heritage Program staff conducted systematic surveys on Anchorage Municipal Park lands during the 2008 field season to determine the extent and locations of infestations of non-native vascular plants. This report focuses on high-priority species (those ranked 60 or higher by the Invasiveness Ranking System for Non-Native Plants of Alaska* (Appendix I, Carlson *et al.* 2008), and low and unranked species of concern.

I. Study area

Surveys for non-native plants were conducted along the Chester Creek Greenbelt, Campbell Creek Greenbelt, Tony Knowles Coastal Trail, and Kincaid Park trails. Trails included in the Kincaid Park survey are: the Multi-use Trail, the Mize Loop, Alex Sisson Trail, Margaux's Loop, Andrew Lekisch Trail and Jodhpur Loop (Fig. 1).

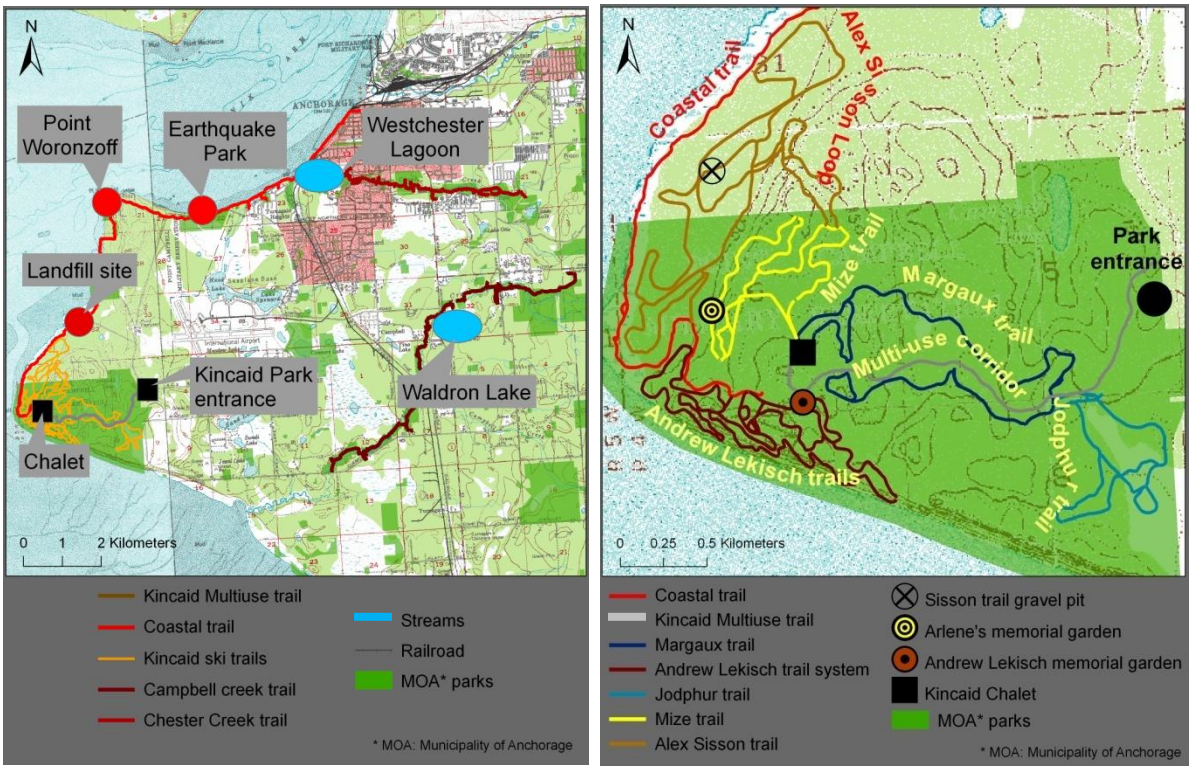

Figure 1 Map of study area

Map of the entire survey area (left). Trails surveyed within Kincaid Park, highlighting sites that constitute potential dispersal foci for aggressively non-native species (namely: memorial gardens, the Sisson trail gravel pit, the Multiuse trail, the park entrance on Raspberry Road, and the Chalet).

* The Invasiveness Ranking System for Non-Native Plants of Alaska (Appendix I, Carlson *et al.* 2008) evaluates a given species with respect to potential ecosystem impacts, biological attributes, known distribution, efficacy of control measures, and the potential for establishment in the different ecogeographic regions of Alaska. Based on this evaluation, species are ranked between zero and 100, (lowest to highest invasiveness, respectively (see http://akweeds.uaa.alaska.edu/akweeds_ranking_page.htm for further information).

II. Plot types

To determine the distribution, abundance, and identity of non-native plants, two types of plots were read during the surveys: exhaustive species plots, where all native and non-native species were recorded, and outlier plots, where only non-native species were recorded. All information on non-native plant species was collected in accordance with Alaska Exotic Plant Information Clearinghouse (AKEPIC) protocols, regardless of plot type (see 'Data dictionary' and 'Field Datasheet' at http://akweeds.uaa.alaska.edu/).

Plots (both exhaustive and outlier) with no non-native species, or that had only low-aggressive non-native species (invasiveness ranking less than 60), or species that are rejected from consideration (*Poa annua, Taraxacum officinale* ssp*. officinale, Stellaria media, Poa pratensis,* and *Hordeum jubatum*, see Appendix IV for justification) are not discussed in this report. Nonetheless, all plot data have been entered into a database, and locality information for all non-native populations found during the 2008 surveys (including those of species rejected from consideration in this report) have been entered into the AKEPIC database.

a. Plot naming and numbering convention

Exhaustive species plots were named using the following convention: *Project identifier* (ANC_MUNI), *first three letters of the trail name*, *plot number*, *subplot letter*. For example, "ANC_MUNI_COA_001A" refers to Coastal Trail, Plot 1, subplot A. Plots completed within Kincaid Park deviate from this convention. Instead of the first three letters of the trail name, *Kincaid plots are denoted by KIN*, followed by *two to three* letters that indicate which Kincaid *trail* the plot in located on. For example, "ANC_MUNI_KINAS_003E" refers to the Alex Sisson trail, Plot 3, subplot E. Outlier plots are denoted by project, trail number and plot type only, for example "ANC_MUNI_KINAS_outlier".

Plot numbers increase in the following directions (Fig. 2):

1) **Coastal Trail**[*]: from the downtown trailhead near the intersection of 2nd Avenue and K Street to the fork in the paved trail that splits towards the Kincaid Chalet and the Multi-use trail (on the top of the hill, right before the Chalet). The short section of trail that runs east along the north edge of Westchester Lagoon between the "ironworker" memorial garden and the first milepost of the Chester Creek Trail is included as part of the Coastal Trail survey.
2) **Chester Creek Trail**[†]: from the first Westchester Lagoon milepost to the intersection of the Chester Creek and Goose Lake trails.
3) **Campbell Creek Trail**: from the trail terminus close to the intersection of Tudor Road and South Bragaw Street to Campbell Lake.

[*] Please note Plots 5-6 are located out of numerical order, and were set up in the area between Elderberry Park and Westchester Lagoon area.

[†] Please note Plots 8-11 are located out of numerical order, and were set up in the Westchester Lagoon area.

4) **Kincaid Trail system**: in general, plot numbers increase in the direction of (winter/ski) trail travel.
   a) **Multi-use trail** plot numbers increase from the Raspberry Road park entrance to the Coastal Trail terminus at the Kincaid Chalet (*i.e.* uphill).
   b) **Mize Loop** plot numbers increase from the stadium in a counter-clockwise direction around the loop (*i.e.* direction of trail travel).
   c) **Sisson Trail** plot numbers increase from the intersection of the connector of Arlene's Way and the Mize Loop, along the northbound section of Arlene's Way and then in a counter-clockwise around the Sisson Loop (*i.e.* direction of trail travel).

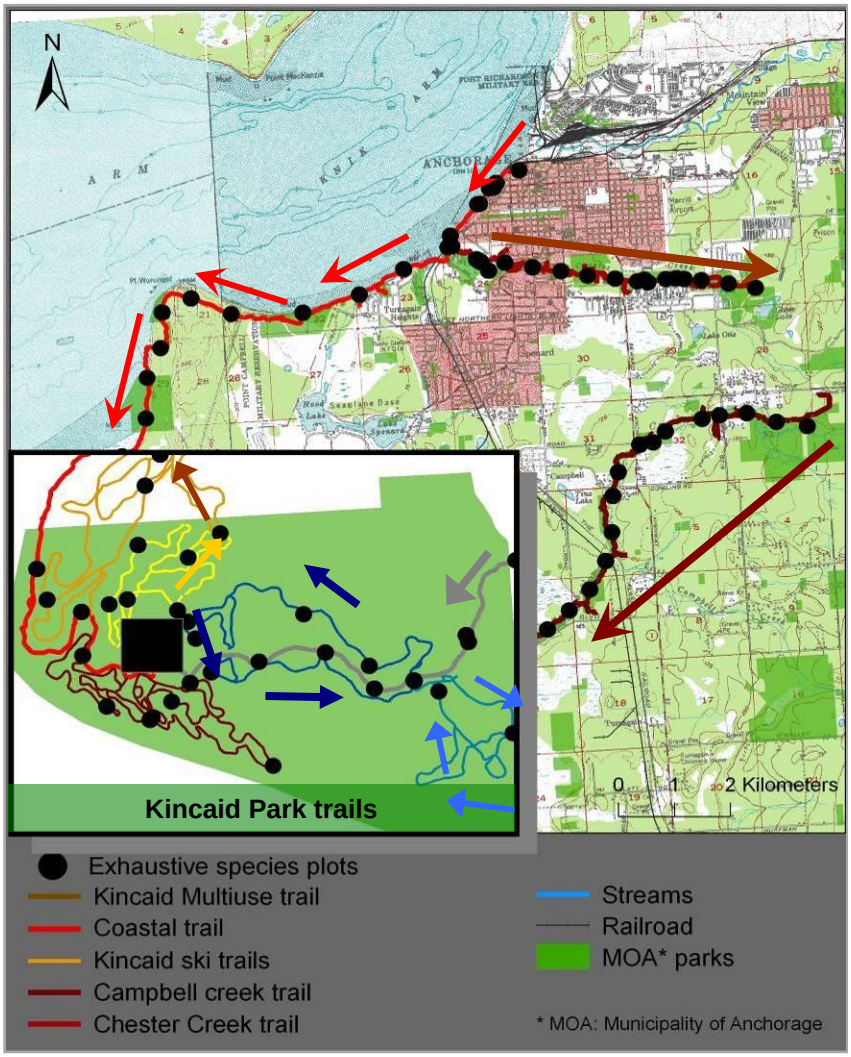

Figure 2 Locations of exhaustive species plots, and direction of trail survey.

Exhaustive species plots are indicated with black circles. Trail survey direction is indicated by arrows. For all trails in Kincaid we followed the ski direction.

d) **Margaux's Loop** plot numbers increase from the stadium, counter-clockwise around the loop (*i.e.* direction of trail travel).
e) **Lekisch Trail** plot numbers increase from the Andrew Lekisch Memorial Garden clock-wise through the trail system (*i.e.* direction of trail travel).
f) **Jodhpur Loop** plot numbers increase from the start of the trail by the bridge crossing at Raspberry Road, clockwise around the loop (*i.e.* direction of trail travel).

N.B.: Land around the **chalet**, **bunker**, **soccer fields** and **stadium** was also surveyed for outlying infestations.

b. Exhaustive species plots

Regardless of the presence or absence of non-native species, AKNHP completed exhaustive species plots at least every 0.50 miles along each trail corridor inventoried (Fig. 3). At these plots we recorded, among other data, the percent cover for all native and non-native species found within the plot boundaries.

In areas where high-priority invasive species were found, the exhaustive species plot interval was shortened to one plot every 0.25 miles. Additional exhaustive species plots were completed at locations susceptible to invasion, such as highly disturbed sites (areas undergoing trail maintenance, construction sites, etc.), stream crossings proximal to populations of high-priority species, and sections of trail close to gardens hosting high-priority species.

Plots were oriented perpendicular to the trail to capture the transition from non-native to native vegetation and detect whether there was a decrease in invasive species cover away from the trail. In areas with no non-native species, or low-ranked (invasiveness ranking less than 60) non-native species, a total of five (5) 1 x 2 m subplots were completed. In areas hosting high-priority species, a total of ten (10) 1 x 2 m subplots were completed (see inset box, Fig. 3). When necessary, plot dimensions were modified to accommodate private property, infrastructure, and natural barriers (*e.g.* fence lines, creeks).

For each plot, locality information (latitude, longitude, elevation, and estimated accuracy) was collected using a handheld Garmin GPS unit. We also documented percent cover of dominant vegetation types as well as of classes of unvegetated soil (*e.g.* gravel, rocks, silt, leaf litter, etc.), together with topographic information of the site (slope, aspect, proximity to a floodplain, etc.). Vegetation and site attribute data were recorded on paper datasheets (see Appendix II for a blank field datasheet). The vegetation types of all exhaustive plots infested by high-priority weed species have been classified in accordance with level III of The Alaska Vegetation Classification (Viereck *et al.* 1992).

For each subplot, species composition data and percent foliar covers of all native and non-native plant species were recorded. Stem counts were read for any high-priority non-native species found within the subplot, and when pertinent, the type and age of

disturbance, the aggressiveness of the infestation, and any control actions taken were noted. In addition, the general species composition of the vegetation on the opposite side of the trail was noted.

c. Outlier plots

If a high-priority invasive species was encountered between "scheduled" exhaustive species plots the infestation was documented as an outlier plot (Fig. 3). Although outlier plots mainly targeted high-priority species, they were also read for moderately-aggressive and poorly-documented non-native species. For these plots the species identity, estimated number of stems and/or percent cover of that species within a specified section of the trail, and geographic coordinates of the site were recorded.

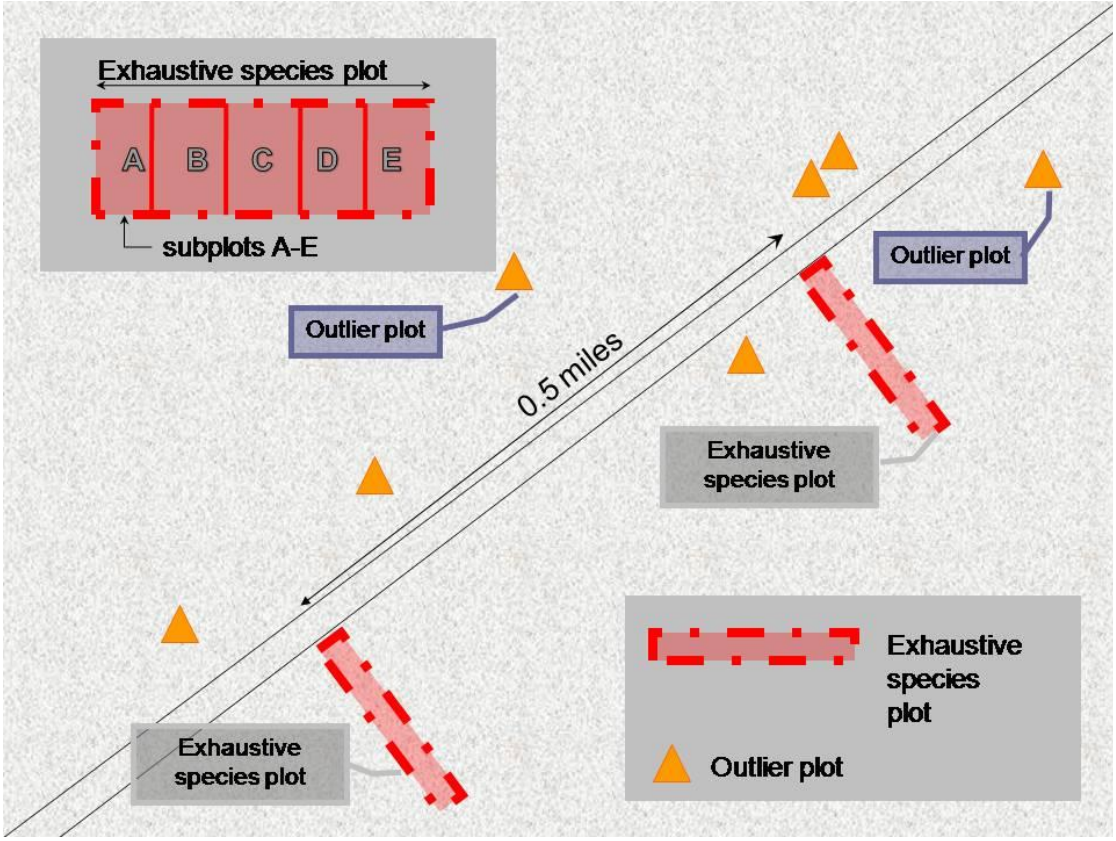

Figure 3 Schematic of exhaustive species plot and outlier species plot organization.
Inset box shows organization of plots and subplots. Exhaustive species plots were set up at regular intervals (generally 0.5 miles) along the trail, regardless of the presence or absence of a high priority species at that point. Outlier plots were read only when a high-priority species was observed and its presence was not being captured by an exhaustive species plot.

III. Post-fieldwork analyses

Two calculations related to the abundance and occurrence of non-native species within the study area are reported in this work:

1. **Percent cover** of non-native species within a given exhaustive species plot was calculated by dividing the sum of subplot cover values for the non-native species in question by the number of subplots comprising the plot. For example, if the cover of Species A was recorded at 4%, 3% and 3% in three of the five subplots comprising Plot X, then the total cover for Species A in Plot X would be: (4%+3%+3%)/5 = 2%

   Similarly, percent cover of non-native species within a given trail system or across the entire study area was calculated by dividing the sum of subplot cover values for that non-native species by the number of subplots completed for the trail or for the entire study area.

2. **Frequency of occurrence** was calculated for each non-native species by dividing the number of times the non-native species was recorded by the total number of subplots (n=496) completed in the study area. For example, if Species A was recorded 20 times within the study area, then its frequency of occurrence would be; 20/496 = 0.04.

Results and Discussion

A total of 92 exhaustive species plots were read along the Tony Knowles Coastal Trail, Chester Creek Greenbelt, Campbell Creek Greenbelt, and the Multi-Use Trail, Alex Sisson Loop, Mize Loop, Margaux's Loop, Andrew Lekisch Trail and Jodhpur Loop in Kincaid Park (Fig. 2); 492 outlier plots were read across the study area. In all, approximately 45 miles of trail were surveyed, and the cumulative area in which exhaustive species inventories were conducted sums to 992 m^2 (Table 1).

Table 1: Number of plots completed and area surveyed presented by trail.

Trail	Number of Plots	Number of Subplots	Area Surveyed (m^2)	Miles Surveyed*
Chester Creek Greenbelt	19	95	190	4.0
Campbell Creek Greenbelt	19	90	180	7.0
Tony Knowles Coastal Trail	22	128	256	10.0
Multi-use Trail	5	38	76	4.5
Sisson Trail	5	27	54	5.8
Mize Loop	5	21	42	2.8
Margaux's Loop	7	35	70	2.7
Lekisch Trail	7	44	88	4.4
Jodhpur Loop	3	18	36	3.3

* Distances are approximate

High-priority vascular species were detected at 53 out of 92 plots (*i.e*. over 50% of all exhaustive species plots contained a high-priority infestation). A total of 56 non-native taxa were identified across the study area; 14 of these species are considered high-priority species (Table 2). Please note, although *Hordeum jubatum* (foxtail barley, invasiveness rank is 63 points) is a highly invasive species, it is rejected from further consideration because it is ubiquitous in naturally and anthropogenically disturbed sites throughout the state, and because it is thought that there are native and exotic genotypes for this species in Alaska that cannot be distinguished morphologically. *Poa pratensis* (52, Kentucky, spreading or rough bluegrass), *Taraxacum officinale* ssp. *officinale* (58, common dandelion), *Poa annua* (46, annual bluegrass), and *Stellaria media* (42, chickweed) are also not treated in this report. This decision is based on one or more of the following reasons: the species' relatively low aggressiveness, it has a broad (and hence hard to control) statewide or local abundance, and/or there are native and non-native genotypes in Alaska that cannot be distinguished morphologically (see Appendix IV "Species rejected from consideration" for more information).

Table 2: Occurrence of high-priority species recorded in the study area

Scientific Name	Family	Common Name	Coastal Trail	Chester Creek	Campbell Creek	Kincaid Park
Bromus inermis ssp. *inermis*	Poaceae	smooth brome	X	X	X	X
Campanula rapunculoides†	Campanulaceae	creeping bellflower	X			
Caragana arborescens	Fabaceae	Siberian peashrub	X			X
Cirsium arvense†	Asteraceae	Canada thistle			X	X
Hieracium aurantiacum	Asteraceae	orange hawkweed	X			X
*Hordeum jubatum**	Poaceae	foxtail barley	X	X	X	X
Leucanthemum vulgare	Asteraceae	oxeye daisy	X		X	X
Linaria vulgaris	Scrophulariaceae	butter and eggs	X	X	X	X
Medicago sativa ssp. *falcata*	Fabaceae	Yellow alfalfa	X			
Melilotus alba	Fabaceae	white sweetclover	X	X	X	X
Melilotus officinalis†	Fabaceae	yellow sweetclover			X	X
Phalaris arundinacea	Poaceae	reed canarygrass	X	X	X	X
Prunus padus	Rosaceae	European bird cherry	X	X	X	
Vicia cracca	Fabaceae	bird vetch	X	X	X	X

Notes: * *Hordeum jubatum* is rejected from further consideration due to its broad distribution in Alaska, and because it is thought that there are native and non-native genotypes for this species in Alaska which cannot be distinguished morphologically.
† Species recorded as outlier populations only.

In addition, there are three low-ranked (invasiveness ranking below 60 points) non-native species (Table 3) that are considered species of concern in this report because they have been observed acting as aggressive colonizers within this study area. The taxonomic and ecological reasons for treatment of these species in this report are further discussed in Appendix IV, under "Low-ranked species of concern".

Table 3: Occurrence of low-ranked species of concern recorded in the study area

Scientific Name	Rank	Family	Common Name	Coastal Trail	Chester Creek	Campbell Creek	Kincaid Park
Galeopsis tetrahit s.l.	40	Lamiaceae	bristle-stemmed and split lip hempnettle	X	X	X	X
Crepis tectorum	54	Asteraceae	narrow-leaved hawksbeard	X	X	X	X
Hieracium umbellatum	54	Asteraceae	narrow-leaved hawkweed			X	

Note: low-ranked indicates an invasiveness ranking below 60 points (Carlson *et al.* 2008).

Fourteen non-native species detected in this study have not yet been ranked in Alaska (Table 4, see the 'Unranked species' section in Appendix IV for further discussion). Of these species: *Coronilla varia*, *Prunus virginiana*, and *Sonchus asper* appear to be or have the potential of becoming highly aggressive in Alaska and are thus treated as species of concern in this report.

Table 4: Occurrence of unranked species of concern recorded in the study area

Scientific Name	Family	Common Name	Coastal Trail	Chester Creek	Campbell Creek	Kincaid Park
Coronilla varia	Fabaceae	purple crownvetch		X		
Prunus virginiana†	Rosaceae	chokecherry			X	
Sonchus asper	Asteraceae	perennial sowthistle, prickly sowthistle, spiny sowthistle	X			

† species detected as outlier populations only.

The remaining eleven species are either not highly aggressive or need further monitoring before their invasiveness can be properly evaluated. A subset of these eleven species has been documented escaping cultivation (Table 5), but we do not fully understand their potential to disrupt ecosystem structure and processes. For this reason, we suggest that infestations for the six species listed in Table 5 be monitored so that their ability to disperse and persist in native vegetation can be quantified.

Table 5: Occurrence of unranked species recorded in the study area that merit monitoring.

Scientific Name	Family	Common Name	Coastal Trail	Chester Creek	Campbell Creek	Kincaid Park
Campanula glomerata†	Campanulaceae	Dane's blood				X
Centaurea montana†	Ranunculaceae	perennial cornflower				X
Erucastrum gallicum	Brassicaceae	dog mustard				X
Lychnis chalcedonica †	Caryophyllaceae	Maltese cross				X
Rosa rugosa	Rosaceae	rugosa rose	X		X	
Trollius sp. †	Ranunculaceae	globeflower				X

† Species detected as outlier populations only.

I. Study-wide trends

a. Non-native species most frequently recorded on MOA lands

Non-native species occupy **43%** of the total area encompassed by exhaustive species plots completed within the study area (92 plots, 496 subplots, 992 m^2). Of the 56 non-native taxa identified in this study, *Taraxacum officinale* ssp. *officinale* (common dandelion, 58)* is the most common species, representing 9%† of the total exhaustive plot area surveyed in this study (Table 6). However, we do not discuss management of this species due to its high abundance, distribution and high colonization capacity from surrounding populations. Control efforts directed at species with small population sizes will result in the greatest benefits. *Poa annua* (annual bluegrass, 46) and *Trifolium hybridum* (alsike clover, 57) occupy 6% and 5% of the total exhaustive plot survey area, respectively. However, these moderately aggressive species are not considered high priority species in this project because they are very widespread in Alaska, they appear to remain restricted to disturbed sites, and their invasiveness ranks are below 60.

The next five most prevalent species have invasiveness rankings greater than 60, and represent 4%, 3%, 2%, 2% and 1% of the total exhaustive plot survey area, respectively, they are: ***Vicia cracca*** (bird vetch, 73), ***Bromus inermis* ssp. *inermis*** (smooth brome, 62), ***Leucanthemum vulgare*** (oxeye daisy, 61), ***Linaria vulgaris*** (butter and eggs, 61) and ***Medicago sativa*** ssp. ***falcata*** (yellow alfalfa, 64).

* The information summarized in brackets refers to the species' invasiveness rank and its common name. Hereafter, whenever a species is first mentioned in the report, its common name and invasiveness rank will be provided in brackets in a similar fashion.

† In this report species' abundances and percent of total non-native plant cover are calculated using exhaustive species plot data only. Consequently, our statistics must be interpreted with caution, as the data do not necessarily reflect true relative abundances. For instance, it is most likely that *Melilotus alba* is more abundant and frequent than *Medicago sativa* ssp. *falcata*.

Although comprising only 1% of the total exhaustive plot area, ***Prunus padus*** (74, European bird cherry) is considered highly invasive in Alaska, and **poses a considerable management problem** to the MOA. While the foliar cover of *Prunus padus* is currently not high in the parks, they are widely dispersed and most individuals are seedlings and saplings. If these young individuals are not controlled, they will likely mature into large, fruit-bearing trees, causing a major shift in the plant community. In Phase II of this project AKNHP will collect more detailed information on this species' population ecology and distribution within the Anchorage Bowl, which will allow the MOA to make informed decisions on how to manage *Prunus padus* most effectively.

Last, ***Melilotus alba*** (white sweetclover, 81), ***Caragana arborescens*** (Siberian peashrub, 66), ***Hieracium aurantiacum*** (orange hawkweed, 79), ***Phalaris arundinacea*** (reed canarygrass, 83), and ***Sonchus asper*** (perennial sowthistle, 73), are all high-priority species whose individual covers currently occupy less than 1% of the total exhaustive plot survey area. *Campanula rapunculoides* (creeping bellflower, 64), *Cirsium arvense* (Canada thistle, 76), and *Melilotus officinalis* (yellow sweetclover, 69) are high-priority non-native species that were only detected a limited number of times, and only in outlier populations. Because these species were not recorded in exhaustive species plots, percent cover and frequency values are not available. Please see Appendix IV for additional information on the biology, potential ecological and economic impacts, recommended control methods, and local distribution of each non-native plant species reported here.

Table 6: Percent cover and frequency of occurrence of non-native species recorded on MOA trails. Percent cover represents the foliar cover a given non-native species occupies relative to the total area surveyed within exhaustive species plots along a particular trail. Species are listed in order of decreasing percent cover; yellow boxes indicate high-priority species. Frequency of occurrence indicates the total number of plots at which the targeted species was observed.

Scientific Name	Family	Common Name	Invasiveness Ranking	Percent Cover	Frequency of Occurrence
*Taraxacum officinale ssp. officinale**	Asteraceae	common dandelion	58	9.27	0.57
*Poa annua**	Poaceae	annual bluegrass	46	5.74	0.09
Trifolium hybridum	Fabaceae	alsike clover	57	4.80	0.23
Vicia cracca	Fabaceae	bird vetch, cow vetch	73	4.36	0.13
Bromus inermis ssp. *inermis*	Poaceae	smooth brome	62	2.81	0.08
Leucanthemum vulgare	Asteraceae	oxeye daisy	61	2.38	0.07
Linaria vulgaris	Scrophulariaceae	butter and eggs	61	1.75	0.12
Trifolium repens	Fabaceae	white clover, Dutch clover, ladino clover	59	1.34	0.07
Prunus padus	Rosaceae	European bird cherry	74	1.10	0.09
Galeopsis tetrahit s.l.	Lamiaceae	hemp-nettle	40	1.04	0.04

Scientific Name	Family	Common Name	Invasiveness Ranking	Percent Cover	Frequency of Occurrence
Medicago sativa ssp. *falcata*	Fabaceae	yellow alfalfa	64	1.03	0.02
Trifolium pratense	Fabaceae	red clover	53	0.95	0.05
Plantago major	Plantaginaceae	common plantain	44	0.89	0.12
Phleum pratense	Poaceae	common timothy	54	0.82	0.06
Elymus repens	Poaceae	quackgrass	59	0.68	0.06
Polygonum aviculare	Polygonaceae	prostrate knotweed	45	0.52	0.03
Melilotus alba	Fabaceae	white sweetclover	81	0.44	0.04
Poa pratensis ssp. *(irrigata, pratensis)**	Poaceae	Kentucky bluegrass	52	0.42	0.02
Matricaria discoidea	Asteraceae	pineapple weed	32	0.38	0.04
Phalaris arundinacea	Poaceae	reed canarygrass, reed canarygrass	83	0.36	0.01
Sorbus aucuparia	Rosaceae	European mountain ash	59	0.29	0.01
Tripleurospermum perforata	Asteraceae	scentless false mayweed	48	0.26	0.02
Lupinus polyphyllus	Fabaceae	bigleaf lupine, marsh lupine	55	0.23	0.02
Stellaria media	Caryophyllaceae	common chickweed	42	0.21	0.02
Chenopodium album	Chenopodiaceae	common lambsquarters	37	0.21	0.03
Silene dioica	Caryophyllaceae	red catchfly	42	0.20	0.01
Persicaria lapathifolia	Polygonaceae	curlytop knotweed	47	0.09	0.01
Lolium perenne ssp. *multiflorum*	Poaceae	Italian ryegrass, annual ryegrass	41	0.09	0.01
*Hordeum jubatum**	Poaceae	foxtail barley	63	0.09	0.01
Caragana arborescens	Fabaceae	Siberian peashrub	66	0.08	<0.01
Rumex acetosella	Polygonaceae	common sheep sorrel, field sorrel, red sorrel	51	0.07	0.01
Cerastium fontanum ssp. vulgare	Caryophyllaceae	common mouse-ear chickweed	36	0.05	<0.01
Coronilla varia	Fabaceae	purple crown-vetch	NR	0.05	0.01

Scientific Name	Family	Common Name	Invasiveness Ranking	Percent Cover	Frequency of Occurrence
Euphrasia nemorosa	Scrophulariaceae	common eyebright	NR	0.05	<0.01
Hieracium aurantiacum	Asteraceae	orange hawkweed	79	0.04	<0.01
Lolium perenne ssp. perenne	Poaceae	perennial rye grass	NR	0.04	<0.01
Rumex longifolius	Polygonaceae	door-yard dock	48	0.03	<0.01
Cheiranthus allionii	Brassicaceae	Siberian wallflower	NR	0.02	<0.01
Rosa rugosa	Rosaceae	rugosa rose	NR	0.02	<0.01
Crepis tectorum	Asteraceae	narrowleaved hawk's beard	54	0.01	0.01
Erucastrum gallicum	Brassicaceae	dog mustard	NR	0.01	<0.01
Hieracium umbellatum	Asteraceae	narrowleaved hawkweed	54	T	<0.01
Capsella bursa-pastoris	Brassicaceae	shepherd's purse	40	T	<0.01
Centaurea montana†	Asteraceae	perennial cornflower, mountain bluet	NR	T	<0.01
Alopecurus pratensis	Poaceae	field meadow foxtail	NR	T	<0.01
Sonchus asper	Asteraceae	perennial sowthistle, prickly sowthistle, spiny sowthistle	NR	T	<0.01
Cirsium arvense†	Asteraceae	Canada thistle	76	NA	NA
Melilotus officinalis†	Fabaceae	yellow sweetclover, king's crown	69	NA	NA
Campanula rapunculoides†	Campanulaceae	creeping bellflower	64	NA	NA
Silene latifolia†	Caryophyllaceae	white campion	42	NA	NA
Lepidium densiflorum†	Brassicaceae	common pepperweed, pepperweed	25	NA	NA
Leucanthemum x *superbum*†	Asteraceae	shasta daisy	NR	NA	NA
Lychnis chalcedonica†	Caryophyllaceae	Maltese cross	NR	NA	NA
Prunus virginiana†	Rosaceae	chokecherry	NR	NA	NA
Campanula glomerata†	Campanulaceae	Dane's Blood	NR	NA	NA
Trollius sp. †	Ranunculaceae	globeflower	NR	NA	NA

Notes: Municipal Trails include: the Campbell and Chester Creek Greenbelts, the Coastal Trail, and the Jodhpur, Sisson, Margaux's, Mize, Multi-Use, and Lekisch Trails at Kincaid Park
Highlighted cells indicate invasiveness rankings greater than 60
† Species detected only in outlier populations

* Species rejected from consideration due to their abundance, broad distribution across the state, or unresolved taxonomic issues whereby it is not possible to easily distinguish the non-native species from its native counterpart
NA = not available, cover was not consistently recorded for outlier populations
NR = not ranked
T = trace (cover less than 0.01%)

b. MOA land cover types most susceptible to invasion

Land cover types that were most frequently invaded by high priority species within the MOA lands surveyed were **open meadows** (mesic, forb and graminoid), **open broadleaf forests**, and **broadleaf woodlands** (Fig. 4). Ruderal (weedy) species often flourish in these early successional vegetation types due to low competition for light, moisture, and nutrients. In some cases a repetitive disturbance regime (such as trampling or mowing) holds a habitat in an early successional stage, which increases the habitat's susceptibility to invasion and prolongs the residence of weedy species. In general, non-native invasive species are most abundant at the transition from the trail to native vegetation. Ecotones such as these generally support higher species numbers than either of the adjacent landcover types due to an intergrading of ecological niches. The abundance of ruderal species typically decreases as one moves away from the disturbed trail corridor into native vegetation where competition for growth resources (light, moisture and nutrients) is greater.

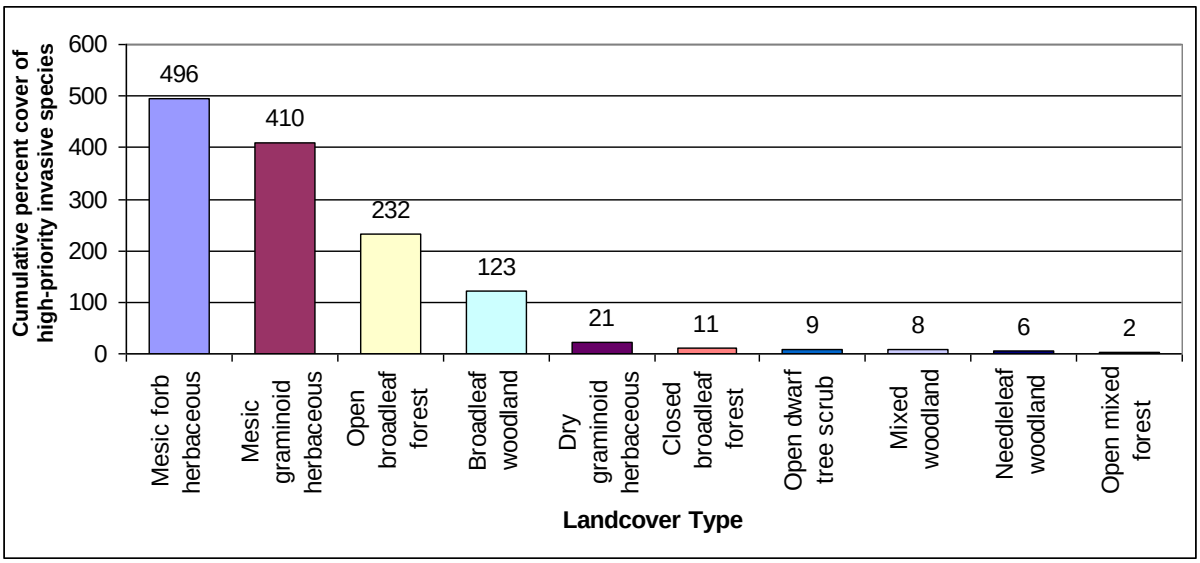

Figure 4 Cumulative percent cover of high-priority invasive species presented by landcover type.

N.B.: Low-ranked and unranked species of concern as well as non-native species rejected from consideration due to their overall broad distribution and abundance across the state or to unresolved taxonomic issues regarding their nativity are not included (see Table 6).

II. Study-wide control priorities

a. Identifying priorities for control work

In order to select which infestations should be targeted for control/eradication work, we suggest using the following decision making tree:

Question 1: Does the species have the potential to be highly aggressive, *i.e.,* to spread into areas with little to no disturbance and compete with or replace native vegetation or cause ecological harm?

- High aggressiveness is often (but not necessarily) correlated with ecological impacts and the difficulty of controlling a species (see Carlson *et al*. 2008). We gave top priority to species that are known to be aggressively invasive and are extremely hard to extirpate once established, such as orange hawkweed (*Hieracium aurantiacum*).
- This category would include species with invasiveness ranks greater than or equal to 60 points, species with ranks lower than 60 points that appear to be spreading rapidly in Alaska, and especially if they are doing so in natural areas in the Anchorage Bowl, and unranked species whose biology and/or invasion history in Canada or the Lower 48 suggest they could become problematic in Alaska.

  If yes:
  Question 2: Is the infestation small, and/or is the invasive species comprising the infestation one with few populations in the study area?

    If yes:
    Question 3: Is the infestation located at a site from which it could quickly disperse to currently weed-free trail systems or trails that only have low-aggressive species?

      If yes:
      Question 4: Are there highly disturbed areas (or are there likely to be) in/near the infestation that would be especially susceptible to invasion?

Using these criteria, one can start to prioritize the management of invasive plant populations. Infestations for which all answers are affirmative should be controlled first, while those for which all or most answers are negative could be prioritized last.

b. Priority areas and species for control work

We recognize that focusing control efforts initially on high priority areas and on particular non-native species will improve overall invasive plant management goals. To this end, we have identified a number of invasive species 'hotspots'. These **'hotspots'** are selected either because they have a **high diversity and richness** of aggressively invasive species, or because the infested site (with **one or more aggressively**

invasive species) is located in an **overall low-disturbance**, weed-free area. The following are invasive species hotspots that we suggest could be prioritized for immediate control work.

1 Coastal Trail:
   a. Trailside and ditch that run parallel to the railroad between Elderberry Park and Westchester Lagoon
   b. Westchester Lagoon
   c. Earthquake park and vicinity
   d. Point Woronzoff
   e. Land around the soil storage area near the airport

2 Kincaid Park
   a. Kincaid chalet and vicinity
   b. trail sections proximal to horticultural/memorial gardens
   c. Arlene's Loop: Arlene's Overlook and the *Hieracium aurantiacum* (orange hawkweed) infestation en route to the Sisson Loop (see Figure 33 for the outlier plot at which this species was found).
   d. gravel/materials site of the lower Sisson Loop (see Summary of key findings for the Sisson Loop)
   e. Multi-use trail (especially sections infested with *Phalaris arundinacea* and *Melilotus alba*)
   f. Lekisch Trail: this loop is one of the least used in the park, yet on it we detected aggressive invaders like *Prunus padus*, *Melilotus alba*, *Bromus inermis* ssp. *inermis* and *Leucanthemum vulgare*, as well as *Campanula glomerata* and *Centaurea montana*

3 Chester Creek Trail
   a. Valley of the Moon Park
   b. Trail section by Tikishla Park (*Phalaris arundinacea*)
   c. Trail sections around the Davenport Field Complex (Lake Otis and 24th) and around the baseball fields by the Sullivan Arena (*Phalaris arundinacea, Vicia cracca*)
   d. Trail sections that intersect streets and major roadways, specifically: the intersections with the Minnesota Bypass (*Coronilla varia*), Bunker Street (*Medicago sativa* ssp. *falcata*), Seward Highway (*Vicia cracca*), Northern Lights Boulevard, and the trail section between "C" and "A" Streets (*Phalaris arundinacea*)

4 Campbell Creek Trail
   a. Waldron Lake
   b. trail sections that overpass or underpass major roadways, including the intersections with Minnesota Boulevard, Arctic Boulevard, "C" Street, the Old and New Seward Highways, and Lake Otis Boulevard

High-priority species that should be targeted for eradication are those with high invasiveness rankings that are currently restricted in distribution and/or were generally found forming discrete populations. Such high-priority, narrowly-distributed species include:

- *Phalaris arundinacea* (83)
- *Melilotus alba* (81)
- *Hieracium aurantiacum* (79)
- *Cirsium arvense* (76)
- *Prunus padus* (74)[*]
- *Melilotus officinalis* (69)
- *Caragana arborescens* (66)
- *Campanula rapunculoides* (64)
- *Medicago sativa* spp. *falcata* (64)

The **low- and unranked species** with infrequent occurrences that should also be **prioritized for eradication** are:

- *Galeopsis tetrahit* s.l.[†] (40, low-ranked)
- *Coronilla varia* (NR)
- *Sonchus asper* (NR)
- *Hieracium umbellatum* (54, low-ranked)
- *Prunus virginiana* (NR)

Listed in decreasing order of abundance, the following **high-priority species** are too abundant and widespread along Municipality trails for their eradication to be feasible. Instead, efforts focused on **containment**[‡].

- *Vicia cracca* (73)
- *Bromus inermis* ssp. *inermis* (62)
- *Leucanthemum vulgare* (61)
- *Linaria vulgaris* (61)
- *Crepis tectorum* (54, low-ranked)

Due to their widespread distribution, eradication of these species will be time consuming and expensive. If time and money becomes available to tackle these problematic species, it would be most effective to start control work on the small, isolated populations at the periphery of these species' distributions along a given trail or area.

[*] Specific recommendations for the control of this species will be made in Phase II of this report.

[†] s.l.: sensu lato. Latin expression used by taxonomists when referring to a particular taxonomic unit (species, genus, etc.) in its wider circumscription.

[‡] These recommendations may change and have to be reassessed on a trail by trail basis. For e.g. while eradication of *Vicia cracca* may still be possible on the Multi-use trail in Kincaid, it is probably an unrealistic goal for Campbell Creek trail.

Non-native low- and unranked species that do not appear to pose as great a threat to native vegetation and Municipal Park lands as the species listed above include:

- *Alopecurus pratensis* (NR)
- *Campanula glomerata* (NR)
- *Centaurea montana* (NR)
- *Cheiranthus allionii* (NR)
- *Erucastrum gallicum* (NR)
- *Euphrasia nemorosa* (NR)
- *Leucanthemum* x *superbum* (NR)
- *Lolium perenne* ssp. *multiflorum* (41, low-ranked)
- *Lolium perenne* ssp. *perenne* (NR)
- *Lychnis chalcedonica* (NR)
- *Persicaria lapathifolia* (47, low-ranked)
- *Rosa rugosa* (NR)
- *Trollius* sp. (NR)

These species are either new to the area, uncommon or only recently recognized as potentially highly invasive and should therefore be monitored so that their ability to persist and/or displace native vegetation can be properly assessed.

III. Campbell Creek Greenbelt

a. Summary of key findings

Non-native species occupy **31%** of the total area encompassed by exhaustive species plots completed along the Campbell Creek Greenbelt (19 plots, 95 subplots, 190 m^2). Problem species detected in exhaustive species plots along the Campbell Creek Greenbelt (listed in order of decreasing abundance) are: ***Vicia cracca*** (73), ***Prunus padus*** (74), ***Bromus inermis* ssp. *inermis*** (62), ***Linaria vulgaris*** (61), ***Melilotus alba*** (81), ***Phalaris arundinacea*** (83), and ***Leucanthemum vulgare*** (61). See Table 7 for percent covers of each species.

High-priority, low-priority, and unranked species of concern detected along the Campbell Creek Greenbelt as outlier populations only are: ***Cirsium arvense*** (76), ***Melilotus officinalis*** (69), ***Centaurea montana*** (unranked species of concern), ***Crepis tectorum*** (54, low-ranked), and ***Prunus virginiana*** (unranked species of concern).

Vicia cracca, *Prunus padus, Bromus inermis* ssp. *inermis, and Linaria vulgaris* are abundant and widespread along the Campbell Creek Greenbelt. Due to their distributions, we do not feel that eradication of these species is an efficient use of resources, but **targeted containment work is strongly advised**. In particular, we suggest the following:

1. Re-locate and control small populations of ***Vicia cracca*** (1-50 stems)
2. Re-locate larger (>50 stems) and small but semi-continuous populations of ***Vicia cracca*** and ***Bromus inermis* ssp. *inermis***, prioritize the infestations based on their proximity to areas that are not heavily infested and the risk of them dispersing into these more weed-free zones, and conduct monitoring and containment work.

In general, eradication efforts should focus on highly invasive species that form small and discrete populations. **Control priorities**[*], listed in decreasing order of importance, for the Campbell Creek Greenbelt are:

1. Control ***Melilotus alba*** infestations where trail intersects creeks and water bodies, specifically: Campbell Creek Plots 1, 12 (including surrounding area) and 14 outlying plots (see Appendix IV for locations or database for coordinates).
2. Control trace amount of ***Phalaris arundinacea*** at Campbell Creek Plot 17
3. Controls trace ***Hieracium umbellatum*** at Campbell Creek Plot 2 at the intersection of the trail with Northwood Dr.
4. Control single outlying population of ***Crepis tectorum*** detected behind the MOA Tudor Rd. complex (N 61.17652989°, W -149.81566°)

[*] Coordinates are given for locations without obvious landmarks

5. Control ***Cirsium arvense*** at the junction of the Campbell Creek Trail with the northern terminus of Cache Dr. south of Waldron Lake area (N 61.17736255°, W -149.85189°).
6. Control ***Melilotus officinalis*** detected west of the Minnesota Drive underpass at a small wetland park (N 61.14319657°, W -149.90934°)
7. Control ***Leucanthemum vulgare*** at Campbell Creek Plots 2 and 12, as well as at seven outlying locations (see Appendix IV for locations or database for coordinates).
8. Control ***Galeopsis tetrahit*** s.l. populations at Campbell Creek Plot 6, two outlying populations at the southwest end of Taku Lake (N 61.14932173°, W-149.88485°), and one infestation where E 64th Ave meets the trail (N 61.16279505°, W -149.8768°).

Monitor the distribution of the following unranked species to determine their potential to spread along the trail corridor and invade native vegetation:

1. ***Prunus virginiana****,* detected at eight outlying locations in 2008
2. ***Rosa rugosa***, which as of 2008 was present at 14 locations along the Campbell Trail (Plot 15, and at 13 outlying locations)
3. ***Centaurea montana***: a single population was detected near the blue bridge east of the trail's intersection with Lake Otis Boulevard (N 61.17802019°, W -149.82768°)

Finally, specific control measures for the many populations of ***Prunus padus*** occurring along Campbell Creek will be recommended in Phase II of this report.

Please refer to Appendix IV for species biographies, recommended control methods and distribution maps. Plots where high-priority, non-native species were detected are discussed in detail below.

Table 7: Percent cover of non-native species recorded along the Campbell Creek Greenbelt.
Percent cover represents the foliar cover a given non-native species occupies relative to the total area surveyed by exhaustive species plots along this trail. Species are listed in order of decreasing percent cover; yellow boxes indicate high-priority species.

Scientific Name	Family	Common Name	Invasiveness Ranking	Percent Cover
Vicia cracca	Fabaceae	bird vetch, cow vetch	73	6.82
Taraxacum officinale ssp. *officinale**	Asteraceae	common dandelion	58	4.27
Prunus padus	Rosaceae	European bird cherry	74	3.71
Trifolium hybridum	Fabaceae	alsike clover	57	3.39
Bromus inermis ssp. *inermis*	Poaceae	smooth brome	62	2.49
Phleum pratense	Poaceae	common timothy	54	2.19
Trifolium repens	Fabaceae	Dutch clover, ladino clover, white clover	59	2.02

Scientific Name	Family	Common Name	Invasiveness Ranking	Percent Cover
Poa annua	Poaceae	annual bluegrass, walkgrass	46	2.00
Plantago major	Plantaginaceae	common plantain	44	1.72
Galeopsis tetrahit s.l.	Lamiaceae	hemp-nettle	40	0.42
Linaria vulgaris	Scrophulariaceae	butter and eggs	61	0.42
Melilotus alba	Fabaceae	white sweetclover	81	0.42
Trifolium pratense	Fabaceae	red clover	53	0.23
Elymus repens	Poaceae	quackgrass	59	0.22
Rumex longifolius	Polygonaceae	dooryard dock	48	0.18
Matricaria discoidea	Asteraceae	pineapple weed	32	0.13
Rosa rugosa	Rosaceae	rugosa rose	NR	0.11
Poa pratensis ssp. *irrigata**	Poaceae	spreading bluegrass	52	0.06
Poa cf. *pratensis**	Poaceae	Kentucky bluegrass	52	0.05
Tripleurospermum perforata	Asteraceae	scentless false mayweed	48	0.05
Phalaris arundinacea	Poaceae	reed canarygrass	83	0.03
Poa pratensis ssp. *pratensis**	Poaceae	Kentucky bluegrass	52	0.02
Leucanthemum vulgare	Asteraceae	oxeye daisy	61	0.01
*Stellaria media**	Caryophyllaceae	common chickweed, nodding chickweed	42	0.01
Alopecurus pratensis	Poaceae	field meadow foxtail	NR	T
Chenopodium album	Chenopodiaceae	common lambsquarters, white goosefoot	37	T
Hieracium umbellatum	Asteraceae	hawkweed	54	T
Centaurea montana†	Asteraceae	perennial cornflower, mountain bluet	NR	NA
Cirsium arvense†	Asteraceae	Canada thistle	76	NA
Crepis tectorum†	Asteraceae	narrowleaved hawk's beard	54	NA
*Hordeum jubatum**†	Poaceae	foxtail barley	63	NA
Melilotus officinalis†	Fabaceae	yellow sweetclover, king's crown	69	NA
Prunus virginiana†	Rosaceae	chokecherry	NR	NA

Notes:
* Species rejected from consideration due to abundance, broad distribution, or unresolved taxonomic questions regarding their nativity
† Species detected in outlier plots only
NA = not available, cover was not consistently recorded for outlier populations (sometimes only stem counts were done)
NR = not ranked
T = trace (cover less than 0.01%)

b. Exhaustive species plot results

Campbell Creek Plot 1

- Dominant vegetation class: Mesic forb herbaceous
- Geographic coordinates: N 61.137709°, W -149.925475°
- Located at a small park between Arlene St. and Northwood Dr.
- Total non-native species cover: **70%**
- Noteworthy observations: ***Vicia cracca*** accounts for **32%** of the total area surveyed in Plot 1 and ***Melilotus alba*** comprises an additional **8%**. Although not a highly aggressive non-native species, unranked *Alopecurus pratensis* was detected in this plot at trace amounts.

Figure 5 Campbell Creek Plot 1

An infestation of *Vicia cracca* and *Melilotus alba*.

Campbell Creek Plot 2

- Dominant vegetation class: Dry graminoid herbaceous
- Geographic coordinates: N 61.138361°, W -149.922039°
- Located at the trail's intersection with Northwood Drive
- Total non-native species cover: **21%**
- Noteworthy observations: ***Leucanthemum vulgare*** was the only high-priority species detected at this plot where it is present in trace amounts only. Trace amounts of the low-ranked forb ***Hieracium umbellatum*** (54) were also detected at this plot.

Campbell Creek Plots 3 and **4** are not detailed in this section as high-priority species were not detected at either site.

Campbell Creek Plot 5

- Dominant vegetation class: Open dwarf tree scrub
- Geographic coordinates: N 61.144162°, W -149.898572°
- Located between Minnesota and Arctic Boulevards, near the southern end of Rovenna St.
- Total non-native species cover: **22%**
- Noteworthy observations: ***Prunus padus*** seedlings and saplings occupy **9%** of this plot. No other high-priority species were detected. The *Prunus padus* infestation appears to be a **mid-seral stand**; 49 percent of the *Prunus padus* individuals are woody with a diameter of less than 1 inch, 43% are woody with a diameter greater than 1 inch and over 3.3 feet tall, and 9% are non-woody seedlings.

Figure 6 Campbell Creek Plot 5

Prunus padus seedlings

Campbell Creek Plot 6

- Dominant vegetation class: Mesic forb herbaceous
- Geographic coordinates: N 61.147117°, W -149.890902°
- Located between Arctic Boulevard and C Street
- Total non-native species cover: **11%**
- Noteworthy observations: No high-priority species are present in Plot 6. However, low-ranked ***Galeopsis tetrahit*** s.l. covered **8%** of the plot.

Campbell Creek Plots 6-9 are not detailed in this section as high-priority species were not detected at these locations.

Campbell Creek Plot 10

- Dominant vegetation class: Mesic forb herbaceous
- Geographic coordinates: N 61.165670°, W -149.873978°
- Located south of the trail's intersection with Dowling Road
- Total non-native species cover: **66%**
- Noteworthy observations: ***Vicia cracca*** is the only high-priority species present; it comprises **48%** of Plot 10 and was observed overgrowing the non-native grass *Phleum pratense* and climbing a native *Salix* shrub just outside of the plot.

Figure 7 Campbell Creek Plot 10
Vicia cracca infestation

Campbell Creek Plot 11

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.169580°, W -149.871622°
- Located between International Airport Road and Dowling Road, near the west end of 57th Place
- Total non-native species cover: **61%**
- Noteworthy observations: High-priority species at this plot are ***Bromus inermis* ssp. *inermis***, comprising **46%** of Plot 11, and ***Vicia cracca***, which comprises **11%** and extends from this location along the trail past the nearby parking area.

Figure 8 Campbell Creek Plot 11
Vicia cracca infestation

Campbell Creek Plot 12

- Dominant vegetation class: Dry graminoid-forb herbaceous
- Geographic coordinates: N 61.173900°, W -149.863969°
- Located at the trail's intersection with International Airport Road
- Total non-native species cover: **41%**
- Noteworthy observations: High-priority species present are ***Vicia cracca*** (**20%**), **1%** ***Bromus inermis* ssp. *inermis***, and traces of ***Melilotus alba*** and ***Leucanthemum vulgare***. *Melilotus alba* was also observed outside of the plot on the hillside near 54th Ave.

Figure 9 Campbell Creek Plot 12
Showing *Vicia cracca* in bloom

Campbell Creek Plot 13

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.174112°, W -149.859423°
- Located south of the undeveloped crossing under the New Seward Highway bridge
- Total non-native species cover: **24%**
- Noteworthy observations: ***Vicia cracca*** (**11%** cover) was observed overgrowing the native grass *Calamagrostis canadensis* and a *Populus balsamifera* ssp. *balsamifera* sapling. The only other high-priority species detected was ***Linaria vulgaris*** which covers an additional **5%** of the plot.

Campbell Creek Plot 14

- Dominant vegetation class: Open broadleaf forest
- Geographic coordinates: N 61.175832°, W -149.855224°
- Located near the south end of Pavalof Street (in the Waldron Lake area)
- Total non-native species cover: **69%**
- Noteworthy observations: This plot is **highly infested** by a **mature stand** of ***Prunus padus*** which comprises **62%** of Plot 14; outside of the plot this mature *Prunus padus* stand extends almost to Campbell Creek. Of the total *Prunus padus* cover, 53% are mature trees, 41% are trees with diameter ranging from 3 to 5 inches, 6% are non-woody seedlings, and a trace amount are woody seedlings. ***Linaria vulgaris*** is also present at 1% cover.

Figure 10 Campbell Creek Plot 14
Showing mature *Prunus padus* trees

Campbell Creek Plot 15

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.177575°, W -149.842708°
- Located near the parking area at the west end of East 47th Place (off of Lake Otis Boulevard)
- Total non-native species cover: **9%**
- Noteworthy observations: Trace amounts of ***Vicia cracca*** and ***Prunus padus*** woody and non-woody seedlings were detected at this plot.

Campbell Creek Plot 16 is not detailed in this section as high-priority species were not detected at this location.

Campbell Creek Plot 17

- Dominant vegetation class: Needleleaf woodland
- Geographic coordinates: N 61.178020°, W -149.827677°
- Located near the blue bridge east of the trail's intersection with Lake Otis Boulevard
- Total non-native species cover: **14%**
- Noteworthy observations: ***Vicia cracca*** comprises **4%** of Plot 17, ***Linaria vulgaris*** and unranked ***Rosa rugosa*** are each present at **2%** and ***Phalaris arundinacea*** is present at **1%**.

Figure 11 Campbell Creek Plot 17
Showing a tussock of *Phalaris arundinacea* in foreground

Campbell Creek Plot 18 is not detailed in this section as high-priority species were not detected at this location.

Campbell Creek Plot 19

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.175292°, W -149.807857°
- Located at the trail's intersection with the newly constructed Elmore Road
- Total non-native species cover: **11%**
- Noteworthy observations: ***Vicia cracca*** is the only high-priority species present at this plot where it occupies **3%** of the plot.

IV. Chester Creek Greenbelt

a. Summary of key findings

Chester Creek Greenbelt was acquired by the MOA from the 1970s through 1981 as multiple parcels (Klein 1999). Non-native species occupy **34%** of the total area encompassed by exhaustive species plots completed along the Chester Creek Greenbelt (19 plots, 90 subplots, 180 m^2). Problem species detected in exhaustive species plots along the Chester Creek Greenbelt are (listed in order of decreasing abundance): ***Vicia cracca*** (73), ***Linaria vulgaris*** (61), ***Phalaris arundinacea*** (83), ***Prunus padus*** (74), ***Bromus inermis* ssp. *inermis*** (62), ***Coronilla varia*** (unranked species of concern), ***Melilotus alba*** (81) and ***Galeopsis tetrahit*** s.l. (40, low-ranked, see Table 8 for percent covers). ***Medicago sativa* ssp. *falcata*** (64) and ***Crepis tectorum*** (54, low- ranked) were detected as **outlier** populations only.

Based on the total percent cover calculations derived from the exhaustive species plots data[*] (Table 8), the following patterns are observed:

1. ***Vicia cracca*** appears to be the **most abundant** invasive species along **both greenbelts**.
2. ***Linaria vulgaris*** and ***Phalaris arundinacea*** are **more abundant** along the **Chester** Creek trail than along the Campbell Creek one.
3. ***Bromus inermis* ssp. *inermis*, *Melilotus alba***, and ***Phalaris arundinacea*** appear to be more abundant **towards the coast and in open habitats**, whereas ***Prunus padus*** and ***Vicia cracca*** are more abundant **upstream and in forested habitats**.

Due to the widespread distribution of *Linaria vulgaris* along the Chester Creek Greenbelt we consider that prioritizing this species for control is not the most efficient use of resources at this time. **Control priorities** listed in decreasing order of importance[†] for the Chester Creek Greenbelt are:

1. **Control discrete populations of *Phalaris arundinacea*** present around the bridge that crosses from Chester Creek Trail to W. 19th St., along the section of trail running adjacent to the sports fields behind the Sullivan Arena, and along the feeder path connecting Chester Creek trail to Tikishla Park (these populations were observed during a recreational bike ride in summer 2009 and are not associated with an exhaustive or outlier plot location). Controlling these small clumps of *Phalaris arundinacea* now, while they are still small and discrete, will be much more efficient than if they are controlled in a few years' time, by which time they will likely have formed much less manageable populations. *Phalaris arundinacea* forms larger

[*] Please note that our total percent cover calculations must be interpreted with caution. For instance, they suggest that *Prunus padus* is more abundant along the Campbell Creek Greenbelt than on the Chester Creek Greenbelt, when this is not the case given that *Prunus padus* often creates dense, single species stands along Chester Creek, while it primarily grows interspersed with other native shrubs and trees on Campbell Creek trail.

[†] Coordinates are given for locations without obvious landmarks.

infestations in the Westchester Lagoon area (Plot 2 and at two outlier plots [N 61.20623326°, W -149.91439° and N 61.20421221°, W -149.91054°]). These larger populations will require a long-term, dedicated control effort and should be addressed only if time and funding allow.

2. Control ***Melilotus alba*** populations at Plot 7 on the west side of the Seward Highway underpass and an outlier plot in the same location (N 61.20169303°, W -149.86854°).
3. Control trace amounts of ***Galeopsis tetrahit*** s.l. at Plot 12, and at two outlying populations located east of the Seward Highway underpass (N 61.20124318°, W -149.85889° and N 61.20071813°, W -149.85776°). Revisit Plot 1 in the Westchester Lagoon area to confirm that no new plants have germinated after the five individuals found in 2008 were pulled.
4. Control ***Coronilla varia*** populations along the ditch that runs parallel to Hillcrest Drive overlooking Westchester Lagoon, on the bank between the trail and the Minnesota Boulevard Bypass (west of the brown wooden staircase), and at the east end of the ballpark directly east of Lake Otis Boulevard, where the trail reenters the forest.
5. Control ***Medicago sativa* ssp. *falcata*** growing next to the brown wooden staircase that connects the Chester Creek trail to West 16th Avenue at the top of the Minnesota bypass.
6. A single population of ***Crepis tectorum*** was detected at the north end of the Northern Lights overpass (N 61.19872475°, W -149.82202°); this population should be eradicated.
7. Control ***Bromus inermis* ssp. *inermis*** populations at three plots (Plots 1, 2 and 8; all in the Westchester Lagoon vicinity) and five outlying locations (three in the Westchester Lagoon area and two near Tikishla Park, see Appendix IV for locations or database for coordinates).

Finally, specific control measures for *Prunus padus* along both the Chester and Campbell Creek greenbelts will be recommended in Phase II of this report.

Please refer to Appendix IV for detailed species biographies, control methods and distribution maps. Plots where high-priority, non-native species were detected are discussed in detail below.

Table 8: Percent cover of non-native species recorded along the Chester Creek Greenbelt.
Percent cover represents the foliar cover a given non-native species occupies relative to the total area surveyed by exhaustive species plots along this trail. Species are listed in order of decreasing percent cover; yellow boxes indicate high-priority species.

Scientific Name	Family	Common Name	Invasiveness Ranking	Percent Cover
Vicia cracca	Fabaceae	bird vetch, cow vetch	73	8.56
Taraxacum officinale ssp. *officinale**	Asteraceae	common dandelion	58	7.60
Poa annua	Poaceae	annual bluegrass, walkgrass	46	2.63

Scientific Name	Family	Common Name	Invasiveness Ranking	Percent Cover
Elymus repens	Poaceae	quackgrass	59	2.37
Linaria vulgaris	Scrophulariaceae	butter and eggs	61	2.27
Phalaris arundinacea	Poaceae	reed canarygrass	83	1.98
Trifolium hybridum	Fabaceae	alsike clover	57	1.92
Prunus padus	Rosaceae	European bird cherry	74	1.78
Phleum pratense	Poaceae	common timothy	54	1.14
Bromus inermis ssp. *inermis*	Poaceae	smooth brome	62	0.72
Sorbus aucuparia	Rosaceae	European mountain ash	59	0.67
Plantago major	Plantaginaceae	common plantain	44	0.57
Matricaria discoidea	Asteraceae	pineapple weed	32	0.47
Trifolium repens	Fabaceae	Dutch clover, ladino clover, white clover	59	0.33
Coronilla varia	Fabaceae	purple crown-vetch	NR	0.28
Trifolium pratense	Fabaceae	red clover	53	0.10
Melilotus alba	Fabaceae	white sweetclover	81	0.07
Galeopsis tetrahit s.l.	Lamiaceae	hemp-nettle	40	0.06
*Hordeum jubatum**	Poaceae	foxtail barley	63	0.01
Poa pratensis ssp. *pratensis**	Poaceae	Kentucky bluegrass	52	T
*Stellaria media**	Caryophyllaceae	common chickweed, nodding chickweed	42	T
Medicago sativa ssp. *falcata*†	Fabaceae	yellow alfalfa	64	NA
Crepis tectorum†	Asteraceae	narrowleaved hawk's beard	54	NA
Lepidium densiflorum†	Brassicaceae	common pepperweed, pepperweed	25	NA

Notes:
* Species rejected from consideration due to abundance, broad distribution, or unresolved taxonomic questions regarding their nativity
† Species detected in outlier plots only
NA = not available, cover was not consistently recorded for outlier populations (sometimes only stem counts were done)
NR = not ranked
T = trace (cover less than 0.01%)

b. Exhaustive species plot results

Chester Creek Plot 1

- Dominant vegetation class: Mesic forb herbaceous
- Geographic coordinates: N 61.208628°, W -149.922250°
- Located at Westchester Lagoon
- Total non-native species cover: **43%**
- Noteworthy observations: Plot 1 is a horticultural plot (Ironworkers Memorial) containing the high-priority species ***Bromus inermis* ssp. *inermis*** (**1%** cover) and trace ***Linaria vulgaris***. Five individuals (**1%** cover) of low-ranked ***Galeopsis tetrahit*** s.l. were pulled from this plot during the 2008 field season.

Figure 12 Chester Creek Plot 1
Showing plot location

Chester Creek Plot 2

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.206233°, W -149.914391°
- Located at Westchester Lagoon
- Total non-native species cover: **54%**
- Noteworthy observations: ***Phalaris arundinacea*** (**34%** cover) and ***Bromus inermis* ssp. *inermis*** (**10%**) are the only high-priority species present in Plot 2. This plot is adjacent to Westchester Lagoon, thus the presence of *Phalaris arundinacea*, which can form dense stands in wetlands, is concerning. ***Vicia cracca*** plants were pulled on the trailside opposite this plot.

Figure 13 Chester Creek Plot 2
This plot is infested with a dense stand of *Phalaris arundinacea*.

Chester Creek Plot 3

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.205394°, W -149.904877°
- Located at the south end of the tunnel under the Minnesota Boulevard Bypass
- Total non-native species cover: **38%**
- Noteworthy observations: ***Linaria vulgaris*** (covering **1%** of the plot area) is the only high-priority species present. Unranked ***Coronilla varia*** contributes an additional **5%** cover. The abundance of *Coronilla varia* increases from this plot towards the Minnesota Boulevard Bypass

Figure 14 Chester Creek Plot 3
Showing plot location

Chester Creek Plot 4

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.204394°, W -149.895813°
- Located in the Valley of the Moon Park
- Total non-native species cover: **67%**
- Noteworthy observations: ***Prunus padus*** woody seedlings less than 1 inch tall are present in trace amounts at this plot. No other high-priority species were detected.

Figure 15 Chester Creek Plot 4
Showing location

Chester Creek Plot 5

- Dominant vegetation class: Broadleaf woodland
- Geographic coordinates: N 61.203476°, W -149.886405°
- Located between C and A Streets
- Total non-native species cover: **39%**
- Noteworthy observations: The high-priority species present at this plot are: ***Vicia cracca*** (**42%**), ***Linaria vulgaris*** (**1%**), and trace cover of non-woody ***Prunus padus*** seedlings.

Chester Creek Plot 6 is not detailed in this section as high-priority species were not detected at this location.

Chester Creek Plot 7

- Dominant vegetation class: Open broadleaf forest
- Geographic coordinates: N 61.201693°, W -149.868538°
- Located at the Seward Highway underpass
- Total non-native species cover: **10%**
- Noteworthy observations: ***Linaria vulgaris*** and ***Melilotus alba*** covered **2%** and **3%** of the total plot area, respectively.

Chester Creek Plot 8

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.206076°, W -149.913963°
- Located at Westchester Lagoon (re-did a plot here to capture the invasive species hotspot that the band of largely non-native plants forms around the lagoon)
- Total non-native species cover: **73%**
- Noteworthy observations: ***Vicia cracca*** comprises **33%** of the total plot area. The invasive grasses ***Phalaris arundinacea*** and ***Bromus inermis* ssp. *inermis*** are present at **25%** and **10%**, respectively. The presence of *Phalaris arundinacea* at the Westchester Lagoon edge is concerning as this species can form dense stands in wetlands.

Figure 17 Chester Creek Plot 8
Showing non-native grass infestations

Figure 16 Chester Creek Plot 7
Infestation of *Linaria vulgaris* and *Melilotus alba*

Chester Creek Plot 9

- Dominant vegetation class: Broadleaf woodland
- Geographic coordinates: N 61.205875°, W -149.913280°
- Located at Westchester Lagoon, inland from the Lanie Fleischer Chester Creek Trail sign
- Total non-native species cover: **67%**
- Noteworthy observations: ***Vicia cracca*** has a **55%** canopy cover value at this plot, and was growing up the trunks of native *Populus balsamifera* ssp. *balsamifera*. ***Linaria vulgaris*** is present at **2%**.

Figure 18 Chester Creek Plot 9
Showing location and *Vicia cracca* overgrowing native vegetation.

Chester Creek Plot 10

- Dominant vegetation class: Open broadleaf forest
- Geographic coordinates: due to GPS inaccuracies, coordinates are not available for this plot. Based on aerial photography, we estimate the plot location to be: N 61.205827°, W -149.910804°
- Located at Westchester Lagoon, in the forested section backing West 16th Avenue
- Total non-native species cover: **55%**
- Noteworthy observations: ***Linaria vulgaris*** is the only high-priority species present and accounts for **35%** of plot area.

Chester Creek Plot 11

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.200971°, W -149.861216°
- Located east of Woodside Park
- Total non-native species cover: **56%**
- Noteworthy observations: ***Vicia cracca*** is the only high-priority species present. It comprises **19%** of the plot and was observed overgrowing stands of the moderately-invasive grass *Phleum pratense*.

Chester Creek Plot 12

- Dominant vegetation class: Open low shrub
- Geographic coordinates: N 61.20124318°, W -149.8588863°
- Located east of Woodside Park
- Total non-native species cover: **2%**
- Noteworthy observations: Trace amounts of ***Galeopsis tetrahit*** s.l. are present at this plot.

Figure 19 Chester Creek Plot 12
Showing location

Chester Creek Plot 13

- Dominant vegetation class: Broadleaf woodland
- Geographic coordinates: N 61.200718°, W -149.857765°
- Located east of Woodside Park
- Total non-native species cover: **21%**
- Noteworthy observations: ***Prunus padus*** is the only high-priority species present at this site. The mid-seral bird cherry tree stand comprises nearly all of the non-native cover (**21%**). *Taraxacum officinale* ssp. *officinale* contributes a trace amount of cover. Of the total *Prunus padus* cover 3% are non-woody seedlings, 34% are woody seedlings less than 3.3 feet tall, and 63% are woody seedlings greater than 3.3 feet tall. The abundance of *Prunus padus* seedlings and saplings increases towards the creek.

Figure 20 Chester Creek Plot 13
Infestation of the highly-invasive tree species, *Prunus padus*

Chester Creek Plot 14 is not detailed in this section as high-priority species were not detected at this location.

Chester Creek Plot 15

- Dominant vegetation class: Broadleaf woodland
- Geographic coordinates: N 61.201137°, W -149.848226°
- Located west of the Maplewood Street trailhead
- Total non-native species cover: **11%**

- Noteworthy observations: ***Prunus padus*** is the only high-priority species present and comprises nearly all (**11%**) of the non-native cover (*Taraxacum officinale* ssp. *officinale* contributes a trace amount of cover). Within this mixed-age stand, 9 of *Prunus padus* are non-woody seedlings, 18% are woody seedlings (less than 3.3 feet tall), 27% are saplings (1-3 inches diameter), 18% are suckerings; and 27% are mature trees. A stand of *Prunus padus* saplings (1-3 inches diameter) was observed outside of the plot, approximately 20 feet from the trail.

Chester Creek Plot 16

- Dominant vegetation class: Mesic forb herbaceous
- Geographic coordinates: N 61.200941°, W -149.845594°
- Located near the Maplewood Street trailhead
- Total non-native species cover: **50%**
- Noteworthy observations: ***Vicia cracca*** is the only high-priority species present in this plot where it accounts for **33%** of the plot. *Vicia cracca* was observed overgrowing the native forb *Heracleum maximum*.

Chester Creek Plot 17

- Dominant vegetation class: Broadleaf woodland
- Geographic coordinates: N 61.200524°, W -149.839949°
- Located near the small pond west of Lake Otis Boulevard
- Total non-native species cover: **trace** percent
- Noteworthy observations: Approximately 40 non-woody ***Prunus padus*** seedlings were found within this plot; however, several larger trees are in the vicinity. In trace amounts, *Taraxacum officinale* ssp. *officinale* was the only other non-native species detected at this location.

Chester Creek Plot 18

- Dominant vegetation class: Open mixed forest
- Geographic coordinates: N 61.199693°, W -149.830958°
- Located east of the ball fields east of Lake Otis Boulevard
- Total non-native species cover: **8%**
- Noteworthy observations: ***Vicia cracca*** is the only high-priority species present; it covers **2%** of the plot.

Figure 21 Chester Creek Plot 18
Infestation of *Vicia cracca*

V. Tony Knowles Coastal Trail

a. Summary of key findings

Non-native species occupy **63%** of the total area encompassed by exhaustive species plots completed along the Tony Knowles Coastal Trail (22 plots, 128 subplots, 256 m^2). Problem species detected in exhaustive species plots along the Tony Knowles Coastal Trail are ***Leucanthemum vulgare*** (61), ***Vicia cracca*** (73), ***Linaria vulgaris*** (61), ***Medicago sativa* ssp. *falcata*** (64), ***Melilotus alba*** (81), ***Prunus padus*** (74), ***Hieracium aurantiacum*** (79), and ***Bromus inermis* ssp. *inermis*** (62) (see Table 9 for percent cover of each species). *Prunus padus* was observed in greater numbers in summer 2009 than suggested by the 2008 survey (Cortés-Burns pers. obs.). This ornamental tree species appears to be forming small, discrete infestations in the section of trail from Westchester Lagoon to Lynn Ary Park. Control measures specific to *Prunus padus* will be presented in Phase II of this report.

In addition to the infestations recorded in the exhaustive species plots, a number of non-native species were recorded in outlier plots. The high-priority, low-ranked and unranked species of concern detected as **outlier populations only** are: ***Phalaris arundinacea*** (83), ***Caragana arborescens*** (66), ***Campanula rapunculoides*** (64), and ***Crepis tectorum*** (54, low-ranked), ***Galeopsis tetrahit*** (40, low-ranked) and ***Rosa rugosa*** (unranked species of concern).

In general, *Leucanthemum vulgare* and *Melilotus alba* are more abundant along the Coastal Trail than they appear to be along the Chester and Campbell Creek greenbelts and the Coastal Trail is host to a greater abundance of "common" non-native weeds such as *Taraxacum officinale* ssp. *officinale*, *Poa annua*, and *Trifolium hybridum* compared to other trails surveyed for this project.

In general, we recommend that control efforts be focused on the following smaller and/or more discrete populations of invasive species. **Control priorities**[*] for the Coastal Trail, listed in decreasing order of importance, are:

1. ***Melilotus alba*** populations at Plot 15, three outlier populations all at Point Woronzoff, and two additional outlier populations located: 1) north of the water treatment facility at Westchester Lagoon (N 61.21020963°, W -149.9229126°) and 2) at the beginning of the uphill towards the Kincaid Chalet (N 61.15684826°, W -150.0709359°). These infestations should be targeted for **eradication**.
2. Control and if possible **eradicate** the ***Hieracium aurantiacum*** population at Plot 8, and two adjacent populations at the west end of Westchester Lagoon associated with the Fish Passage Project construction (N 61.20852579°, W -149.9235866°, and N 61.20856921°, W -149.9235655°).

[*] Coordinates are given for locations without obvious landmarks

3. Contain the ***Sonchus asper*** infestation at Point Woronzoff Plot 15 and the one at the airport soil storage site (N 61.17654707°, W -150.0385608°). One should aim to completely **eradicate** this species, as it is still infrequent in the Anchorage Bowl.
4. **Contain** or (if time and funding allow) **eradicate** the following dense stands of ***Phalaris arundinacea***: Populations around Westchester Lagoon, around the lagoon at Point Woronzoff, near the airport soil storage site (N 61.17654707°, W -150.0385608°), and over the leach field at the Kincaid Chalet.
5. **Eradicate** the following discrete stands of ***Phalaris arundinacea***: populations west of Lynn Ary Park (N 61.20107738°, W -149.9576882°), at the Earthquake Park Memorial and west of the Memorial (N 61.1982241°, W -149.9852949°), in the grassy areas around the parking lot accessed opposite Postmark Drive, and on the uphill climb to the Kincaid Chalet (N 61.15766365°, W -150.063724°)
6. **Eradicate** the large yet isolated population of ***Medicago sativa* ssp. *falcata*** at Coastal Trail Plot 6, located west of the tunnel leading from Elderberry Park onto the Coastal Trail.
7. **Extirpate *Campanula rapunculoides*** located near the Earthquake Park Memorial.
8. Control the five outlier populations of ***Crepis tectorum***. Two populations were found on either end of the northern Westchester Lagoon tunnel; the first near the water treatment facility on the north end of the tunnel and the second in the open area on the south end of the tunnel. The other three *Crepis tectorum* populations were found (1) in the fields along the trail west of the pond at Point Woronzoff, (2) at the beginning (N 61.15684826°, W -150.0709359°) and (3) near the midsection of the uphill climb towards the Kincaid Chalet (N 61.15702059°, W -150.0622425°).
9. Contain and, if possible, **extirpate** the large ***Galeopsis tetrahit*** s.l. population at the soil storage site (N 61.17654707°, W -150.0385608°); **eradicate** smaller populations at the Earthquake Park Memorial and west from Earthquake Park (N 61.1982241°, W -149.9852949°).
10. ***Vicia cracca*** infestations should be targeted for control and eradication work, starting with the small and isolated populations located around Point Woronzoff and then moving towards Earthquake Park.
11. **Control** the three outlying stands of ***Caragana arborescens*** that are growing (1) at the west end of Westchester Lagoon associated with residential plantings (61.20620107°, W -149.9247109°), (2) as one mature shrub and seedlings growing along the trail margin by the wall that runs along the Coastal Trail just north of the Fish Creek bridge (adjacent waypoints are: N 61.20633845°, W -149.9307943° and N 61.2058829°, W -149.9317305°), and (3) as a hedge that extends from the Point Woronzoff parking lot (N 61.20239862°, W -150.019892°), overlooking the inlet.
12. **Monitor**, and if it starts to expand, **control,** the single population of ***Rosa rugosa*** located south of the southern Westchester Lagoon tunnel on the ocean side of the Coastal Trail.
13. **Contain *Leucanthemum vulgare*** in the Westchester Lagoon area to help prevent the spread of this species up the Chester Creek Trail where it is currently present in minimal amounts (not recorded in any of the plots). ***Leucanthemum vulgare***, as well as ***Vicia cracca*** and ***Linaria vulgaris***, is abundant along the section of the Coastal Trail that backs residential development between Westchester Lagoon and Point Woronzoff. A **weed management plan** for this area should aim to at least

contain these species, with the goal of preventing their further expansion along the trail, and especially towards Kincaid.

14. If time allows, **contain** the ***Bromus inermis* ssp. *inermis*** populations at Plot 22 and at the following outlier populations: 1) the Kincaid terminus of the Coastal Trail, where this species was probably used to reseed the Chalet leach field, 2) Point Woronzoff, where there is a large stand near the parking lot and lagoon, 3) in the bluff area between Point Woronzoff and Earthquake Park (N 61.20190459°, W -150.0056255°), and 4) the northeast end of the bridge spanning Fish Creek.

Please refer to Appendix IV for species biographies, control methods and distribution maps. Plots where high-priority, non-native species were detected are discussed in detail below.

Table 9: Percent cover of non-native species recorded along the Tony Knowles Coastal Trail.
Percent cover represents the foliar cover a given non-native species occupies relative to the total area surveyed by exhaustive species plots along this trail. Species are listed in order of decreasing percent cover; yellow boxes indicate high-priority species.

Scientific Name	Family	Common Name	Invasiveness Ranking	Percent Cover
Taraxacum officinale ssp. *officinale**	Asteraceae	common dandelion	58	17.69
Poa annua	Poaceae	annual bluegrass, walkgrass	46	8.05
Trifolium hybridum	Fabaceae	alsike clover	57	7.38
Leucanthemum vulgare	Asteraceae	oxeye daisy	61	5.79
Vicia cracca	Fabaceae	bird vetch, cow vetch	73	5.51
Trifolium repens	Fabaceae	Dutch clover, ladino clover, white clover	59	3.45
Trifolium pratense	Fabaceae	red clover	53	3.44
Linaria vulgaris	Scrophulariaceae	butter and eggs	61	3.21
Medicago sativa ssp. *falcata*	Fabaceae	yellow alfalfa	64	2.89
Medicago sp.	Fabaceae	alfalfa	64	1.09
Elymus repens	Poaceae	quackgrass	59	0.89
Melilotus alba	Fabaceae	white sweetclover	81	0.78
Silene dioica	Caryophyllaceae	red catchfly	42	0.78
Sorbus aucuparia	Rosaceae	European mountain ash	59	0.66
*Stellaria media**	Caryophyllaceae	common chickweed, nodding chickweed	42	0.57
*Poa pratensis**	Poaceae	Kentucky bluegrass	52	0.35
Plantago major	Plantaginaceae	common plantain	44	0.30
Prunus padus	Rosaceae	European bird cherry	74	0.25
Hieracium aurantiacum	Asteraceae	orange hawkweed	79	0.16
Bromus inermis ssp. *inermis*	Poaceae	smooth brome	62	0.08
Matricaria discoidea	Asteraceae	pineapple weed	32	0.08
Rumex acetosella	Polygonaceae	common sheep sorrel, field sorrel, red sorrel	51	0.08

Scientific Name	Family	Common Name	Invasiveness Ranking	Percent Cover
*Hordeum jubatum**	Poaceae	foxtail barley	63	0.05
Phleum pratense	Poaceae	common timothy	54	T
Sonchus asper	Asteraceae	perennial sowthistle, prickly sowthistle, spiny sowthistle	NR	T
Alopecurus pratensis†	Poaceae	field meadow foxtail	NR	NA
Campanula rapunculoides†	Campanulaceae	creeping bellflower	64	NA
Caragana arborescens†	Fabaceae	Siberian peashrub	66	NA
Crepis tectorum†	Asteraceae	narrowleaved hawk's beard	54	NA
Galeopsis tetrahit s.l. †	Lamiaceae	hemp-nettle	40	NA
Phalaris arundinacea†	Poaceae	reed canarygrass, reed canarygrass	83	NA
Rosa rugosa†	Rosaceae	rugosa rose	NR	NA
Silene latifolia†	Caryophyllaceae	white campion	42	NA
Tripleurospermum perforata†	Asteraceae	scentless false mayweed	48	NA

Notes:
* Species rejected from consideration due to abundance or broad distribution
† Species detected as an outlier population only
NA = not available, cover was not consistently recorded for outlier populations
NR = not ranked
T = trace (cover less than 0.01%)

b. Exhaustive species plot results

Coastal Trail Plot 1

- Dominant vegetation class: Mesic forb herbaceous
- Geographic coordinates: N 61.220555°, W -149.898221°
- Located at the downtown terminus of the Coastal Trail
- Total non-native species cover: **48%**
- Noteworthy observations: High-priority species are ***Linaria vulgaris*** (**26%** of the total area in Plot 1) and ***Prunus padus*** (**6%**). *Linaria vulgaris* cover increases away from the trail. *Prunus padus* individuals occurred as a 6.5-foot tall suckering and a non-woody seedling, the non-woody seedling was pulled.

Figure 22 Coastal Trail Plot 1
Downtown terminus of the Coastal Trail

Coastal Trail Plot 2

- Dominant vegetation class: Mesic graminoid-forb herbaceous
- Geographic coordinates: N 61.218686°, W -149.906146°
- Located across the trail from the Oscar Anderson House Museum
- Total non-native species cover: **18%**
- Noteworthy observations: ***Linaria vulgaris*** is the only high-priority species present and comprises **3%** of the plot area. The presence of ***Sorbus aucuparia*** (59, 3%) is noteworthy; this non-native species is becoming more common in the Anchorage area.

Coastal Trail Plot 3 is not detailed in this section as high-priority species were not detected at this location.

Coastal Trail Plot 4

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.210378°, W -149.922476°
- Located near the water treatment facility by the north Westchester Lagoon tunnel
- Total non-native species cover: **39%**
- Noteworthy observations: ***Linaria vulgaris*** is the only high-priority species present. It comprises **14%** of the plot and decreases in abundance with distance from the trail.

Coastal Trail Plot 5

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.217983°, W -149.907111°
- Located near Elderberry Park*
- Total non-native species cover: **71%**
- Noteworthy observations: ***Linaria vulgaris*** and ***Leucanthemum vulgare*** are the only high-priority species present at this plot. *Linaria vulgaris* covers **26%** of the plot area, with cover values peaking in subplots farthest from the trail; *Leucanthemum vulgare* contributes an additional **13%**. Although not a high-priority species, ***Sorbus aucuparia*** is present at 14%.

Coastal Trail Plot 6

- Dominant vegetation class: Mesic forb herbaceous
- Geographic coordinates: N 61.217911°, W -149.908461°
- Located near the Elderberry Park tunnel*
- Total non-native species cover: **88%**
- Noteworthy observations: ***Medicago sativa* ssp. *falcata*** is the only high-priority species present at this plot where it occupies **51%** of the total area. Cover is

* Two new plots were read in the section between Elderberry Park and Westchester Lagoon after reading Plot 4

consistently high across all subplots, and the infestation **expands c. 50-100 m, starting shortly after the tunnel by Elderberry Park**.

Coastal Trail Plot 7

- Dominant vegetation class: Open broadleaf forest
- Geographic coordinates: N 61.215372°, W -149.912780°
- Located near the end of West 7th Ave, south of a trailside bench
- Total non-native species cover: **137%***
- Noteworthy observations: This plot is highly infested by ***Vicia cracca*** which occupies **80%** of the total area. *Vicia cracca* is the only high-priority species present; ***Sorbus aucuparia*** covered 1% of the plot area.

Coastal Trail Plot 8

- Dominant vegetation class: Mesic forb herbaceous
- Geographic coordinates: N 61.208569°, W -149.923566°
- Located near the Fish Passage Project bridge and boardwalk
- Total non-native species cover: **155%***
- Noteworthy observations: ***Leucanthemum vulgare*** (**82%** of total area), ***Hieracium aurantiacum*** (**4%**), and ***Linaria vulgaris*** (**2%**) are the high-priority species present at this site. Cover of *Leucanthemum vulgare* is high across all subplots whereas *Hieracium aurantiacum* is restricted to subplots close to the main trail.

Coastal Trail Plot 9

- Dominant vegetation class: Mesic graminoid-forb herbaceous
- Geographic coordinates: N 61.205314°, W -149.938735°
- Located between Fish Creek and Lynn Ary Park
- Total non-native species cover: **101%***
- Noteworthy observations: ***Leucanthemum vulgare*** (**26%** of the total area) and ***Linaria vulgaris*** (**12%**) are the only high-priority species present.

Figure 23 Coastal Trail Plot 9
Showing *Leucanthemum vulgare* in bloom.

* Note cover exceeds 100% as non-native species occur as overlapping strata.

Coastal Trail Plot 10

- Dominant vegetation class: Mesic forb herbaceous
- Geographic coordinates: N 61.201533°, W -149.953983°
- Located at the Marston Drive trailhead
- Total non-native species cover: **30%**
- Noteworthy observations: ***Vicia cracca*** (**25%** of the total area) and ***Leucanthemum vulgare*** (**1%**) are the only high-priority species present. *Vicia cracca* cover decreases with distance from the trail.

Figure 24 Coastal Trail Plot 10

Coastal Trail Plot 11

- Dominant vegetation class: Mesic forb herbaceous
- Geographic coordinates: N 61.199085°, W -149.973221°
- Located between the Marston Drive trailhead and the Earthquake Park Memorial
- Total non-native species cover: **79%**
- Noteworthy observations: ***Vicia cracca*** (**36%** of the total area) and ***Leucanthemum vulgare*** (**17%**) are the only high-priority species present. The covers of both *Vicia cracca* and *Leucanthemum vulgare* decrease with distance from the trail.

Figure 25 Coastal Trail Plot 11
Showing *Leucanthemum vulgare* in bloom.

Coastal Trail Plots 12 and **13** are not detailed in this section as high-priority species were not detected at these locations.

Coastal Trail Plot 14

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.202516°, W -150.010136°
- Located on buff section between Earthquake Park and Point Woronzoff
- Total non-native species cover: **52%**
- Noteworthy observations: ***Leucanthemum vulgare*** (**9%** of the total area) is the only high-priority species present.

Coastal Trail Plot 15

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.200491°, W -150.020121°
- Located on the south end of Point Woronzoff
- Total non-native species cover: **83%**
- Noteworthy observations: ***Melilotus alba*** is the only high-priority species at this plot where it covers **20%** of the total area and occurs in all subplots. The widespread (and thus not prioritized for control in this report) invasive species *Hordeum jubatum* is present at 1%, and the unranked species of concern, ***Sonchus asper*** was detected in **trace** amounts.

Figure 26 Coastal Trail Plot 14
Showing *Melilotus alba* in bloom.

Coastal Trail Plots 16-21 are not detailed in this section as high-priority species were not detected at these locations.

Coastal Trail Plot 22

- Dominant vegetation class: Broadleaf woodland
- Geographic coordinates: N 61.157592°, W -150.063541°
- Located at the switchback midway up the hill towards the Kincaid Chalet
- Total non-native species cover: **60%**
- Noteworthy observations: ***Bromus inermis* ssp. *inermis*** is the only high-priority species present at this plot where it occupies only **1%** of the total area. N.B.: there are **outlying populations of *Phalaris arundinacea* and *Crepis tectorum*** that are suggested for control in this area.

Figure 27 Coastal Trail Plot 22

VI.Kincaid Park

❑ Overview and summary of key findings

Ralph G. Kincaid homesteaded lands in the 1950s that today include Kincaid Park. The westernmost section of the park, formerly known as Point Campbell Military Reservation, was operated as a Nike-Hercules anti-aircraft missile site between 1959 and 1979. Park lands were acquired by MOA in the 1970s and today Kincaid Park is the largest self-contained park in Anchorage (1665 acres, Klein 1999).

Non-native species occupy **40%** of the total area encompassed by exhaustive species plots completed along Kincaid Park trails (32 plots, 183 subplots, 366 m^2). Forty (40) non-native species were identified in exhaustive plots completed on Kincaid Park trails. Of this total, six are designated as high-priority species; they are, listed in decreasing order of abundance: ***Bromus inermis* ssp. *inermis*** (62), ***Leucanthemum vulgare*** (61), ***Linaria vulgaris*** (61), ***Melilotus alba*** (81), ***Caragana arborescens*** (66), and ***Vicia cracca*** (73), Additional high-priority species that were detected as outlier populations only are: ***Cirsium arvense*** (76), ***Hieracium aurantiacum*** (79), ***Melilotus officinalis*** *(69),* and ***Phalaris arundinacea*** (83). A single ***Prunus padus*** (74) tree was observed in 2009 on the Lekisch trail (Cortés-Burns, pers. obs.); however, the exact location was not recorded as the observation occurred during a recreational walk outside of the field season. Low-ranked species of concern detected are ***Galeopsis tetrahit*** s.l. (40) and ***Crepis tectorum*** ([54], see Table 10 for species percent covers and Table 11 for species presence presented by trail). The presence of the following unranked species ***Alopecurus pratensis, Erucastrum gallicum*** and ***Euphrasia nemorosa*** is noteworthy, especially that of *Euphrasia nemorosa*, which has previously only been recorded in southeast Alaska. These lesser-known, unranked species are naturalized in Alaska yet appear to remain restricted to areas of highest disturbance (based on observations made in this state or in provinces and states with a similar vegetation and climate). The presence of unranked garden escapees ***Campanula glomerata***, ***Centaurea montana***, ***Cheiranthus allionii***, ***Lychnis chalcedonica*** and ***Trollium* sp.** is concerning as these species are able to establish in native vegetation and we do not fully understand these species' potential to disrupt ecosystem structure and processes.

Although Kincaid Park remains comparatively weed-free when compared to the Chester Creek or Campbell Creek greenbelts, there are a number of highly aggressive non-native plant infestations and invasive species hotspots in this park that should be prioritized for immediate control work and follow-up monitoring, to prevent their expansion to weed-free areas of the park. The **three largest invasive plant hotspots** in the park are:

1. the entire Multi-use trail
2. disturbed sections of the Alex Sisson Loop, especially the gravel/materials site
3. area surrounding the Kincaid chalet, including the perimeter of the Stadium

The ***Hieracium aurantiacum*** (orange hawkweed) infestation located on Arlene's Way en route to the Sisson Loop proper (see Figure 33 *Hieracium aurantiacum* outlier plot) will require both **immediate control work and long term adaptive management strategies**. The trailsides adjoining **horticultural gardens** should be monitored for the potential spread of non-native garden plants onto the trail system.

Control priorities for Kincaid Park, listed by species (occurring in both exhaustive and outlier plots) in decreasing order of importance, are:

1. ***Hieracium aurantiacum*** (79) Eradicate the population on Arlene's Way en route to the Sisson Loop, scout the area for additional populations not previously detected, and establish long term management plans for this site, as new individuals are likely to come up.
2. ***Cirsium arvense*** (76) Eradicate the *Cirsium arvense* population in the vegetated islands of the upper parking lot.
3. ***Prunus padus*** (74) Relocate and treat the *Prunus padus* individual on the Lekisch Trail. Control work should be followed up by monitoring the site and surrounding area for 2-3 years, given that this tree was observed in flower and could therefore have produced viable seeds (cherries).
4. ***Phalaris arundinacea*** (83) Eradicate small, discrete populations found along the Multi-use trail, around the upper parking lot, and the isolated stand (approximately 350 stems) by the Stadium's light pole opposite the Margaux Menaker Memorial; contain the population growing over the leach field southwest of the Kincaid chalet (note this population co-occurs with *Bromus inermis* ssp. *inermis*, which is listed as a control priority for the Coastal Trail).
5. ***Melilotus alba*** (81) Control the infestations of *Melilotus alba* around the Kincaid chalet and upper parking lot. These infestations are localized enough that consistent extirpation/control efforts could be effective. *Melilotus alba* also occurs on the Multi-use, Sisson Loop, Margaux's and Lekisch Trail; see discussion of these trails for control recommendations.
6. ***Melilotus officinalis*** (69) Eradicate the single population of *Melilotus officinalis* at the gravel extraction area along the Sisson Trail. Please note that multiple invasive species occur at this highly disturbed site. At a minimum, *Crepis tectorum, Leucanthemum vulgare, Melilotus alba,* and *M. officinalis* should be controlled at this site.
7. ***Vicia cracca*** (73) Eradicate the dense stand of *Vicia cracca* (approximately 15,000 stems) by the light pole opposite the Margaux Menaker Memorial, and plants detected in the vegetated islands of the upper parking lot and along the Margaux and Multi-use Trails. We propose that *Vicia cracca* be pulled from all locations and that sites are monitored for at least 3-5 years following control work.
8. ***Caragana arborescens*** (66) Control the infestations of *Caragana arborescens* around the Kincaid chalet, upper parking lot and encourage removal at Arlene's Overlook on the Mize Trail, and replacement with similar looking native plants, such as *Potentilla fruticosa*.

9. ***Galeopsis tetrahit*** s.l. (40) control populations at the Kincaid chalet, and along the Sisson, Multi-use and Margaux's Loop trails; see discussion of these trails for detailed control recommendations.
10. ***Erucastrum gallicum*** (NR) Control populations of *Erucastrum gallicum* on the Multi-use, Sisson and Margaux's Loop Trails; see discussion of these trails for detailed recommendations.
11. ***Bromus inermis* ssp*. inermis*** (62) Control or contain the population of *Bromus inermis* ssp. *inermis* at the leach field located to the southwest of the chalet (note this population co-occurs with *Phalaris arundinacea* and is also listed as a control priority for the Coastal Trail) and the multiple populations occurring from the chalet down to the new soccer fields and in the stadium. *Bromus inermis* ssp. *inermis* also occurs along the Lekisch, Margaux and Mize trails; see discussion of these trails for control recommendations.
12. ***Linaria vulgaris*** (61) Control the *Linaria vulgaris* populations growing in an *Alnus* stand that extends from the upper parking lot down to the stadium. *Linaria vulgaris* also occurs along the Sisson Loop and Multi-use Trail; see discussion of these trails for control recommendations.
13. ***Leucanthemum vulgare*** (61) *Leucanthemum vulgare* occurs on the Multi-use, Lekisch and Mize Trails where it is often associated with horticultural gardens. This species should be eradicated from within and around these gardens and populations located at the Raspberry Road entrance should be contained or eradicated to prevent this species from spreading further into the park.
14. ***Crepis tectorum*** (54) Control the discrete populations along the Multi-use Trail and develop a management plan and best management practices for the discontinuous yet widespread presence of *Crepis tectorum* along the Sisson Loop.
15. Monitor the persistence and dispersal of the non-native ornamentals ***Campanula glomerata*** (NR), ***Centaurea montana*** (NR) and ***Trollius sp.*** (NR).

Please also refer to Appendix IV for species biographies, control methods and distribution maps. Plots where high-priority, non-native species were detected are discussed on a trail by trail basis in the following sections, and control recommendations are provided in this sections as well as in Appendix IV.

In general, established trails such as the Jodhpur Loop, which is isolated from the impacts of road-associated disturbances and from recent trail development and/or maintenance work, are relatively weed-free. Recently constructed trails such as the Multi-use trail and trail sections that adjoin horticultural plots or high use areas (*e.g.* Kincaid chalet and disturbed sections of the Sisson Loop) support a greater cover of non-native and invasive species. The presence of highly **invasive species in the vicinity of the Kincaid chalet** is **particularly concerning** as this area serves as a trailhead for many of the trails within Kincaid Park and thus, there is a greater potential for species to disperse along these corridors and invade new areas.

Finally, we clarify that because of the highly disturbed and developed character of lands surrounding the Kincaid chalet, exhaustive plot surveys (that aim to document the interaction between exotic and native vegetation) were not read in these areas. Instead,

a broad survey for outlier populations was conducted in the vicinity of the **Kincaid chalet, bunker, upper parking lots, stadium, and soccer fields**. The high-priority invasive species detected within this area are: ***Phalaris arundinacea*** (83), ***Melilotus alba*** (81), ***Cirsium arvense*** (76), ***Vicia cracca*** (73), ***Caragana arborescens*** (66), ***Bromus inermis* ssp. *inermis*** (62) and ***Linaria vulgaris*** (61).

Table 10: Percent cover of non-native species recorded on major Kincaid Park Trails.
Percent cover represents the foliar cover a given non-native species occupies relative to the total area surveyed by exhaustive species plots along this trail. Species are listed in order of decreasing percent cover; yellow boxes indicate high-priority species.

Scientific Name	Family	Common Name	Invasiveness Ranking	Percent Cover
Poa annua	Poaceae	annual bluegrass, walkgrass	46	7.60
Taraxacum officinale ssp. *officinale**	Asteraceae	common dandelion	58	6.79
Bromus inermis ssp. *inermis*	Poaceae	smooth brome	62	5.91
Trifolium hybridum	Fabaceae	alsike clover	57	5.15
Galeopsis tetrahit s.l.	Lamiaceae	hemp-nettle	40	2.58
Leucanthemum vulgare	Asteraceae	oxeye daisy	61	2.38
Polygonum aviculare	Polygonaceae	prostrate knotweed, yard knotweed	45	1.42
Linaria vulgaris	Scrophulariaceae	butter and eggs	61	1.15
Plantago major	Plantaginaceae	common plantain	44	1.03
*Poa pratensis**	Poaceae	Kentucky bluegrass	52	0.84
Tripleurospermum perforata	Asteraceae	scentless false mayweed	48	0.68
Matricaria discoidea	Asteraceae	pineapple weed	32	0.67
Lupinus polyphyllus	Fabaceae	bigleaf lupine, marsh lupine	55	0.63
Phleum pratense	Poaceae	common timothy	54	0.53
Chenopodium album	Chenopodiaceae	common lambsquarters, white goosefoot	37	0.50
Melilotus alba	Fabaceae	white sweetclover	81	0.38
Persicaria lapathifolia	Polygonaceae	curlytop knotweed	47	0.25
Lolium perenne ssp. *multiflorum*	Poaceae	Italian ryegrass, annual ryegrass	41	0.25
Caragana arborescens	Fabaceae	Siberian peashrub	66	0.22
Vicia cracca	Fabaceae	bird vetch, cow vetch	73	0.22
*Hordeum jubatum**	Poaceae	foxtail barley	63	0.19
*Stellaria media**	Caryophyllaceae	common chickweed, nodding chickweed	42	0.16

Scientific Name	Family	Common Name	Invasiveness Ranking	Percent Cover
Cerastium fontanum ssp. *vulgare*	Caryophyllaceae	common mouse-ear chickweed, mouse-ear chickweed	36	0.14
Euphrasia nemorosa	Scrophulariaceae	common eyebright	NR	0.14
Rumex acetosella	Polygonaceae	common sheep sorrel, field sorrel, red sorrel	51	0.14
Lolium perenne ssp. *perenne*	Poaceae	perennial rye grass	41	0.11
Cheiranthus allionii	Brassicaceae	Siberian wallflower	NR	0.05
Crepis tectorum	Asteraceae	narrowleaved hawk's beard	54	0.03
Erucastrum gallicum	Brassicaceae	dog mustard	NR	0.02
Capsella bursa-pastoris	Brassicaceae	shepherd's purse	40	0.01
Elymus repens	Poaceae	quackgrass	59	0.01
Alopecurus pratensis	Poaceae	field meadow foxtail	NR	T
Trifolium pratense	Fabaceae	red clover	53	T
Trifolium repens	Fabaceae	white clover, Dutch clover, ladino clover	59	T
Cirsium arvense†	Asteraceae	Canada thistle	76	NA
Hieracium aurantiacum†	Asteraceae	orange hawkweed	79	NA
Lychnis chalcedonica†	Caryophyllaceae	Maltese cross	NR	NA
Melilotus officinalis†	Fabaceae	yellow sweetclover, king's crown	69	NA
Phalaris arundinacea†	Poaceae	reed canarygrass, reed canarygrass	83	NA
Rumex longifolius†	Polygonaceae	door-yard dock	48	NA
Prunus padus†	Rosaceae	European bird cherry	74	NA
Campanula glomerata†	Campanulaceae	Dane's Blood	NR	NA
Centaurea montana†	Asteraceae	perennial cornflower	NR	NA
Trollius sp. †	Ranunculaceae	globeflower	NR	NA

Notes:
* Species rejected from consideration due to abundance or broad distribution
† Species detected as an outlier population only
NA = not available, cover was not consistently recorded for outlier populations
NR = not ranked
T = trace (cover less than 0.01%)

Table 11: Location and percent cover of non-native species recorded in Kincaid Park.
Species are listed in order of decreasing percent cover; yellow boxes indicate high-priority species.

Scientific Name	Percent Cover	Multi-use	Sisson	Margaux	Lekisch	Chalet and vicinity	Jodhpur	Mize
Poa annua	7.60			X	X		X	X
*Taraxacum officinale ssp. officinale**	6.79	X	X	X	X		X	X
Bromus inermis ssp. *inermis*	5.91			X	X	X		X
Trifolium hybridum	5.15	X	X	X	X	X	X	X
Galeopsis tetrahit s.l.	2.58	X	X	X				
Leucanthemum vulgare	2.38	X	X		X			X
Polygonum aviculare	1.42	X	X	X	X			
Linaria vulgaris	1.15	X	X		X	X		
Plantago major	1.03	X	X	X	X		X	
*Poa pratensis**	0.84	X		X	X		X	
Tripleurospermum perforata	0.68	X	X	X		X		
Matricaria discoidea	0.67	X	X	X	X		X	X
Lupinus polyphyllus	0.63	X	X		X			X
Phleum pratense	0.53	X	X				X	
Chenopodium album	0.50	X		X				
Melilotus alba	0.38	X	X	X	X	X		
Persicaria lapathifolia	0.25	X	X	X				
Lolium perenne ssp. *multiflorum*	0.25	X		X				
Caragana arborescens	0.22					X		X
Vicia cracca	0.22	X		X		X		
*Hordeum jubatum**	0.19		X			X		
*Stellaria media**	0.16			X				
Cerastium fontanum ssp. *vulgare*	0.14		X					
Euphrasia nemorosa	0.14		X			X		
Rumex acetosella	0.14		X					
Lolium perenne ssp. *perenne*	0.11	X		X				

Scientific Name	Percent Cover	Multi -use	Sisson	Margaux	Lekisch	Chalet and vicinity	Jodhpur	Mize
Cheiranthus allionii	0.05	X						
Crepis tectorum	0.03	X	X					
Erucastrum gallicum	0.02	X	X	X				
Capsella bursa-pastoris	0.01	X		X				
Elymus repens	0.01	X	X				X	
Alopecurus pratensis	T			X		X		
Trifolium pratense	T	X					X	
Trifolium repens	T		X			X		
Phalaris arundinacea†	NA	X				X		
Hieracium aurantiacum†	NA		X					
Cirsium arvense†	NA					X		
Melilotus officinalis†	NA		X					
Rumex longifolius†	NA			X				
Lychnis chalcedonica†	NA	X						
Prunus padus†	NA				X			
Centaurea montana†	NA				X			
Campanula glomerata†	NA				X			
Trollius sp. †	NA				X			
Total # of non-native species per trail		26	23	21	16	13	9	8

Notes: Species occurring in exhaustive and outlier plots are included.
* Species rejected from consideration
† Species detected as an outlier only
T = trace (cover less than 0.01%)
NA = percent cover is not available for species detected as outliers only

❑ Multi-use Trail

a. Summary of key findings

Non-native species occupy **61%** of the total area encompassed by exhaustive species plots completed along the Multiuse Trail (5 plots, 38 subplots, 76 m^2). High-priority species along the Multi-use trail are ***Leucanthemum vulgare*** (61) which, comprises 10% of cumulative area of all Multi-use plots, ***Linaria vulgaris*** (63, 4%), ***Melilotus alba*** (81, 1%), and ***Vicia cracca*** (75, 1%). Low-ranked species of concern ***Galeopsis tetrahit*** s.l. (40) accounts for 9% of the total area while low-ranked ***Crepis tectorum*** (54) and unranked species of concern ***Erucastrum gallicum*** are present in trace amounts.

This section has a relatively rich (24 non-native species, see Table 11) and continuous distribution of non-native species. The diversity and size of these infestations may be due to the importation of contaminated fill for construction of the trail in 2007 or sowing with contaminated seed.

Recently seeded sections of this trail will be in a transitional phase for the next several years. Several of the non-native species that were possibly included in the seed mix may be out-competed by native species over time. For example, *Chenopodium album* and *Tripleurospermum perforata* are non-native species that are not expected to persist in the absence of repeated disturbance. Similarly, the bunchgrass species *Lolium perenne* ssp. *perenne* and *Lolium perenne* ssp*. multiflorum* provide a quick, temporary cover but have shown limited persistence in Alaska (AKEPIC 2005).

However, other non-native species pose considerable danger to the integrity of native vegetation. Of special concern are *Phalaris arundinacea*, *Melilotus alba* and *Vicia cracca.* These species have the potential to form monocultures along the multi-use trail and could easily spread to the main Kincaid access road. The highly aggressive grass, *Phalaris arundinacea* (83) was not recorded in any of the exhaustive species plots, but outlier populations were found along the Multi-use Trail opposite the lower (Stadium) parking lot, along the fenced portion of the Multi-use Trail that crosses over the lower tunnel, and across from the Raspberry Road parking lot.

Control priorities, listed in decreasing order of importance, for the Multi-use trail, are listed below. Coordinates are given for locations without obvious landmarks. Please note that **several high-priority species** (*Melilotus alba*, *Vicia cracca*, *Linaria vulgaris*, and *Leucanthemum vulgare*) recommended for control occur at the same **outlier plot located just east of the upper tunnel** (N 61.15411115°, W -150.0328557°). An **additional** outlier location **hosting multiple high-priority species** (*Melilotus alba*, *Vicia cracca* and *Galeopsis tetrahit* s.l.) is located approximately 0.2 km **west of the Raspberry Road bridge** (N 61.15184577°, W -150.0279236°).

1. Control the ***Melilotus alba*** populations at Multi-use Plots 6 and 7 and the outlier populations located: (a) revegetated slope on the roadside by the planted median at the Raspberry Road entrance, (b) two infestations on the south side of the trail between the Raspberry Road entrance and Raspberry Road parking lot (N 61.15842389°, W -150.0147865° and N 61.15639983°, W -150.0159422°), (c) opposite the Raspberry Road parking lot, east of the bridge (N 61.15266141°, W -150.0214607°), (d) just east of the upper tunnel (N 61.15411115°, W -150.0328557°), and (e) between the upper tunnel and the Raspberry Road bridge (N 61.15344747°, W -150.0312843°). The aggressive behavior of this species across the state combined with its presence in widely different habitats within Kincaid Park [*e.g.* in areas of high disturbance (Multi-use Trail) and along low-use trail sides (Lekisch Loop)], lead us to advise that this species should be repeatedly controlled to prevent it from spreading throughout Kincaid Park.
2. Control ***Vicia cracca*** at Multi-use Plots 1, 7, the two outlier infestations approximately 0.2 km west of the Raspberry Road bridge (N 61.15184577°, W -150.0279236°), one infestation just east of the upper tunnel (N 61.15411115°, W -150.0328557°), and another one across from the water tower access road (N 61.15462831°, W -150.0382452°). *Vicia cracca* is able to grow in relatively shaded areas by creeping over the native understory vegetation to gain access to sunlight. Because the Multi-use trail intersects with the relatively clean Margaux and Lekisch Loops, we propose that all *Vicia cracca* populations along the Multi-use trail be pulled and that the sites be monitored for at least 3-5 years following control work.
3. Control the ***Phalaris arundinacea*** outlier populations between the Little Campbell Lake access road and the Raspberry Road parking lot (N 61.15789725°, W -150.0152398°), across from the Raspberry Road parking lot (N 61.15502955°, W -150.0169164°), opposite the lower (Stadium) parking lot, and along the fenced portion of the Multi-use Trail that crosses over the lower tunnel.
4. Control ***Crepis tectorum*** at Multi-use trail Plot 6 and the two outlier populations across from the access road to Little Campbell Lake (N 61.15903426°, W -150.0129936°) and between the upper tunnel and the Raspberry Road bridge (N 61.15219471°, W -150.0293965°).
5. Control the ***Linaria vulgaris*** populations at Multi-use Plots 1, 6 and 7, the two outlier locations just east of the upper tunnel (N 61.15411115°, W -150.0328557°), and one near the south end of the stadium tunnel (N 61.15333515°, W -150.0509475°).
6. Control the ***Leucanthemum vulgare*** populations at Multi-use Plot 1 and at the outlier location just east of the upper tunnel (N 61.15411115°, W -150.0328557°).
7. Control ***Galeopsis tetrahit*** s.l. at Multi-use Plots 5, 6 and 8, and at the following four outlier populations: (1,2) two located across from the access road to Little Campbell Lake (N 61.15919427°, W -150.0108672° and N 61.15903426°, W -150.0129936°), (3) one located across from the Raspberry Road Parking lot (N 61.15552551°, W -150.0165162), and (4) one approximately 0.2 km west of the Raspberry Road bridge (N 61.15184577°, W -150.0279236°).

8. Monitor the population of ***Erucastrum gallicum*** at Multi-use Plot 1.
9. ***Lolium perenne* ssp. *perenne*** and ***Lolium perenne* ssp. *multiflorum*** at Plots 5 and 8, at outlier locations across from the access road to little Campbell Lake (N 61.15919427°, W -150.0108672°), and approximately 0.2 km west of the Raspberry Road bridge (N 61.15184577°, W -150.0279236°) should be monitored and managed adaptively.

High-priority, low-ranked, and unranked species of concern were detected in many of the exhaustive plots read along the Multi-use Trail. These locations are described below.

b. Exhaustive species plot results

Multi-use Plot 1

- Dominant vegetation class: Mesic forb herbaceous
- Geographic coordinates: N 61.159194°, W -150.010867°
- Located at the Raspberry Road entrance to Kincaid Park
- Total non-native species cover: **101%**[*]
- Noteworthy observations: The high-priority species present are: ***Leucanthemum vulgare*** (**32%** of the total area), ***Linaria vulgaris*** (**9%**), and ***Vicia cracca*** (**3%**). Unranked ***Erucastrum gallicum*** is also present in trace amounts. *Leucanthemum vulgare* may have escaped from the horticulture plot below the park entrance sign. *Vicia cracca* was observed overgrowing native vegetation. This plot ends at a chain link fence which also marks an abrupt transition in dominance from non-native *Leucanthemum vulgare* to native *Calamagrostis canadensis* on the far side of the fence. It is possible that mowing may encourage the proliferation of weed species by providing a repeated disturbance or distributing seeds or plant pieces from which a new plant could regenerate. On the opposite side of the road we recorded *Melilotus alba*, as well as other less aggressive invasive species.

Figure 28 Multi-use Plot 1

Due to an error in our plot numbering system, we labeled a number of outlier plots between the first and second exhaustive species plots on the Multi-use trail plots “2-4”, even though they correspond to outlier, high priority species only plots. Consequently, the second plot on the Multi-use trail is Plot number 5; **plot numbers 2-4** do not exist and are thus not detailed in this section.

Multi-use Plot 5

- Dominant vegetation class: Mesic forb herbaceous
- Geographic coordinates: N 61.154456°, W -150.017223°
- Located across from the Raspberry Road parking lot

[*] Note cover exceeds 100% as non-native species occur as overlapping strata.

- Total non-native species cover: **49%**
- Noteworthy observations: No high-priority species were detected at this plot; however low-ranked species of concern ***Galeopsis tetrahit*** s.l. comprises **38%** of the total plot area and is a dominant species in all sub-plots.

Multi-use Plot 6

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.154865°, W -150.017461°
- Located across from the Raspberry Road parking lot
- Total non-native species cover: **53%**
- Noteworthy observations: The high-priority species ***Melilotus alba*** (**6%** of total area) and ***Linaria vulgaris*** (**1%**) were detected at this plot. Two potentially low-ranked species of concern; ***Galeopsis tetrahit*** s.l. (**5%**) and ***Crepis tectorum*** (trace cover) and an unranked species, ***Cheiranthus allionii*** (trace cover), are also present.

Figure 29 Multi-use Plot 6

Multi-use Plot 7

- Dominant vegetation class: Mixed woodland
- Geographic coordinates: N 61.151977°, W -150.028859°
- Located between the Upper Tunnel and the bridge over Raspberry Road
- Total non-native species cover: **16%**
- Noteworthy observations: The high-priority species ***Linaria vulgaris*** (**3%** of the total area), ***Vicia cracca*** (**2%**), and ***Melilotus alba*** (**1%**) are present. Their distributions are restricted to the two subplots closest to the trail.

Figure 30 Multi-use Plot 7

Multi-use Plot 8

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.153987°, W -150.042587°
- Located between the water tower access road and the maintenance bunker
- Total non-native species cover: **33%**
- Noteworthy observations: No high-priority species are present at this plot but the low-ranked ***Galeopsis tetrahit*** s.l. comprises **4%** of the total plot area. Cover of *Galeopsis tetrahit* s.l. decreases away from the trail.

Figure 31 Multi-use Plot 8

❑ Sisson Trail

a. Summary of key findings

The Sisson Trail, which was constructed between 1991 and 1992, generally supports native vegetation. However, the disturbed areas adjacent to the airport bear a considerable abundance of non-native species.

The first stretch of the Sisson Loop, from its intersection with the Mize Loop through the uphill climb that connects skiers back to the Mize (Ski for Women trail sections) has scattered infestations of ***Crepis tectorum*** and ***Euphrasia nemorosa*** (as well as one infestation of ***Hieracium aurantiacum***)**.** Continuing along the Sisson after Arlene's way, going in the direction of ski, ***Linaria vulgaris*** and ***Crepis tectorum*** occur in a scattered but semi-continuous way through to the chain link fence that separates the airport from municipal lands. It is also in this portion of the Sisson that ***Melilotus alba*** plants were detected. As one moves **away from the chain link fence** boundary towards the Coastal trail, there is a rapid **decrease** in the occurrence and frequency of non-native plant species. **Weediness increases** again as one goes back, still in the ski direction, **towards** the **gravel/materials pit** (Figure 34).

Non-native species occupy **25%** of the total area encompassed by exhaustive species plots completed along the Sisson Trail (5 plots, 27 subplots, 54 m^2). ***Linaria vulgaris*** (61) represents 1% of the cumulative exhaustive species plots area; low-ranked ***Crepis tectorum*** (54) is present at 0.2%, and unranked species of concern ***Euphrasia nemorosa*** accounts for 1% of the total area of Sisson Trail plots. Several additional high-priority species occur as outlier populations: ***Melilotus alba*** (81), ***Melilotus officinalis*** (69), and ***Leucanthemum vulgare*** (61).

An **outlier population of *Hieracium aurantiacum* located along Arlene's Way** en route to the Sisson Loop proper was detected and controlled (Figs. 32 and 33). This infestation represents the **only occurrence of *Hieracium aurantiacum* in Kincaid Park.** This highly-aggressive species reproduces vegetatively, by rhizomes, and sexually, producing abundant seed. It is able to establish on a wide variety of substrates ranging from exposed gravel to small, single-track trails with a considerable layer of native vegetation (mosses, lichens, dwarf shrubs). It is very likely that this species will quickly disperse to the more disturbed areas of the Lower Sisson Loop and areas slated for future construction. For these reasons control of this population is a **high priority**. The only effective way of eradicating this species is to apply herbicides. However, given that the infestation was small when detected (75 stems) and that the plants found were immediately pulled and dug, we suggest that it may still be possible to eradicate or at least contain this infestation. Please see Appendix IV as well as the below list of control priorities for more detailed recommendations.

Figure 33 *Hieracium aurantiacum* outlier plot
Location of *Hieracium aurantiacum* population along Arlene's Way/Sisson Loop, Kincaid Park.

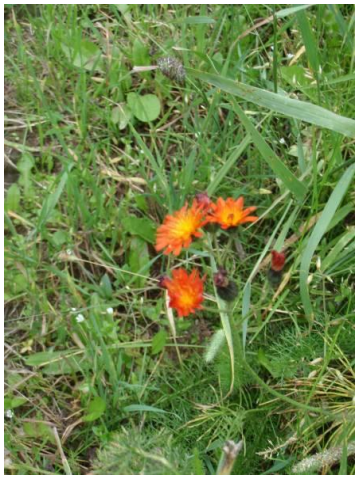

Figure 32 *Hieracium aurantiacum* **in flower**
Outlier plot along the Sisson Loop.

The **gravel extraction area** (N 61.16513109°, W -150.0592448°) marks an **invasive plant species hotspot**. This highly disturbed site hosts many invasive species, including *Crepis tectorum, Erucastrum gallicum, Hordeum jubatum, Leucanthemum vulgare, Lupinus polyphyllus, Melilotus alba, Melilotus officinalis, Persicaria lapathifolia, Rumex acetosella, Trifolium hybridum,* and *Tripleurospermum perforata* (Fig. 34). At a minimum, *Crepis tectorum, Leucanthemum vulgare, Melilotus alba,* and *M. officinalis* should be controlled (eradicated or contained, depending on the size of each patch) at this site (see below for details on this and other control priorities for the Sisson Trail).

Figure 34 Sisson gravel materials pit: an invasive species hotspot
This site contains a number of invasive non-native plant species, including *Melilotus alba, Melilotus officinalis, Polygonum lapathifolium, Erucastrum gallicum, Tripleurospermum perforatum, Crepis tectorum*, and *Leucanthemum vulgare*.

Control priorities[*]**,** listed in decreasing order of importance, for the Sisson Loop are:

1. Revisit and, if necessary, control the population of ***Hieracium aurantiacum*** located on Arlene's Way (N 61.167210°, W -150.049221°); monitor for multiple growing seasons following any control work, as this species could easily resprout from fragments of rhizomes left behind, or from a seed bank, if present.
2. Control and eradicate the outlier populations of ***Melilotus alba*** along the airport maintenance way (N 61.16778648°, W -150.0523607°) and *Melilotus alba* and ***M. officinalis*** at the gravel extraction area (waypoint 30, see above).
3. Develop a weed management plan and implement best management practices for the gravel extraction area. This site contains multiple invasive species, some that are highly aggressive, and appears to be used by maintenance or construction vehicles. Species like ***Crepis tectorum, Melilotus alba, M. officinalis, Leucanthemum vulgare***, and ***Erucastrum gallicum***, which were all observed here, could spread into new areas of the park if best management practices are not developed that would prevent the use of machinery that has been at this site from going to other, more weed-free sites without first being cleaned. Similarly, any land fill extracted from this site would constitute a veritable source of aggressive invasive species, and should therefore not be used in other parts of the park without cleaning it first (e.g. heat treatments, etc.)
4. Control ***Galeopsis tetrahit*** s.l. outlier populations along the airport maintenance road between the gravel extraction area and the airport (N 61.16675575°, W -150.052904° and N 61.16856306°, W -150.0504791°)
5. Monitor ***Euphrasia nemorosa*** populations to check that their behavior and rate of spread does not change over time.

Species like ***Crepis tectorum*** and ***Linaria vulgaris*** are very widespread, even if in low numbers, throughout the loop. Therefore, the priority should be to target species that are as or more invasive than these two but are present in smaller numbers and at a lower frequency on the trail. High-priority and low-ranked species and unranked species of concern were detected in only two of the exhaustive plots read along the Sisson Trail. These locations are described below.

[*] Coordinates are given for locations without obvious landmarks.

b. Exhaustive species plot results

Sisson Loop Plot 1 is not detailed in this section as high-priority species were not detected at this location.

Sisson Plot 2

- Dominant vegetation class: Mixed woodland
- Geographic coordinates: N 61.166756°, W -150.052904°
- Located northeast of the gravel extraction area
- Total non-native species cover: **45%**
- Noteworthy observations: Two populations of ***Linaria vulgaris*** were found at Plot 2 where they comprised **3%** of the total area. *Linaria vulgaris* colonizes areas by wind dispersal of seeds; disturbed conditions are required for establishment (AKEPIC, 2005). This section of the Sisson Trail crosses a gravel pit and is therefore lacking an organic horizon in areas. Seeds may arrive from the neighboring airport and establish in this disturbed soil. *Hordeum jubatum* occupies an additional 4% of the area but is not considered a high-priority species in this study. Low-ranked species of concern ***Crepis tectorum*** is also present at **1%** cover.

Figure 35 Sisson Loop Plot 2
Showing disturbed mineral soil in foreground.

Sisson Loop Plots 3 and 4 are not detailed in this section as high-priority species were not detected at these locations.

Sisson Plot 5

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.164951°, W -150.054943°
- Located adjacent to the east of the gravel extraction area
- Total non-native species cover: **37%**
- Noteworthy observations: The only population of unranked ***Euphrasia nemorosa*** identified in this study occurs in Plot 5 where it occupies **5%** of the total area. The plants occurred in the trail proper and were not observed invading native vegetation. *Euphrasia nemorosa* is not considered a high-priority species, however we suspect this small annual plant is often overlooked and for this reason we do not have a good understanding of its distribution.

Figure 36 Sisson Loop Plot 5
Showing *Euphrasia nemoralis* in bloom.

❑ Margaux's Loop

a. Summary of key findings

Non-native species occupy **42%** of the total area encompassed by exhaustive species plots completed along Margaux's Loop (7 plots, 35 subplots, 70 m^2). ***Bromus inermis* ssp*. inermis*** (62) comprises 3% of the cumulative area of Margaux's Loop exhaustive species plots and is the only high-priority species present. Low-ranked species of concern ***Galeopsis tetrahit*** s.l. (40, also 3%) occurs at locations along Margaux's Loop that are proximal to construction areas; the presence of these species on an established trail likely relates to migration of seed and propagules from areas of recent earthwork.

Outlying populations of unranked ***Erucastrum gallicum*** and ***Lolium perenne* ssp*. multiflorum*** and of aggressively invasive ***Melilotus alba*** (81) were found on the north end of the bridge that crosses Raspberry Road. The 35 stems of *Melilotus alba* were hand pulled. Outliers of *Galeopsis tetrahit* s.l., *Melilotus alba*, ***Rumex longifolius*** (48), and ***Vicia cracca*** (73) were also found on the earthen embankments flanking the south end of the lower bridge. The *Melilotus alba* and *Rumex longifolius* plants were hand pulled and removed.

Control priorities, listed in decreasing order of importance, for Margaux's Loop are:

1. Revisit the bridge area, and control ***Vicia cracca*** at the south end of the bridge, as well as eradicate any new ***Melilotus alba*** and ***Erucastrum gallicum*** plants at the north end of the bridge. Monitor the ***Lolium perenne* ssp*. multiflorum*** population at the north end of the bridge and manage adaptively.
2. Control ***Galeopsis tetrahit*** s.l. at and near Plots 3 and 5.
3. Although there are higher control priorities for the park, additional control work that could be carried out on the Margaux Trail includes:
    - Monitor the southern half of Margaux's Loop where it parallels the newly-constructed Multi-use trail. The Multi-use trail is host to a variety of non-native species that could easily establish on any disturbed sections of Margaux's Loop (*i.e.* where mineral soil is exposed).
    - Control the populations of ***Bromus inermis* ssp*. inermis*** located at Margaux's Plots 1 and 2.

High-priority and low-ranked species of concern were detected in three Margaux Loop exhaustive plots. These plots are described below.

b. Exhaustive plot results

Margaux's Plot 1

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.155599°, W -150.050004°
- Located opposite the Margaux Menaker Memorial.
- Total non-native species cover: **83%**
- Noteworthy observations: ***Bromus inermis* ssp. *inermis*** is the only high-priority species present in Plot 1 where it comprises **21%** of the total area. Low-ranked species of concern ***Galeopsis tetrahit*** s.l. occupies an additional **21%** area.

Figure 37 Margaux's Plot 1
Located opposite the Margaux Menaker Memorial.

Margaux's Plot 2

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.153507°, W -150.048417°
- Located on the backside of the new biathlon range
- Total non-native species cover: **6%**
- Noteworthy observations: The grading and seeding associated with construction of the new biathlon range in 2007 makes this site susceptible to the establishment of invasive non-native species. Presently, ***Bromus inermis* ssp. *inermis*** is the only high-priority species at this site, where it occupies **2%** of the total area.

Figure 38 Margaux's Plot 2
Showing recent seeding

Margaux's Plot 3

- Dominant vegetation class: Mesic forb herbaceous
- Geographic coordinates: N 61.154319°, W -150.034524°
- Located at the lower tunnel
- Total non-native species cover: **27%**
- Noteworthy observations: Trace cover of moderately invasive, unranked *Alopecurus pratensis* was recorded at Plot 3. It is possible that this species was introduced as a contaminant in mulch and straw spread to stabilize the newly seeded slope. ***Bromus inermis* ssp. *inermis*** and ***Galeopsis tetrahit* s.l**. occur, in trace amounts, just outside of this plot.

Figure 39 Margaux's Plot 3
Showing straw spread to stabilize the slope.

Margaux's Loop Plot 4 is not detailed in this section as high-priority species were not detected at this location.

Margaux's Plot 5

- Dominant vegetation class: Mesic forb herbaceous
- Geographic coordinates: N 61.153346°, W -150.029341°
- Located off of the World Cup Start Area access road
- Total non-native species cover: **35%**
- Noteworthy observations: No high-priority species were detected at Plot 5. However, low-ranked ***Galeopsis tetrahit*** s.l. occupies 1% of the total area. This plot is located next to the gravel service road that accesses the World Cup start area. *Galeopsis tetrahit* s.l. occurs on the opposite side of this gravel road, and one stem of *Melilotus alba* was found (and pulled) close to the plot boundary.

Margaux's Loop Plots 6 and 7 are not detailed in this section as high-priority species were not detected at these locations.

Figure 40 Margaux's Plot 5

Galeopsis tetrahit s.l. is present in trace amounts and a stem of *Melilotus alba* was detected nearby, along Raspberry Road.

❑ Lekisch Trail

a. Summary of key findings

Non-native species occupy **36%** of the total area encompassed by exhaustive species plots completed along the Lekisch Trail (7 plots, 44 subplots, 88 m^2). The Lekisch Trail was constructed in 1987 and hosts several high-priority species, namely, ***Bromus inermis* ssp. *inermis*** (62) which comprises 21% of the cumulative area of all Lekisch Trial plots, ***Linaria vulgaris*** (61, 1%), ***Melilotus alba*** (81, 0.34%), ***Leucanthemum vulgare*** (61, 0.14%) and ***Prunus padus*** (74, percent cover not available).

The main infestation of ***Melilotus alba*** was restricted to **Plot 3** in 2008 (see below, under exhaustive plot results, and Figs. 40 and 46), but during 2009 some **new, small, and discrete infestations** of this species were spotted throughout the loop, and are especially abundant on sections of the trail closest to the coast and sand dunes (plants were hand-pulled when possible). This species is currently not widespread along the Lekisch Trail but appears to be spreading quickly. The **source of propagules has yet to be determined**, but it is unlikely that the population at Plot 3 is the only focus of dispersal. The **aggressive** behavior of this species across the state combined with its **presence in widely different habitats within Kincaid Park** (*e.g.* in areas of high disturbance [Multi-use Trail] and here along low-use trail sides [Lekisch Loops]), make this species a **top priority** for future weed control and monitoring work in Kincaid Park. We recommend that *Melilotus alba* on this trail be **controlled on an annual basis**, and that the trail be monitored for up to five years following the conclusion of control work to ensure no new plants germinate from a seed bank (if present) or disperse from the Kincaid Chalet and Multi-Use Trail, where this species is quite abundant.

Figure 41 Lekisch Trail Plot 3

A medium to large infestation of *Melilotus alba* was detected underneath the bench in 2008.

Figure 42 Lekisch Trail Plot 6 and nearby outlier populations of garden escapees

Centaurea montana and *Campanula glomerata* were detected in 2008 at the base of the hill down from Plot 6 (flagged in this photo).

Figure 43 Lekisch Trail outlier populations of *Centaurea montana* and *Campanula glomerata*

At the base of this hill, on the side of the trail overlooking Kincaid Chalet, medium sized infestations of *Centaurea montana* and *Campanula glomerata* were detected in 2008.

AKNHP botanist Helen Cortés-Burns detected medium-sized infestations (75-100 stems) of garden ornamentals ***Campanula glomerata*** (NR, Dane's blood) and ***Centaurea montana*** (NR, perennial cornflower) on the Lekisch Trail after the 2008 surveys had been completed. Both species were found at a single site located at the base of the hill shown in Figures 41 and 42 (downhill from Plot 6, see control priorities for coordinates). This infestation was revisited in summer 2009, and neither species was detected.

Figure 45 *Centaurea montana*

Found in the vicinity of Lekisch Plot 6.

Figure 44 *Campanula glomerata*

Found in the vicinity of Lekisch Plot 6.

In addition, a **second population of *Campanula glomerata*** was found at the intersection of the 2.9 km Lekisch Loop with the beginning of the 7.5 and 5.0 km Lekisch Loops (see control priorities for coordinates) in 2008, and had persisted, even if not expanded, well into summer 2009. These species are common garden plants and are thought to have escaped from plantings within Kincaid Park; however in **2008 they were not observed in the any of the gardens** closest to this site (approximately 20 m uphill along the 7.5 and 5.0 loop trail). Both these sites should be revisited in 2010, and if more plants are found, they should be controlled, and monitored again.

An additional ornamental, globeflower (***Trollius*** sp.), was observed in the vicinity of Plot 3 (N 61.15075101°, W -150.05583708°), where it formed a small infestation (~10 stems) opposite the new bench at Plot 3. This non-native species is not well-documented but it appears capable of escaping gardens and establishing in native (albeit early seral) vegetation. The *Trollius* population was controlled by hand-pulling at the time of observation. The site should be revisited in 2010.

Figure 46 *Trollius* sp.
Found in the vicinity of Plot 3 on the Lekisch Trail.

Also in 2009, one ***Prunus padus*** tree was observed (flowering and therefore producing fruit) on the Lekisch trail (Cortés-Burns, pers. obs.); the location was not recorded as the observation occurred during a recreational walk. This represents the only observation of this highly invasive tree within the Kincaid Park system. We did not see any individuals in 2008, but this negative data should not be taken to indicate that this species was absent in 2008 or that the individual discussed above is the only infestation in Kincaid Park. The tree observed in 2009 was likely overlooked in 2008 because it was growing approximately 4-5 meters off the trail and may not have been in flower at the time of survey, making it less visible.

The invasive grass, *Bromus inermis* ssp. *inermis* forms a semi-continuous infestation along much of the Lekisch Trail, especially at/around Plot 3. Eradication of this species does not constitute an efficient use of resources. We recommend that control efforts focus on the following smaller, discrete populations instead.

Control priorities for the Lekisch Trail, listed in decreasing order of importance are (coordinates are given for sites without obvious landmarks):

1. Relocate and pull the ***Prunus padus*** individual observed in 2009. At this early stage, control work might be very effective and should be followed up by monitoring the site and surrounding area for 2-3 years.
2. Eradicate ***Melilotus alba*** and ***Leucanthemum vulgare*** from Lekisch Trail Plot 3 (***M. alba*** could not be found in 2009 as the old bench was replaced with a new

one, but it is likely new plants will eventually emerge from the seedbank) and surrounding areas. Monitor the entire trail for new *M. alba* plants, as well as for the presence of new non-native species, such as the ***Trollius*** sp. observed in 2009. Eradicate as necessary, prioritizing those infestations that are most aggressive and most likely to be successfully extirpated with the available resources of time, methods, and funds.

3. Control the ***Linaria vulgaris*** population at Plot 1.
4. **Monitor** the location downhill from **Plot 6** (N 61.15374042°, W -150.06229861°), for regrowth of ***Campanula glomerata*** and ***Centaurea montana***. Also **monitor** the **intersection** of the 2.9 km Lekisch Loop with the beginning of the 7.5 and 5.0 km Lekisch Loops (N 61.15038179°, W -150.05066620°) for changes in size or behavior of ***Campanula glomerata****;* eradicate as necessary. Sites should be monitored for at least one growing season to determine the persistence of these relatively unknown non-native species.

Exhaustive plots where high-priority species were detected are described below.

b. Exhaustive species plot results

Lekisch Plot 1

- Dominant vegetation class: Mesic forb herbaceous
- Geographic coordinates: N 61.152955°, W -150.050986°
- Located next to the Andrew Lekisch Memorial Garden
- Total non-native species cover: **68%**
- Noteworthy observations: ***Linaria vulgaris*** comprises **10%** of the total area of Plot 1 and has likely migrated from the adjacent Andrew Lekisch Memorial Garden. ***Bromus inermis*** **ssp.** ***inermis*** was detected in **trace** amounts at this location.

Figure 47 Lekisch Trail Plot 1

Plot 1 adjoins the Andrew Lekisch Memorial Garden.

Lekisch Trail Plot 2 is not detailed in this section as high-priority species were not detected at this location.

Lekisch Plot 3

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.150884°, W -150.056148°
- Located at the recently renovated Lekisch Loop overlook, directly south of the old biathlon range
- Total non-native species cover: **44%**
- Noteworthy observations: This plot transects a high knoll with a lovely view; as a result the site is exposed to weather and receives considerable foot traffic. ***Bromus inermis*** **ssp.** ***inermis*** is present in all subplots comprising Plot 3 and occupies **40%** of the total area. Its abundance likely relates to natural and anthropogenic disturbances that hold this site in an early successional stage,

making it more easily invaded by ruderal species. The bench at this location was replaced in 2009.

Figure 48 Lekisch Trail Plot 3
Melilotus alba plants growing underneath the bench in 2008. Additional individuals were detected on the Lekisch Trail in 2009.

Melilotus alba first-year seedlings comprise **2%** of the total area at this plot and are located in the subplots which cross underneath the bench situated on the top of this knoll. It is possible that **fill imported** for the placement of this bench was **contaminated** with *Melilotus alba* seeds or that plant materials were brought to the site by **visitors**. This site was renovated in 2009 with a new bench and gravel fill. No *Melilotus alba* plants were detected during a revisit to the site in 2009. It is possible the seedlings observed in 2008 were casualties of the reconstruction process. Despite the apparent absence of *Melilotus alba* at Plot 3, discrete populations along the trail in either direction from this plot were observed for the first time in 2009. We highly recommend MOA trail crews focus on **controlling *Melilotus alba* along this otherwise largely weed-free trail**. This species is arguably the most invasive species present in Alaska and new populations that have not yet established in unmanageable numbers require **an early and rapid response**.

Figure 49 Lekisch Trail Plot 3
Bromus inermis ssp. *inermis* stands on either side of the trail leading to the bench.

Leucanthemum vulgare comprises **1%** of the total cover and is located in the two sub-plots closest to the main trail. A dense stand of ***Bromus inermis* ssp. *inermis*** is located just outside of Plot 3 occurring as a 3-6 foot thick band off the trail that gives way to native vegetation beyond.

Lekisch Plot 4

- Dominant vegetation class: Mesic forb herbaceous
- Geographic coordinates: N 61.151833°, W -150.061213°
- Located on the 7.5 km Lekisch Loop
- Total non-native species cover: **10%**
- Noteworthy observations: This plot is located along a single track trail diverging from the main Lekisch Trail. ***Bromus inermis* ssp. *inermis*** is the only high-priority species present and occupies **10%** of the area at this plot. Trace *Taraxacum officinale* ssp*. officinale* is the only other non-native species present. *Bromus inermis* ssp. *inermis* is nearly continuous along the trailside between Lekisch Plots 3 and 4.

Lekisch Plot 5

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.154949°, W -150.063715°
- Located on the section of the 7.5 km Lekisch Loop that runs parallel to the uphill section of the Coastal Trail on its approach to the chalet
- Total non-native species cover: **55%**
- Noteworthy observations: ***Bromus inermis* ssp. *inermis*** occupies **50%** of the total plot area and is the only high-priority species present. *Bromus inermis* ssp. *inermis* extends (with *Taraxacum officinale* ssp. *officinale*) from this plot towards the Coastal Trail for at least 30 meters on both sides of the main Lekisch Trail. Away from the trail *Bromus inermis* ssp. *inermis* eventually gives way to a dense stand of the stinging nettles (*Urtica dioica*).

Figure 50 Lekisch Trail Plot 5

Lekisch Trail Plots 6 and 7 are not detailed in this section as high-priority species were not detected at these locations.

❑ Mize Loop

a. Summary of key findings

Non-native species occupy **35%** of the total area encompassed by exhaustive species plots completed along the Mize Loop (5 plots, 21 subplots, 42 m^2). Problem species on the Mize Loop are ***Bromus inermis* ssp. *inermis*** (62, 3% of the cumulative area of Mize Loop plots), ***Leucanthemum vulgare*** (61, 2%), and ***Caragana arborescens*** (66, 2%). *Leucanthemum vulgare* and *Caragana arborescens* are associated with **horticultural plots** at Pia's and Arlene's Overlooks, respectively. Between Pia's and Arlene's overlooks there is a near continuous infestation of *Leucanthemum vulgare*.

Control priorities for the Mize Loop are:

1. Control ***Bromus inermis* ssp. *inermis*** at Plot 1 (located at the beginning of the Mize Loop) if neighboring populations surrounding the stadium are also selected for control.
2. Contact garden caretakers Paul Denkewalter (Pia's overlook) and Dick Mize (Arlene's overlook) regarding appropriate plantings at these memorials and the possibility of removing ***Leucanthemum vulgare*** and ***Caragana arborescens*** from their plantings (see Plots 1 and 4, respectively).
3. Monitor the areas surrounding the newly constructed soccer fields for the establishment of non-native invasive species.

Exhaustive plots where high-priority species were detected or are at risk of invasion are described below.

b. Exhaustive species plot results

Mize Plot 1

- Dominant vegetation class: Closed broadleaf forest
- Geographic coordinates: N 61.157341°, W -150.051994°
- Located at the beginning of the Mize Trail
- Total non-native species cover: **26%**
- Noteworthy observations: ***Bromus inermis* ssp. *inermis*** occupies **11%** the total area at this plot and is the only high-priority species present.

Mize Loop Plot 2 is not detailed in this section as high-priority species were not detected at this location.

Mize Plot 3

- Dominant vegetation class: Mesic forb herbaceous
- Geographic coordinates: N 61.161408°, W -150.056249°
- Located north of Pia's Overlook

Figure 51 Mize Loop Plot 3
Leucanthemum vulgare in bloom.

- Total non-native species cover: **74%**
- Noteworthy observations: ***Leucanthemum vulgare*** is the only high-priority species detected and occupies **10%** of the total area in Plot 3.

Mize Plot 4

- Dominant vegetation class: Mesic graminoid herbaceous
- Geographic coordinates: N 61.157954°, W -150.060165°
- Located at Arlene's overlook
- Total non-native species cover: **50%**[*]
- Noteworthy observations: a single ***Caragana arborescens*** (Fig. 49) shrub represents the only high-priority species present at Plot 4. This shrub occupies 40% of the plot area*, which was planted by caretaker Dick Mize who seemed receptive to the idea of replacing the planting with a similar-look native or at least non-invasive species when we happened to meet him at this location during the surveys (*e.g.* shrubby cinquefoil *Dasiphora fruticosa* ssp. *floribunda*).

Figure 52 Mize Loop Plot 4
Caragana arborescens growing at the base of 'Arlene's Overlook' sign.

Mize Plot 5

- Dominant vegetation class: Mesic forb herbaceous
- Geographic coordinates: N 61.158181°, W -150.057962°
- Located north of the northernmost soccer field downhill from the Chalet
- Total non-native species cover: **29%**
- Noteworthy observations: At the time of fieldwork *Poa annua* and *Taraxacum officinale* ssp. *officinale* were the only non-native species identified. However this plot is located directly across from land recently cleared for soccer fields and should be monitored for appearance of more aggressive non-native species that may have been imported as contaminants in topsoil and/or seed mix.

[*]Plot 4 consists of a single 5 x 5 m subplot, where c. 90% of the plot was covered by *Poa* spp. grasses (lawn grasses) and a few stems of *Taraxacum officinale* ssp. *officinale*

❑ Jodhpur Loop

a. Summary of key findings

This trail is well-established (constructed in 1980) and is relatively isolated from motorized traffic corridors. Non-native species occupy **33%** of the total area encompassed by exhaustive species plots completed along the Jodhpur Loop (3 plots, 18 subplots, 36 m^2). Only nine non-native species were detected on the Jodhpur Loop. None of these are high-priority species and two of the six (*Poa pratensis* [52] and *Taraxacum officinale* ssp. *officinale* [58]) are rejected from consideration due to their relative abundance and broad distribution in Alaska. *Poa annua* (46) is the most abundant non-native species, representing 28% of the total non-native cover in the Jodhpur Loop plots.

Post-fieldwork deliverables

Upon completion of the fieldwork, all electronic (positional) data were transferred to a collections database. Hardcopy data (species abundances and plot attributes) were merged with the positional database and can now be accessed as a GIS product provided with this report. All high-priority non-native plant species recorded during these surveys have been uploaded into the statewide exotic plants database (AKEPIC) and are available online.

When relevant and possible, voucher specimens were collected to represent the regularly-occurring, non-native taxa as well as non-native species of note (see Appendix III for a voucher list). The species identities of all plant specimens collected have been determined by AKNHP botanists. A total of 123 specimens, representing 71 separate species (23 of these are high-priority non-native species) were collected. Select species have been mounted following standard practices to provide a reference herbarium of non-native species in the Anchorage Bowl area. These species have been curated and are housed at the University of Alaska Anchorage herbarium (UAAH), but are available to Municipality of Anchorage (MOA) and Anchorage Parks Foundation staff upon request.

Conclusions

Invasive species are a problem for maintaining natural ecological integrity on the Municipal Park lands surveyed in this study. In our survey of the Chester Creek and Campbell Creek Greenbelts, Tony Knowles Coastal Trail, and select Kincaid Park trails 56 non-native vascular plant species were documented. Of these 56 non-native species, 13 taxa are considered highly-invasive and nine are either low-ranked or unranked species of concern. The non-native species data collected for this project has been entered into the AKEPIC statewide weeds database and voucher specimens of select non-native species have been prepared and curated in the University of Alaska Herbarium.

Species we suggest to be prioritized for eradication work are those with high invasiveness rankings that are currently restricted in distribution and/or occur infrequently. Such species include: *Medicago sativa* spp. *falcata* (64), *Melilotus alba* (81), *Phalaris arundinacea* (83), *Caragana arborescens* (66), *Hieracium aurantiacum* (79), *Cirsium arvense* (76), *Melilotus officinalis* (69), and *Campanula rapunculoides* (64). The low- and unranked species with infrequent occurrences that we also recommend be prioritized for eradication are: *Galeopsis tetrahit* s.l. (40, low-ranked), *Coronilla varia* (NR)*, Sonchus asper* (NR), *Crepis tectorum* (54, low-ranked), *Hieracium umbellatum* (54, low-ranked), and *Prunus virginiana* (NR). In addition, this study provides the first recorded instance of *Euphrasia nemorosa* in south central Alaska, as this species had only been reported from SE Alaska until this survey.

Locations that we advise to be prioritized for control work are those with either a high diversity of non-native invasive species or those areas with potential to act as dispersal foci. Such locations include:

- Coastal Trail:
  - trailsides and ditch parallel to the railroad between Elderberry Park and Westchester Lagoon
  - Westchester Lagoon
  - Earthquake Park
  - Point Woronzoff
  - Airport soil storage site
- Kincaid Park:
  - Kincaid chalet and vicinity
  - disturbed sections of the Sisson Trail, especially the gravel/materials extraction pit
  - The entire Multi-use Trail
  - Sections of Kincaid Park trails proximal to horticultural gardens
- Campbell Creek Trail
  - Waldron Lake
- Chester Creek Trail
  - Valley of the Moon Park

    - Tikishla Park
- Sections of the Campbell and Chester Creek Trails that overpass or underpass major roadways

Recommendations for control actions for Municipal park lands:

- Eradicate the large, yet discrete populations of ***Medicago sativa* ssp. *falcata*** at Coastal Trail Plot 6, and by the wooden staircase near Bunker Street
- Eradicate the incipient infestations of ***Melilotus alba*** from Lekisch Trail Plot 3 and vicinity
- Relocate and eradicate the ***Prunus padus*** individual observed along the Lekisch Trail
- Monitor and, if possible, replace the ornamental ***Caragana arborescens*** from Arlene's overlook (Mize Trail), as well as control (at a minimum, contain) those around Kincaid chalet, Point Woronzoff and Westchester Lagoon
- Control all infestations of ***Hieracium aurantiacum*** recorded during the surveys (Coastal Trail and, most critically, the population on **Arlene's Way** en route to the Sisson Loop).
- Eradicate ***Cirsium arvense*** from the upper Kincaid parking lot and Waldron Lake
- Contain, and when possible, eradicate all ***Phalaris arundinacea*** populations found along the Coastal Trail, and especially the discrete populations at Kincaid Stadium, by the Chalet, and along the Multi-use trail, especially in areas where this trail intersects with other trails (as these could become potential dispersal foci).
- ***Vicia cracca*** populations on Campbell and Chester Creek Trails should be contained. Control work should be conducted first on those populations that are small and farthest away from any large ones. In Kincaid and on the Coastal Trail most infestations are small, and could therefore be targeted for eradication.

Recommendations for future monitoring work:

- Monitor the spread of *Prunus padus* and *Prunus virginiana* up the Campbell and Chester Creeks
- Survey areas of new construction for the establishment of non-native species (*e.g.* snowmaking installations, biathlon range and soccer fields at Kincaid, Fish Passage project at Westchester Lagoon) so that their populations can be controlled when still at a manageable size.
- Attempt to quantify the potential invasiveness of species that are either currently poorly-documented (*Lolium perenne* ssp. *multiflorum, Lolium perenne* ssp. *perenne, Persicaria lapathifolia*) or that are being sold in Alaska as ornamentals or in wildflower-type seed mixes (*Cheiranthus allionii, Lychnis chalcedonica*, *Campanula glomerata, Centaurea montana, Leucanthemum* x *superbum, Rosa rugosa,* and *Trollius* sp.).

Based on our findings and observations, we strongly advise that the MOA institute stronger standards for the **maximum allowable level of contaminants** in topsoil and seed mixes used for revegetation projects on municipal lands. The diversity and abundance of non-native species that are now well-established along the newly constructed Multi-use Trail are testament to the ecological problems that can arise if

weed-free soil and seed are not mandated for use in new construction. It is our concern that this same scenario might be repeated for the multiple construction projects ongoing at Kincaid Park and the Fish Passage Project at Westchester Lagoon.

Ultimately, the best approach to cost-effective weeds management is **prevention**. Proactive efforts to prevent the introduction and establishment of invasive species can be achieved by creating and implementing a suite of **best management practices** (BMPs), as well as offering **training** for MOA trail crews and resource managers in **invasive plant identification**, modes of introduction and dispersal, and in **weed control methods** that can be implemented on MOA lands.

It is also important that the MOA continues to support **inventory and monitoring work**. This will increase the chances of detecting new, incipient infestations early and will therefore enable MOA natural resource managers to respond to these infestations with the appropriate control methods before they become established (an approach often referred to as: **Early Detection, Rapid Response**). By monitoring known populations MOA will be able to determine whether there have been any changes in the size and/or behavior of existing weed populations, and will also be able to evaluate the effectiveness of control treatments on specific infestations.

Finally, MOA's current involvement in **Anchorage's Cooperative Weed Management Area** group is commendable, and is likely to result in the creation of new collaborations with neighboring land owners (*e.g.*, with the Bureau of Land Management Anchorage Field Office, which manages Campbell Tract). These **partnerships** could, be used to promote the development of an integrated, multi-agency invasive species prevention and management program.

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Appendices

Appendix I: Highly-invasive species recorded in Alaska

Scientific Name	Common Name	Family	Invasiveness Ranking
Myriophyllum spicatum	Eurasian watermilfoil	Haloragaceae	**90**
Polygonum sachalinensis	giant knotweed	Polygonaceae	**87**
Centaurea biebersteinii	spotted knapweed	Asteraceae	**86**
Lythrum salicaria	purple loosestrife	Lythraceae	**83**
Lythrum virgatum	garden yellow loosestrife	Lythraceae	**83**
Phalaris arundinacea	reed canarygrass	Poaceae	**83**
Impatiens glandulifera	ornamental jewelweed	Balsaminaceae	**82**
Melilotus alba	white sweetclover	Fabaceae	**81**
Nymphaea odorata ssp. *odorata*	American white waterlilly	Nymphaeaceae	**80**
Hieracium aurantiacum	orange hawkweed	Asteraceae	**79**
Hieracium caespitosum	narrowleaf hawkweed	Asteraceae	**79**
Bromus tectorum	cheatgrass	Poaceae	**78**
Rubus discolor	Himalayan blackberry	Rosaceae	**77**
Cirsium arvense	Canada thistle	Asteraceae	**76**
Prunus padus	European bird cherry	Rosaceae	**74**
Sonchus arvensis ssp. *uliginosus*	perennial sowthistle	Asteraceae	**73**
Vicia cracca	bird vetch	Fabaceae	**73**
Alliaria petiolata	garlic mustard	Brassicaceae	**70**
Cytisus scoparius	scotchbroom	Fabaceae	**69**
Melilotus officinalis	yellow sweetclover	Fabaceae	**69**
Caragana arborescens	Siberian peashrub	Fabaceae	**66**
Lonicera tatarica	bush honeysuckle	Caprifoliaceae	**66**
Campanula rapunculoides	creeping bellflower	Campanulaceae	**64**
Medicago sativa ssp. *falcata*	Yellow alfalfa	Fabaceae	**64**
Hordeum jubatum	foxtail barley	Poaceae	**63**
Senecio jacobaea	tansy ragwort	Asteraceae	**63**
Bromus inermis ssp. *inermis*	smooth brome	Poaceae	**62**
Cirsium vulgare	bull thistle	Asteraceae	**61**
Leucanthemum vulgare	oxeye daisy	Asteraceae	**61**
Linaria vulgaris	butter and eggs	Scrophulariaceae	**61**
Hordeum murinum ssp. *leporinum*	lepor barley	Poaceae	**60**

Note: highly-invasive species are those ranked 60 or higher by the Invasiveness Ranking System for Non-Native Plants of Alaska (Carlson *et al.* 2008)

Appendix II: Field datasheet

2008 Anchorage Municipality Non-Native Plant surveys — GROUND FORM

Plant Associations Anchorage Parks Foundation Trails - Non-Native Plants

Plot #	Surveyors:		Date:
Coastal Trail COA	**GPS used:**	WP:	Plot Size: ______ x ______ (m)
Chester CHE	Lat (dd):	Elevation (m):	2m x 10m if high infestation
Campbell CAM	Lon (dd):	GPS Error ±	2m x 5 m if low infestation
Kincaid KIN	Photos taken:		

Vegetated	Grnd% Cov	Unvegetated	% Cover
Needleleaf		Litter, duff	
Broadleaf		Wood (>2.5cm)	
Tall shrub (>1.52m)		Silt (feel on tongue)	
Low (20.3cm >1.52m)		Sand (feel b/w fingers)	
Dwarf (<20.3cm)		Small rocks (gravel <7.6cm)	
Forb		Large rocks (cobbles 7.6-20.3cm, boulders >20.3cm)	
Grass			
Sedge			
Moss		Bedrock	
Lichen		Trunks of trees (basal area)	
Unvegetated			
Water		Other (describe):	
Other:			

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

Landform

Landform & distinctive characterstics:

Notes:

Slope (0-100°):

Floodplain? ( ) Yes ( ) No

Disturbance type
- Fill importation
- Material extraction
- ORV disturbance
- Mowing
- Trampling
- Logging
- Mining
- Grazing
- Plowing
- Mechanical Brush/Tree Cutting
- River Action (Flooding/ Erosion-Ice scour/ Deposition, Stream Action
- Herbicide application
- Other mechanical
- Abandoned Homesite
- Forest Fire
- Land Slide/Avalanche
- Caribou/Moose disturb
- Windthrow
- Wind erosion/deposition
- Thermal disturbance
- Glaciation
- Volcanic action
- Costal/Beach

Prunus padus **classes:**

		Infested area:	
PRU PAD 0	non woody seedlings		
PRU PAD W0	woody seedlings <1 inch DBH		
PRU PAD W01	woody seedlings <1 inch DBH AND ≥ 1 meter tall		
PRU PAD 3	DBH = 1-3 inches (2.5-7.5 cm)	0.001 acre	3.7ft radius
PRU PAD 5	DBH = 3-5 inches (2.5-7.5 cm)	0.01 acre	12ft radius
PRU PAD 7	DBH = 5-7 inches (7.5-12.5 cm)	0.1 acre	37ft radius
PRU PAD 7+	DBH = 7+ inches (18+ cm)	1/2 acre	83ft radius
PRU PAD 'S'	Suckering	1 acre	118ft radius

AKEPIC

A. Site Info
- Area Surveyed ______ acres
- Disturbance type ______
- Disturbance years

For Non-Native Species

Species	% Cover	Ht (m)	DBH (cm)	Infested area (acres)	Stem Count of Listed Species	Control action	Notes on Aggressiveness

Stem Count
(1-5) (6-25) (26-50)
(51-150) (151-500) (500+)

Control
- Manual (Pulling,Digging)
- Mechanical (Mow, etc)
- Broadcast Herbicide
- Spot Herbicide
- Aerial Herbicide
- Other
- None

Canopy Cover
Increments of 10% Starting with 1% ending with 100%

Aggressiveness
- Low
- Medium
- High

updated August 5, 2008

Appendix III: Voucher list

Scientific Name	Family	Collection Date	Latitude	Longitude	Location	Habitat
Actaea rubra	Ranunculaceae				Kincaid Park	
Alopecurus pratensis	Poaceae	08/08/2008	61.137709	-149.925475	Campbell Creek Trail	Mesic forb herbaceous
Alopecurus pratensis	Poaceae	07/22/2008	61.202163	-150.009025	Coastal Trail	Mesic forb herbaceous
Arnica chamissonis ssp. *chamissonis*	Asteraceae	08/18/2008	61.1775	-149.82404	Campbell Creek Trail	Open needleleaf forest
Bidens cernua	Asteraceae	08/04/2008	61.20862	-149.92225	Chester Creek Trail	Mesic forb herbaceous
Bromus inermis ssp. *inermis*	Poaceae	07/31/2008	61.208628	-149.922250	Chester Creek Trail	Mesic forb herbaceous
Bromus inermis ssp. *inermis*	Poaceae	07/22/2008	61.208383	-149.921645	Coastal Trail	Mesic graminoid herbaceous
Bromus inermis ssp. *inermis*	Poaceae	06/27/2008	61.150884	-150.056148	Kincaid Park Lekisch Trail	Mesic graminoid herbaceous
Bromus inermis ssp. *inermis*	Poaceae	06/27/2008	61.150884	-150.056148	Kincaid Park Lekisch Trail	Mesic graminoid herbaceous
Bromus inermis ssp. *inermis*	Poaceae	06/27/2008	61.150884	-150.056148	Kincaid Park Lekisch Trail	Mesic graminoid herbaceous
Bromus inermis ssp. *inermis*	Poaceae	06/27/2008	61.150884	-150.056148	Kincaid Park Lekisch Trail	Mesic graminoid herbaceous
Calamagrostis canadensis	Poaceae	08/04/2008	61.159658	-149.875085	Campbell Creek Trail	Mesic graminoid herbaceous
Calamagrostis canadensis	Poaceae	08/04/2008	61.20097	-149.86122	Chester Creek Trail	Mesic graminoid herbaceous
Calamagrostis canadensis	Poaceae	07/21/2008	61.208383	-149.921645	Coastal Trail	Mesic graminoid herbaceous
Campanula glomerata	Campanulaceae	07/20/2008			Kincaid Park Lekisch Loop Trail	
Capsella bursa-pastoris	Brassicaceae	06/30/2008	61.153346	-150.029341	Kincaid Park Margaux Loop Trail	Mesic forb herbaceous
Caragana arborescens	Fabaceae	06/26/2008	61.157954	-150.060165	Kincaid Park Mize Loop Trail	Mesic graminoid herbaceous
Cerastium glomerata	Caryophyllaceae	08/26/2008	61.1659227	-150.050864	Kincaid Park Sisson Loop Trail	Mesic forb herbaceous
Cheiranthus allionii	Brassicaceae	06/30/2008			Kincaid Park	
Chenopodium album	Chenopodiaceae	08/28/2008	61.159194	-150.010867	Kincaid Park Multi-use Trail	Mesic forb herbaceous

Scientific Name	Family	Collection Date	Latitude	Longitude	Location	Habitat
Cirsium arvense	Asteraceae	08/18/2008	61.17736	-149.85188	Campbell Creek Trail	Mesic forb herbaceous
Cirsium arvense	Asteraceae	08/18/2008	61.17736	-149.85188	Campbell Creek Trail	Mesic forb herbaceous
Cirsium arvense	Asteraceae	09/09/2008	61.155510	-150.050692	Kincaid Park	Dry graminoid herbaceous
Coronilla varia	Fabaceae	07/31/2008	61.205394	-149.904877	Chester Creek Trail	Mesic graminoid herbaceous
Crepis tectorum	Asteraceae	08/18/2008	61.17653	-149.81566	Campbell Creek Trail	Mesic graminoid herbaceous
Crepis tectorum	Asteraceae	08/07/2008	61.198725	-149.822024	Chester Creek Trail	Mesic graminoid herbaceous
Crepis tectorum	Asteraceae	07/21/2008	61.209606	-149.922884	Coastal Trail	Dry graminoid herbaceous
Crepis tectorum	Asteraceae	08/26/2008	61.162868	-150.046819	Kincaid Park Sisson Loop Trail	Mesic forb herbaceous
Deschampsia caespitosa	Poaceae	08/18/2008	61.177575	-149.842708	Campbell Creek Trail	Mesic graminoid herbaceous
Deschampsia caespitosa	Poaceae	08/04/2008	61.20126	-149.85889	Chester Creek Trail	Open low shrub
Deschampsia caespitosa	Poaceae	07/22/2008	61.208383	-149.921645	Coastal Trail	Mesic graminoid herbaceous
Diplacus aurantiacus ssp. *aurantiacus*	Scrophulariaceae	08/08/2008	61.141938	-149.907429	Campbell Creek Trail	Mesic forb herbaceous
Elymus repens	Poaceae	08/11/2008	61.165165	-149.877208	Campbell Creek Trail	Mesic graminoid herbaceous
Elymus repens	Poaceae	08/11/2008	61.165165	-149.877208	Campbell Creek Trail	Mesic graminoid herbaceous
Elymus repens	Poaceae	08/04/2008	61.204212	-149.910543	Chester Creek Trail	Broadleaf woodland
Elymus repens	Poaceae	06/30/2008			Kincaid Park	
Epilobium palustre	Onagraceae	08/04/2008	61.20862	-149.92225	Chester Creek Trail	Mesic forb herbaceous
Erysimum cheiranthoides	Brassicaceae	07/31/2008	61.208628	-149.922250	Chester Creek Trail	Mesic forb herbaceous
Erysimum cheiranthoides	Brassicaceae	07/18/2008			Coastal Trail	Dry graminoid herbaceous
Euphrasia nemorosa	Scrophulariaceae	08/26/2008	61.155510	-150.050692	Kincaid Park Stadium	Dry graminoid herbaceous
Festuca rubra	Poaceae	07/22/2008	61.208383	-149.921645	Coastal Trail	Mesic graminoid herbaceous
Festuca rubra	Poaceae	06/26/2008	61.161408	-150.056249	Kincaid Park Mize Loop Trail	Closed broadleaf forest
Galeopsis bifida	Lamiaceae	06/28/2008	61.154319	-150.034524	Kincaid Park Margaux Loop Trail	Mesic forb herbaceous
Galeopsis tetrahit	Lamiaceae	08/28/2008	61.154456	-150.017223	Kincaid Park Multi-Use Trail	Mesic forb herbaceous

Scientific Name	Family	Collection Date	Latitude	Longitude	Location	Habitat
Galium triflorum	Rubiaceae	06/30/2008	61.153346	-150.029341	Kincaid Park Margaux Loop Trail	Mesic forb herbaceous
Hieracium aurantiacum	Asteraceae	07/21/2008	61.208569	-149.923566	Coastal Trail	Mesic forb herbaceous
Hieracium aurantiacum	Asteraceae	07/21/2008	61.208569	-149.923566	Coastal Trail	Mesic forb herbaceous
Hieracium aurantiacum	Asteraceae	07/21/2008	61.208569	-149.923566	Coastal Trail	Mesic forb herbaceous
Hieracium umbellatum	Asteraceae	08/08/2008	61.138361	-149.922039	Campbell Creek Trail	Dry graminoid herbaceous
Hordeum brachyantherum	Poaceae	08/08/2008	61.137709	-149.925475	Campbell Creek Trail	Mesic forb herbaceous
Hordeum brachyantherum	Poaceae	08/04/2008	61.20862	-149.92225	Chester Creek Trail	Mesic forb herbaceous
Hordeum brachyantherum	Poaceae	07/22/2008	61.208383	-149.921645	Coastal Trail	Mesic graminoid herbaceous
Lathyrus japonicus var. maritimus	Fabaceae	07/10/2008	61.1765471	-150.038561	Coastal Trail	Mesic forb herbaceous
Lathyrus palustris	Fabaceae	08/07/2008	61.19995	-149.83247	Chester Creek Trail	Needleleaf woodland
Leucanthemum sp.	Asteraceae	06/26/2008			Kincaid Park	
Leucanthemum vulgare	Asteraceae	07/03/2008	61.217983	-149.907111	Coastal Trail	Mesic graminoid herbaceous
Leucanthemum vulgare	Asteraceae	06/27/2008	61.150884	-150.056148	Kincaid Park Lekisch Loop Trail	Mesic graminoid herbaceous
Leymus mollis	Poaceae	07/22/2008			Coastal Trail	
Lolium perenne ssp. *multiflorum*	Poaceae	07/21/2008			Coastal Trail	
Lolium perenne ssp. *multiflorum*	Poaceae	06/30/2008			Kincaid Park	
Lolium perenne ssp. *perenne*	Poaceae	08/28/2008	61.154456	-150.017223	Kincaid Park Multi-Use Trail	Mesic forb herbaceous
Lupinus polyphyllus	Fabaceae	06/28/2008	61.154319	-150.034524	Kincaid Park Margaux Loop Trail	Mesic forb herbaceous
Lupinus polyphyllus	Fabaceae	06/26/2008	61.161408	-150.056249	Kincaid Park Mize Loop Trail	Closed broadleaf forest
Lupinus polyphyllus	Fabaceae	06/26/2008	61.161408	-150.056249	Kincaid Park Mize Loop Trail	Closed broadleaf forest
Lychnis chalcedonica	Caryophyllaceae	08/28/2008	61.154456	-150.017223	Kincaid Park Multi-Use Trail	Mesic forb herbaceous
Medicago sativa ssp. *falcata*	Fabaceae	07/03/2008	61.217911	-149.908461	Coastal Trail	Mesic forb herbaceous
Medicago sativa ssp. *falcata*	Fabaceae	07/03/2008	61.217911	-149.908461	Coastal Trail	Mesic forb herbaceous
Melilotus alba	Fabaceae	08/08/2008	61.137709	-149.925475	Campbell Creek Trail	Mesic forb herbaceous
Melilotus alba	Fabaceae	07/22/2008	61.200701	-150.020167	Coastal Trail	Mesic graminoid herbaceous

Scientific Name	Family	Collection Date	Latitude	Longitude	Location	Habitat
Melilotus alba	Fabaceae	06/27/2008	61.150884	-150.056148	Kincaid Park Lekisch Loop Trail	Mesic graminoid herbaceous
Melilotus officinalis	Fabaceae	09/09/2008	61.165131	-150.059245	Kincaid Park Sisson Loop Trail	Mesic forb herbaceous
Moehringia lateriflora	Caryophyllaceae	06/26/2008	61.157341	-150.051994	Kincaid Park Mize Loop Trail	Closed broadleaf forest
Myosotis sylvatica	Boraginaceae	06/30/2008			Kincaid Park	
Phalaris arundinacea	Poaceae	08/18/2008	61.178020	-149.827677	Campbell Creek Trail	Needleleaf woodland
Phalaris arundinacea	Poaceae	08/18/2008	61.178020	-149.827677	Campbell Creek Trail	Needleleaf woodland
Phalaris arundinacea	Poaceae	07/31/2008	61.206233	-149.914391	Chester Creek Trail	Mesic graminoid herbaceous
Phalaris arundinacea	Poaceae	07/22/2008	61.208383	-149.921645	Coastal Trail	Mesic graminoid herbaceous
Phleum pratense	Poaceae	08/11/2008	61.16516	-149.87721	Campbell Creek Trail	Mesic graminoid herbaceous
Phleum pratense	Poaceae	08/04/2008	61.20097	-149.86122	Chester Creek Trail	Mesic graminoid herbaceous
Phleum pratense	Poaceae	07/22/2008	61.2024187	-150.009843	Coastal Trail	Mesic forb herbaceous
Plantago major	Plantaginaceae	08/04/2008	61.206076	-149.913963	Chester Creek Trail	Mesic graminoid herbaceous
Poa annua	Poaceae	08/18/2008	61.178020	-149.827677	Campbell Creek Trail	Needleleaf woodland
Poa annua	Poaceae	07/31/2008	61.201693	-149.868538	Chester Creek Trail	Open broadleaf forest
Poa glauca	Poaceae	07/22/2008	61.200491	-150.020121	Coastal Trail	Mesic graminoid herbaceous
Poa palustris	Poaceae	08/18/2008	61.177937	-149.836806	Campbell Creek Trail	Mesic forb herbaceous
Poa pratensis ssp. *irrigata*	Poaceae	08/11/2008	61.165670	-149.873978	Campbell Creek Trail	Mesic forb herbaceous
Poa pratensis ssp. *pratensis*	Poaceae	08/11/2008	61.154922	-149.877837	Campbell Creek Trail	Mesic forb herbaceous
Poa pratensis ssp. *pratensis*	Poaceae	08/04/2008	61.204212	-149.910543	Chester Creek Trail	Broadleaf woodland
Polygonum aviculare	Polygonaceae	06/28/2008	61.154319	-150.034524	Kincaid Park Margaux Loop Trail	Mesic forb herbaceous
Polygonum aviculare	Polygonaceae	06/28/2008	61.154319	-150.034524	Kincaid Park Margaux Loop Trail	Mesic forb herbaceous
Polygonum aviculare	Polygonaceae	06/28/2008	61.154319	-150.034524	Kincaid Park Margaux Loop Trail	Mesic forb herbaceous

Scientific Name	Family	Collection Date	Latitude	Longitude	Location	Habitat
Polygonum aviculare	Polygonaceae	06/28/2008	61.154319	-150.034524	Kincaid Park Margaux Loop Trail	Mesic forb herbaceous
Polygonum lapathifolium	Polygonaceae	06/28/2008	61.154319	-150.034524	Kincaid Park Margaux Loop Trail	Mesic forb herbaceous
Polygonum lapathifolium	Polygonaceae	06/28/2008	61.154319	-150.034524	Kincaid Park Margaux Loop Trail	Mesic forb herbaceous
Polygonum lapathifolium	Polygonaceae	06/28/2008	61.154319	-150.034524	Kincaid Park Margaux Loop Trail	Mesic forb herbaceous
Polygonum lapathifolium	Polygonaceae	06/28/2008	61.154319	-150.034524	Kincaid Park Margaux Loop Trail	Mesic forb herbaceous
Polygonum lapathifolium	Polygonaceae	08/28/2008	61.155526	-150.016516	Kincaid Park Multi-Use Trail	Mesic graminoid herbaceous
Ranunculus abortivus	Ranunculaceae	06/30/2008	61.153346	-150.029341	Kincaid Park Margaux Loop Trail	Mesic forb herbaceous
Ranunculus sceleratus var. multifidus	Ranunculaceae	08/04/2008	61.20862	-149.92225	Chester Creek Trail	Mesic forb herbaceous
Rhinanthus minor	Scrophulariaceae	08/04/2008	61.20862	-149.92225	Chester Creek Trail	Mesic forb herbaceous
Rorippa barbareifolia	Brassicaceae	08/15/2008	61.17352	-149.86453	Campbell Creek Trail	Riparian
Rorippa barbareifolia	Brassicaceae	06/28/2008	61.154319	-150.034524	Kincaid Park Margaux Loop Trail	Mesic forb herbaceous
Rorippa islandica	Brassicaceae	08/04/2008	61.20862	-149.92225	Chester Creek Trail	Mesic forb herbaceous
Rumex acetosella	Fabaceae	07/03/2008	61.217983	-149.907111	Coastal Trail	Mesic graminoid herbaceous
Rumex acetosella	Polygonaceae	08/26/2008	61.166756	-150.052904	Kincaid Park Sisson Loop Trail	Mixed woodland
Rumex longifolius	Polygonaceae	08/08/2008	61.141938	-149.907429	Campbell Creek Trail	Mesic forb herbaceous
Rumex longifolius	Polygonaceae	08/08/2008	61.141938	-149.907429	Campbell Creek Trail	Mesic forb herbaceous
Rumex longifolius	Polygonaceae	08/08/2008	61.141938	-149.907429	Campbell Creek Trail	Mesic forb herbaceous
Silene dioica	Caryophyllaceae	07/01/2008	61.215440	-149.912127	Coastal Trail	Mesic herb meadow
Silene dioica	Caryophyllaceae	07/01/2008	61.215440	-149.912127	Coastal Trail	Mesic herb meadow
Silene latifolia	Caryophyllaceae	09/12/2008	61.202399	-150.019892	Coastal Trail	Mesic graminoid herbaceous
Smilacina stellata	Liliaceae	06/26/2008	61.158181	-150.057962	Kincaid Park Mize Loop Trail	Mesic forb herbaceous
Sonchus asper	Asteraceae	09/12/2008	61.176547	-150.038561	Coastal Trail	Mesic forb herbaceous

Scientific Name	Family	Collection Date	Latitude	Longitude	Location	Habitat
Spergula arvensis	Caryophyllaceae	09/09/2008	61.1651311	-150.059245	Kincaid Park Sisson Loop Trail	Mesic forb herbaceous
Stellaria longipes	Caryophyllaceae	06/26/2008			Kincaid Park	Under alder scrub
Thalictrum sparsiflorum	Ranunculaceae	08/15/2008	61.169580	-149.871622	Campbell Creek Trail	Mesic graminoid herbaceous
Trifolium hybridum	Fabaceae	06/30/2008			Kincaid Park	
Trifolium pratense	Fabaceae	07/10/2008			Coastal Trail	
Trifolium pratense	Fabaceae	08/28/2008	61.159194	-150.010867	Kincaid Park Multi-Use Trail	Mesic forb herbaceous
Trifolium repens	Fabaceae	08/08/2008	61.150359	-149.883684	Campbell Creek Trail	Mesic forb herbaceous
Trisetum spicatum ssp. *majus*	Poaceae	07/22/2008	61.202419	-150.009843	Coastal Trail	Mesic graminoid herbaceous
Vicia cracca	Fabaceae	07/03/2008	61.215372	-149.912780	Coastal Trail	Open broadleaf forest
Vicia cracca	Fabaceae	08/28/2008	61.159194	-150.010867	Kincaid Park Multi-Use Trail	Mesic forb herbaceous

Appendix IV: Biology, distribution and management recommendations for select non-native species

The following provides brief descriptions of the biology, ecological impact, distribution and appropriate control methods for the high-priority, low-ranked and unranked species of concern encountered in this study. More detailed biographies can be found for ranked non-native species at the statewide Non-Native Plants of Alaska website (http://akweeds.uaa.alaska.edu/akweeds_ranking_page.htm) and for selected non-native species in the Invasive Plants of Alaska field guide (AKEPIC 2005).

The descriptions included herein were developed with the intention that information for a single species (*e.g.* the target species for an organized weed pull) or subset of species (*e.g.* all those occurring on the Chester Creek Greenbelt) could be removed, copied and brought into the field by weed management crews.

The mechanical and chemical control recommendations presented are based on management practices shown to be effective in similar ecogeographic regions and on invasive species control research conducted in Alaska.

High-priority species

High-priority species are those ranked 60 or higher by the Invasiveness Ranking System for Non-Native Plants of Alaska (Carlson *et al.* 2008) (see Appendix I for a complete list). This ranking system was developed to identify which non-native plants have the potential to cause most damage in Alaska and to assist land managers and owners in setting priorities for exotic weed management and control. The system evaluates a given species with respect to potential ecosystem impacts, biological attributes, known distribution, efficacy of available control measures, and the potential for establishment in the different ecogeographic regions of Alaska (south-coastal, interior-boreal, and arctic/alpine). Based on this evaluation, species are ranked between zero and 100, where zero indicates low invasiveness and 100 indicates high aggressiveness (see http://akweeds.uaa.alaska.edu/akweeds_ranking_page.htm for further information on the invasiveness ranking system).

Low-ranked species of concern

Based on a combination of taxonomic and ecological reasons we believe that several low-ranked (less than 60 points; Carlson *et al.* 2008) non-native species detected in this study merit concern. These under-ranked species are: *Galeopsis tetrahit* s.l. (40, bristle-stemmed and split lip hempnettle), *Crepis tectorum* (54, narrow-leaved hawksbeard), and *Hieracium umbellatum* (54, narrow-leaved hawkweed). The reasons for which we believe these species are concerning despite their low rankings are provided in their respective biographies.

Unranked species

Fourteen non-native species detected in this study (*Alopecurus pratensis, Campanula glomerata, Centaurea montana*†*, Cheiranthus allionii, Coronilla varia, Erucastrum gallicum*†*, Euphrasia nemorosa, Leucanthemum* x *superbum*†*, Lolium perenne* ssp. *perenne, Lychnis chalcedonica*†*, Prunus virginiana*†*, Rosa rugosa, Sonchus asper* and *Trollius* sp†.) have not been ranked using the Invasiveness Ranking System (Carlson *et al.* 2008). Most non-native species that currently remain unranked will be ranked once additional funds become available, but some represent new introductions to the state that were not prioritized for ranking because they had not yet been reported.

Of the 14 unranked species recorded during these surveys ***Coronilla varia, Prunus virginiana****,* and ***Sonchus asper*** have the potential of becoming highly aggressive in Alaska. *Alopecurus pratensis, Cheiranthus allionii, Euphrasia nemorosa, Erucastrum gallicum* and *Leucanthemum* x *superbum* are naturalized but do not appear to be highly invasive in Alaska, nor are they considered highly invasive in states and Canadian provinces with similar climatic and ecological conditions. Lastly, we place the garden ornamentals *Campanula glomerata*, *Centaurea montana, Lychnis chalcedonica*, *Rosa rugosa* and *Trollius* sp. in a third category, as species that have been documented escaping cultivation, but for which we lack information and therefore do not fully understand their potential to disrupt ecosystem structure and processes. For this reason, species in this last group should be monitored so that their ability to disperse and persist in native vegetation can be quantified.

Species not considered in this report

The following non-native invasive species are rejected from further consideration in this report due to their overall low to medium impact on native ecosystems, their broad local or statewide distributions, and in some cases, the possible introgression of native and non-native species or genotypes.

Hordeum jubatum (63, foxtail barley)

Hordeum jubatum is highly invasive and considered a nuisance weed as its barbed awns can burrow into an animal's mouth or skin thereby posing a threat to animals that may ingest the plant such as dogs or horses. However, *Hordeum jubatum* is not considered a high-priority species in this study as its distribution is largely restricted to areas of medium to high disturbance and its taxonomy and nativity have yet to be adequately determined. It is currently accepted that native and non-native genotypes of *Hordeum jubatum* exist in Alaska, but these cannot be distinguished phenotypically. Furthermore, hybridization between the native and non-native genotypes is possible, further blurring the distinction between these two (potential) taxa.

Taraxacum officinale **ssp.** ***officinale*** (58, common dandelion)

Taraxacum officinale ssp. *officinale* and *Poa annua* are two of the most abundant non-native plant species present in Alaska. However, they are not treated here due to their

† Species detected as outlier populations only

relatively low aggressiveness (invasiveness rankings are less than 60 points) and their widespread distributions. Weed management is most efficient when directed towards species that are uncommon or present as small outlier populations. Therefore, attempting to control well-established and large populations such as *Taraxacum officinale* ssp. *officinale* and *Poa annua* would be an inefficient use of resources.

Poa pratensis* spp. *pratensis* and ssp. *irrigata (52, Kentucky, spreading or rough bluegrass)

Poa pratensis (including subspecies *P. pratensis* ssp. *pratensis* and ssp. *irrigata*) is rejected from consideration due to the following reasons: 1) its low aggressiveness (invasiveness rankings are less than 60 points), 2) difficulty to identify and distinguish the three non-native subspecies (*P. pratensis* ssp. *pratensis*, *P. pratensis* ssp. *irrigata* and *P. pratensis* ssp. *colpodea*) from the native subspecies (*P. pratensis* ssp. *alpigena*) in the field (USDA, NRCS. 2009), 3) the existence of multiple cultivated varieties (*cf*. http://dnr.alaska.gov/ag/PMCwebsite/pmcweb/chapter5/5-bluegrass.htm#merion) which are commonly used for revegetation purposes in Alaska, and 4) because it is not known what subspecies the cultivars were derived from, or whether there is any potential for hybridization between the cultivated and wild taxa.

Poa annua (46, annual bluegrass)

See *Taraxacum officinale* ssp*. officinale* section for justification.

Stellaria media (42, chickweed)

Stellaria media is not treated here on the basis of its low aggressiveness (invasiveness ranking is less than 60 points) and its local abundance. Although *Stellaria media* is not as abundant as *Poa annua* or *Taraxacum officinale* ssp. *officinale* on a statewide basis, it is abundant in the Anchorage area. In addition, the impacts of *Stellaria media* are negligible compared to other weed species and it can be effectively removed by hand pulling if the population is sufficiently small.

Species biographies, distribution maps and control and management recommendations

Alopecurus pratensis (NR, field meadow foxtail)

Species biography

Alopecurus pratensis is a highly palatable grass that has been widely cultivated in North America as a pasture grass and for hay since the 1800s. Throughout most of its range in the northeastern and northwestern U.S. and Canada it appears to have low impacts on biodiversity, although in Oregon it has invaded native wet and dry meadows (NatureServe 2009). **Given its low aggressiveness** in the Lower 48 states, and that this species is **confined to high-use** areas **in Alaska** (*e.g.* roadsides, trails, around cabins), we suspect that it is **similar to *Phleum pratense*** (54, timothy grass, which is grown locally for hay) in terms of its aggressiveness.

Alopecurus pratensis © 2005 Steve Matson

Control methods and management recommendations

Even though *Phleum pratense* and *Alopecurus pratensis* are able to persist in disturbed habitats (urban and remote), they have **not been observed moving off the human footprint** and therefore their impacts on native ecosystems are smaller than those of higher ranked species. Consequently, we **do not suggest this species be prioritized** for control work.

Distribution

Unranked *Alopecurus pratensis* was recorded in trace amounts on the Campbell Creek trail and Margaux's Loop; outlier populations were detected around the Kincaid Chalet, Stadium and on the Coastal Trail.

Bromus inermis* ssp. *inermis (62, smooth brome)

Species biography

Bromus inermis ssp. *inermis.* Virginia Moore © California Academy of Sciences.

Bromus inermis ssp. *inermis* was imported into the United States in the late 1800s as a forage grass and for hay production. In Alaska, it has been widely planted for erosion control (AKEPIC 2005), and is also effectively dispersed as a contaminant in top soil (Densmore *et al.* 2001). This aggressive non-native grass reproduces by seeds and by rhizomes (horizontal belowground stems). Seeds generally remain viable in the soil for 2-10 years (AKEPIC 2005). This species can establish in undisturbed or lightly disturbed, moist, loamy soils, and is fire-tolerant, and winter-hardy even in interior Alaska (AKEPIC 2005). In the Lower 48, it colonizes degraded prairies, roadsides, ditches, and moist wooded areas (Minnesota DNR 2003). In Alaska it forms dense stands that exclude native species and consequently may inhibit natural successional processes (AKEPIC 2005, Cortés-Burns pers. obs.).

Control and management recommendations

Bromus inermis ssp. *inermis* is one of the more problematic and widespread invasive species in Alaska. It **reproduces by rhizomes and seed**, with seeds remaining **viable** for **up to 10 years** in the soil, has been **widely used** for roadside revegetation projects, and is now naturalized in south-central Alaska.

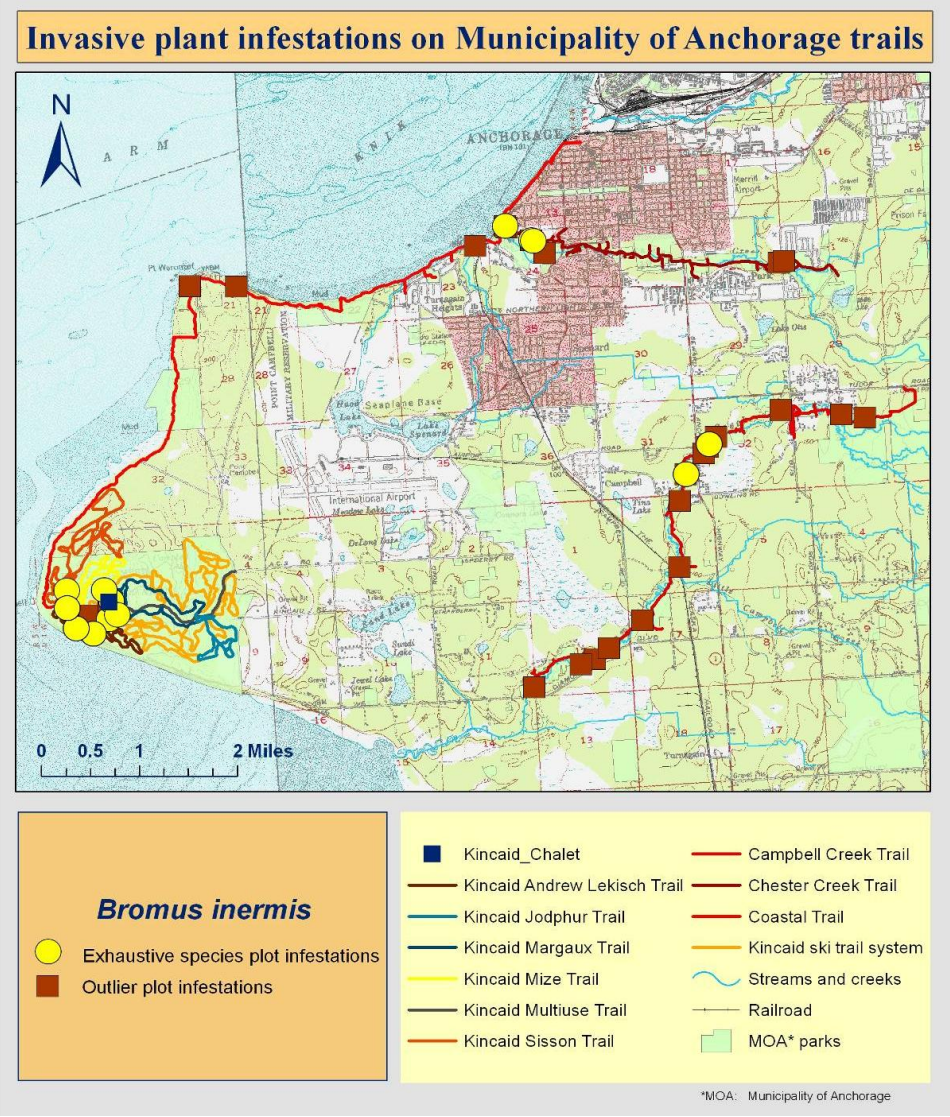
We recommend that control work focus on **containing existing infestations** by preventing plants from going to seed. Populations should be **mowed, cut, or hand weeded before the inflorescence can be felt** at the top of the elongating stem. **Mowing monthly** during the growing season over a **four-year period** can greatly reduce the persistence of *Bromus inermis* ssp. *inermis* (Marten and Hovin 1980).

Control recommendations for *Bromus inermis* ssp. *inermis* in Alaska (Seefeldt 2007)

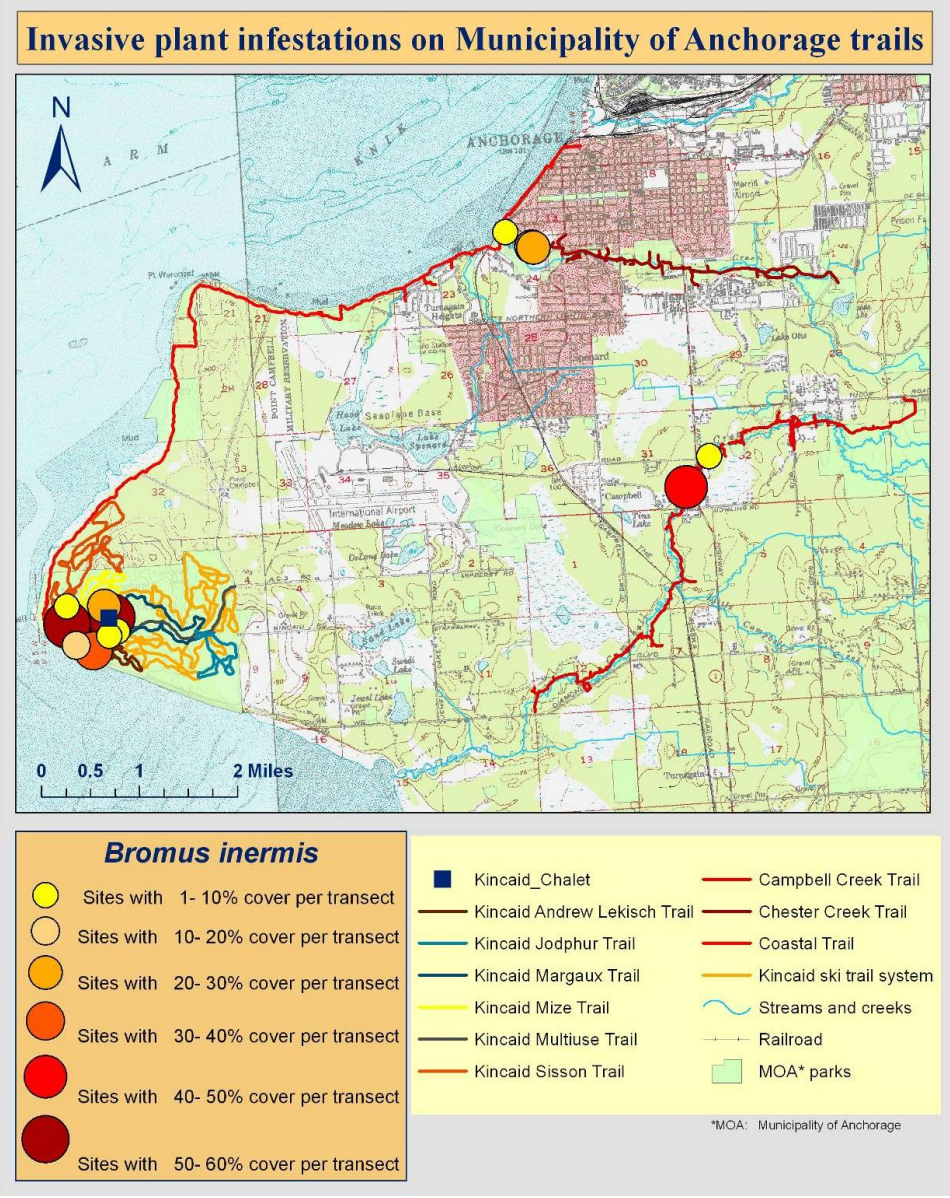
Bromus inermis* ssp. *inermis	**Human-disturbed, naturally-disturbed, and unaltered sites**
Small infestation	• Hand weed and cut before the inflorescence appears • Repeat monthly during the growing season for up to 4 years
Large infestation	• Cut or mow before the inflorescences appear • Repeat monthly during the growing season for up to 4 years

Distribution

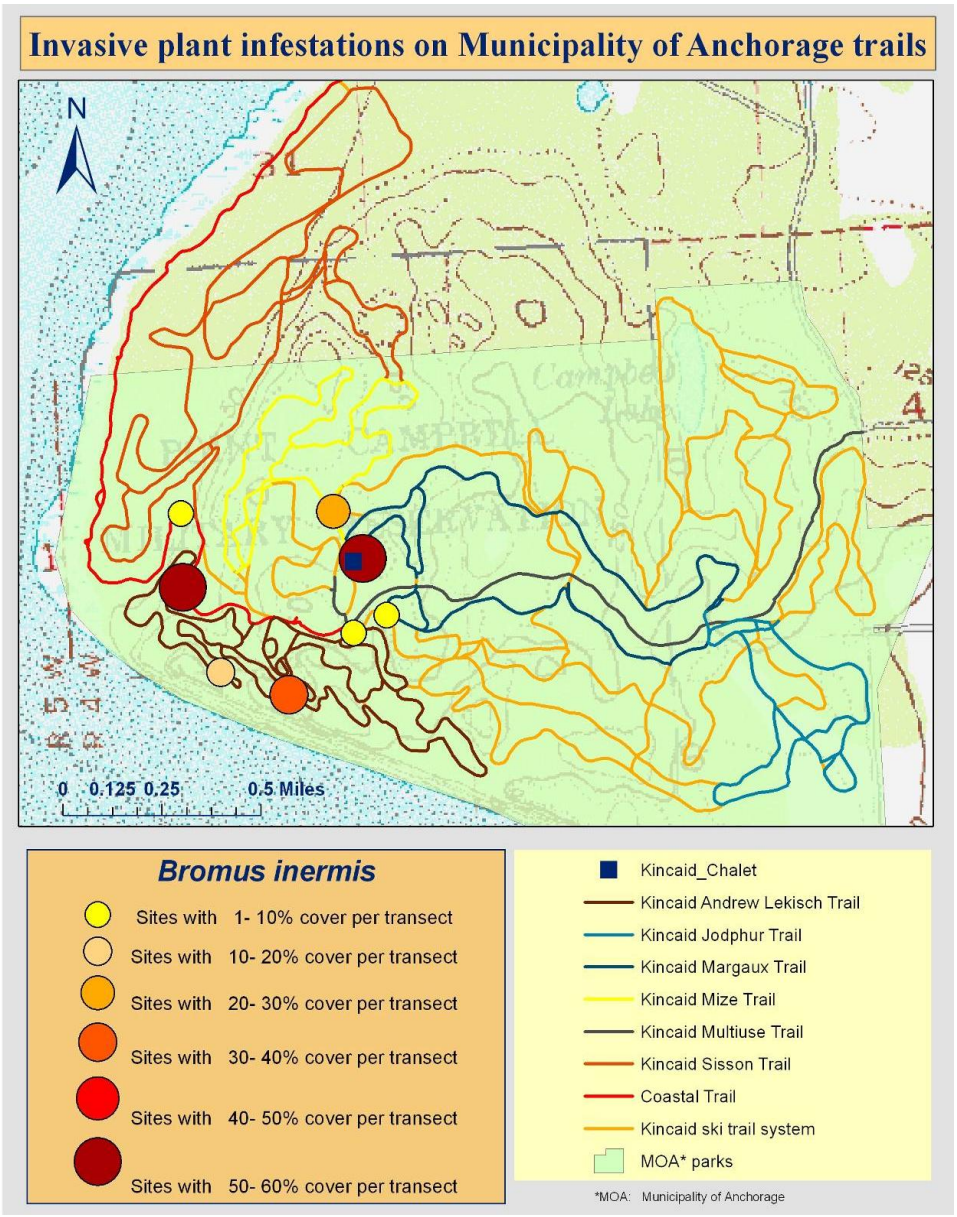
Distribution map of exhaustive species and outlier plots at which *Bromus inermis* ssp. *inermis* (62, smooth brome) was recorded. *Bromus inermis* ssp. *inermis* infestations are frequent throughout the Anchorage Bowl, and were especially abundant around Westchester Lagoon, along Campbell Creek trail, and in select areas of Kincaid Park.



Overview map showing the percent cover of *Bromus inermis* ssp. *inermis* (62, smooth brome) relative to total plant cover within exhaustive species plots.



Map showing the percent cover of *Bromus inermis* ssp. *inermis* (62, smooth brome) relative to all other species within infested exhaustive species plots in Kincaid Park.



Campanula rapunculoides (64, creeping bellflower)

Species biography

Campanula rapunculoides growing along the trail near Earthquake Park © Helen Cortés-Burns.

Campanula rapunculoides is native to Eurasia, and was introduced into Alaska as an ornamental, mainly in wildflower seed mixes. As its common name suggests, this species reproduces by **creeping rhizomes** as well as by **seeds**. Its impacts on native ecosystems have yet to be determined, although it is likely to, at least, reduce soil moisture and nutrients (Royer and Dickinson 1999). The Canadian Wildlife Federation notes that this non-native species is of potentially high concern, as it appears to be invading forest edges, meadows, gardens and lawns, and disturbed areas and roadsides in Ontario and Newfoundland (Canadian Wildlife Federation, http://www.cwf-fcf.org/en/resources/encyclopedias/invasive-species/). In Alaska, it also appears to be escaping gardens and is frequent along roadsides, alleys, and trails in the Anchorage Bowl area, where it could be outcompeting native species, and reducing available habitat for plants such as *Mertensia paniculata* (native bluebells), which are often found in similar habitats (trail margins, forest clearings, etc.). The one population of *Campanula rapunculoides* recorded in 2008 was growing along the Coastal Trail, by Earthquake Park.

Control and management recommendations

Small infestations of *Campanula rapunculoides* appear to **respond well to digging**, but one must dig deep enough to ensure that the root system is removed, and also dig in a broad enough circle around the plant to **avoid leaving rhizome fragments in the soil**, from which new plants could grow back.

Alternatively, **broad spectrum herbicides such as glyphosate** can be used, although there is a risk that native plants will be killed also. Unfortunately, creeping bell flower is resistant to most broad-leaf-specific herbicides, including 2,4-D. (See Lajeunesse and Menalled [2004]) for additional information on herbicide application on creeping bellflower infestations, http://scarab.msu.montana.edu/CropWeedSearch/Docs/CreepingBellflower.htm].

Distribution

Distribution map of exhaustive species and outlier plots at which *Campanula rapunculoides* (64, creeping bellflower) was recorded. Although creeping bellflower is a common garden escapee throughout the Anchorage Bowl area, and can be found along roadsides and alleyways, the MOA invasive species surveys only captured its occurrence by Earthquake Park.

Campanula glomerata (NR, Dane's blood)

Species biography

Campanula glomerata is a beautiful ornamental bellflower native to Europe and temperate Asia. In its native range it is found in grassy places on calcareous soils, and less commonly in woods. This plant prefers sandy to loamy, moist but well drained, soils. In North America this plant can become invasive; similar to closely related *Campanula rapunculoides*, *Campanula glomerata* **can spread by rhizomes as well as seed.**

Control and management recommendations

Similar control methods should be applied to this species as to *C. rapunculoides*. Because it can spread vegetatively, the plant can only be eradicated by **digging out the entire root and rhizomatous system**. In order to achieve this **multiple digs** may be required **per season**, as it is likely that some rhizome fragments will be left in the soil after each control effort.

Distribution

This species was only found in **two sites along the Lekisch trail:** one at the intersection of the 2.9 km Lekisch Loop with the beginning of the 7.5 and 5.0 km trails (N 61.15038179°, W 150.05066620°), and the other at the bottom of a steep hill on the 7.5 km section of the Lekisch (N 61.15374042°, W 150.06229861°).

We revisited both sites in 2009, and while we could not relocate the infestations at the bottom of the steep hill, we did find a small patch of *Campanula glomerata* growing at the intersection of the 2.9 km with the 7.5 and 5.0 km portions of the Lekisch. **No increase in stem count was recorded**. Because this is such a small infestation, and yet it is located in a comparatively weed-free and undisturbed section of Kincaid Park, we recommend that the population be **dug out next field season**, and that monitoring and control work be **repeated at both sites** until no new plants are observed for a full growth season.

Campanula glomerata (close-up of inflorescence in inset picture) was found at two sites along the Lekisch Trail in Kincaid Park in 2008, but when revisited in 2009 it was only found at the site pictured here (red arrow), N 61.15038179°, W -150.05066620°.

Campanula glomerata and *Centaurea montana* were observed at the very bottom of the hill pictured, on the trail margin closest to the Kincaid Chalet, in 2008 (N 61.15374042°, W -150.06229861°). When we revisited this site in 2009 neither of the infestations were relocated. We recommend that this site be revisited again in 2010 to check that the infestations have completely disappeared.

Location of the two *Campanula glomerata* infestations observed in Kincaid Park along the Lekisch Trail in 2008. The infestation marked with a **yellow** pinpoint was not found again in 2009. The one marked in **red** (photograph of the site provided above) was relocated. No significant change in population size was observed.

Caragana arborescens (66, Siberian pea shrub)

Species biography

This shrubby legume is native to Siberia and Manchuria and was introduced to North America to help preserve topsoil during dust bowl erosion of the 1930's (Alberta Invasive Plants Council).

Left: *Caragana arborescens* was planted at Arlene's Overlook, Mize Loop, Kincaid Park. Right: close-up of the shrub showing the pinnately compound leaves and yellow flowers that are born singly on the stem (not in clusters, unlike all other non-native legumes tracked in Alaska).

In Alaska, *Caragana arborescens* has been widely planted for hedges because it is extremely winter hardy. In addition, as a member of the pea family this species is able to **alter natural soil nutrient status** by fixing atmospheric nitrogen (AKEPIC 2005). This soil-improving capability enables it to establish quickly in poor soils. Furthermore, *Caragana arborescens* not only **reproduces by seed** but can also **resprout from rootstocks**. The dense habit of this species **reduces light availability** thereby compromising native tree and shrub regeneration.

This combination of morphological and physiological traits has allowed this ornamental species to become one of the most **aggressive invaders of mixed forests in the Matanuska-Susitna area** (Lapina and Carlson 2005). It has also been observed spreading from disturbed sites into native vegetation along the Steese Highway (Cortés-Burns *et al.* 2007, 2008) and on MOA lands in the Anchorage Bowl area (Cortés-Burns, per. obs.). *Caragana arborescens* is also considered invasive in many Canadian provinces and territories, such as Alberta, where it has invaded the understory of native deciduous forests (Henderson and Chapman 2006), and neighboring Yukon Territory, where it is reported to have spread from yards into open woods and clearings (White *et al.* 1993).

Control and management recommendations

We **strongly advise that *Caragana arborescens* infestations be prioritized for complete extirpation,** which can be done using a **combination of mechanical** (hand pulling, cutting, digging) and **chemical** (cut stamp injection with glyphosate, or basal bark spray treatment around the stem with triclopyr) **methods** (Seefeldt 2007; Minnesota DNR 2003). For *Caragana arborescens* stands in high-traffic areas, the side-effects to the immediate environment and site users should be evaluated prior to the use of any herbicides. Post-control monitoring is recommended to eliminate any new individuals that may grow from the seed bank.

Control recommendations for *Caragana arborescens* in Alaska (Seefeldt 2007)

Caragana arborescens	**Human-disturbed site (*e.g.* horticultural plots)**	**Naturally-disturbed and unaltered sites**
Small or large infestations	• Hand pulling, cutting, digging (before seed set) • Stamp injection • Monitor for 2-3 years	• Hand pulling, cutting, digging (before seed set) • Monitor for 2-3 years

Distribution

Distribution map of exhaustive species and outlier plots at which *Caragana arborescens* (66, Siberian pea shrub) was recorded.

A large population of *Caragana arborescens* is growing on the far side of the wall that runs east along the Coastal Trail just north of the Fish Creek bridge and there is a thick hedge extending from the Point Woronzoff parking lot along the Coastal Trail. Smaller stands are growing at the west end of Westchester Lagoon, at the Kincaid chalet, and at Arlene's Overlook on the Mize Loop.

Centaurea montana (NR, perennial cornflower)

Species biography

Centaurea montana is native to the mountains of central and southern Europe, but is now widely cultivated as an ornamental. It is considered an invasive species in Colorado (US DOI, BLM National List of Invasive Weed Species of Concern; http://www.blm.gov/co/st/en/BLM_Programs/botany/invasiweed.html), and elsewhere has escaped cultivation, and has become naturalized, growing along roadsides and in woodlands in a number of US states and Canadian provinces (USDA, NRCS 2009).

Centaurea montana

Control and management recommendations

During the 2008 field season two populations were observed in areas where it had not been planted intentionally. We recommend that the **distribution** of *Centaurea montana* in the Anchorage area be **characterized and monitored**, and if escaped populations are found to persist, then this species should be targeted for control and eradication.

Centaurea montana is an erect, **stoloniferous**, clump-forming perennial. Given that this plant is widely used in Anchorage gardens, is capable of vegetative (stolons) and sexual reproduction, and that other taxa in this genus (*Centaurea biebersteinii,* syn. *C. maculosa*, spotted knapweed, 86) are known to be highly invasive in North America, we **recommend that any infestations found on MOA trails be revisited and, if still present, controlled.**

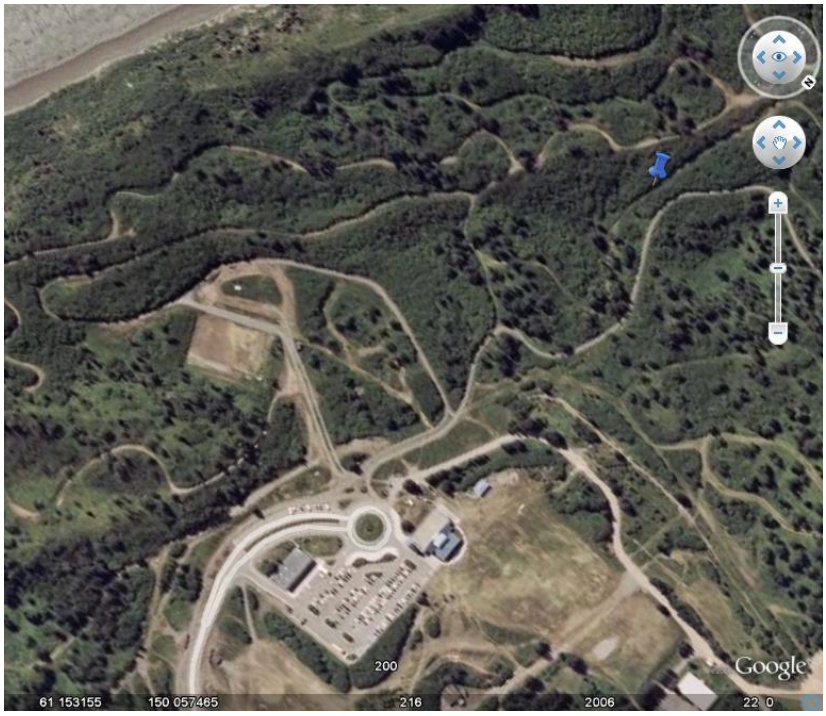
Although we cannot find any reports indicating how to effectively control this exotic plant, we recommend that the **small infestations recorded in 2008** be managed through a combination of **hand pulling and digging**. It is important that as much as possible of the stolons (above-ground runners) be pulled, as any fragments left behind could develop into new plants. Any control work must be conducted **before the plants set seed**, and if possible, before they flower (this would be the only guaranteed way to ensure that no seed is set). Controlled patches should be **revisited** once a month during the rest of the season to ensure that no new plants have grown, and that no flowers are being produced.

Distribution

In 2008 we found a medium sized infestation on the 7.5 km section of the Lekisch Trail in Kincaid (N 61.15374042º, W -150.06229861º), growing alongside a clump of *Campanula glomerata*, and another one close to the intersection of Campbell Creek trail with Lake Otis (N 61.17802º, W -149.82768º). We revisited the Lekisch Trail site in 2009 but did not find any stems of *Campanula glomerata* or *Centaurea montana*. This could suggest both populations died, but it is equally likely they did persist, but were not visible because the area was overgrown with grasses and forbs. We recommend that

this site be revisited again in 2010 and checked thoroughly to make sure that both populations have completely disappeared.

Centaurea montana was recorded along the Campbell Creek Trail in 2008 near the blue bridge east of the trail's intersection with Lake Otis Boulevard (N 61.17802019°, W -149.82768°).



The one infestation of *Centaurea montana* observed in 2008 in Kincaid, on the Lekisch Trail, could not be found again in 2009.

Cheiranthus allionii (NR, Siberian wallflower)

Species biography

Cheiranthus allionii is a biennial plant that is native to Europe. It was observed along the Multi-Use trail in Kincaid Park together with other annual, non-native wildflower-type species such as *Nemophila menziesii* (NR, baby-blue-eyes) and *Lychnis chalcedonica* (NR, Maltese cross). These species were likely introduced as component of **'wildflower' type seed mixes** used in revegetation projects.

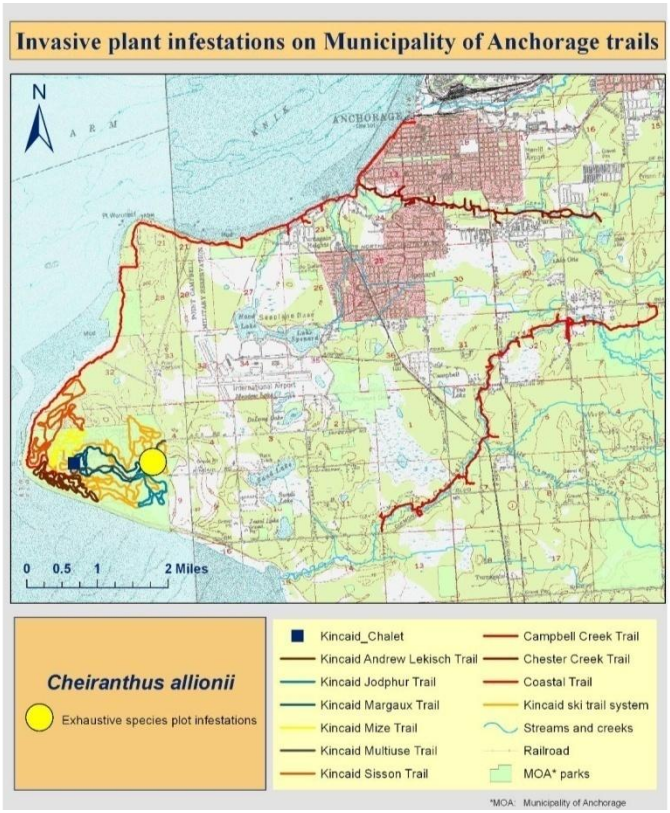
Cheiranthus allionii © G.A. Cooper

Control and management recommendations

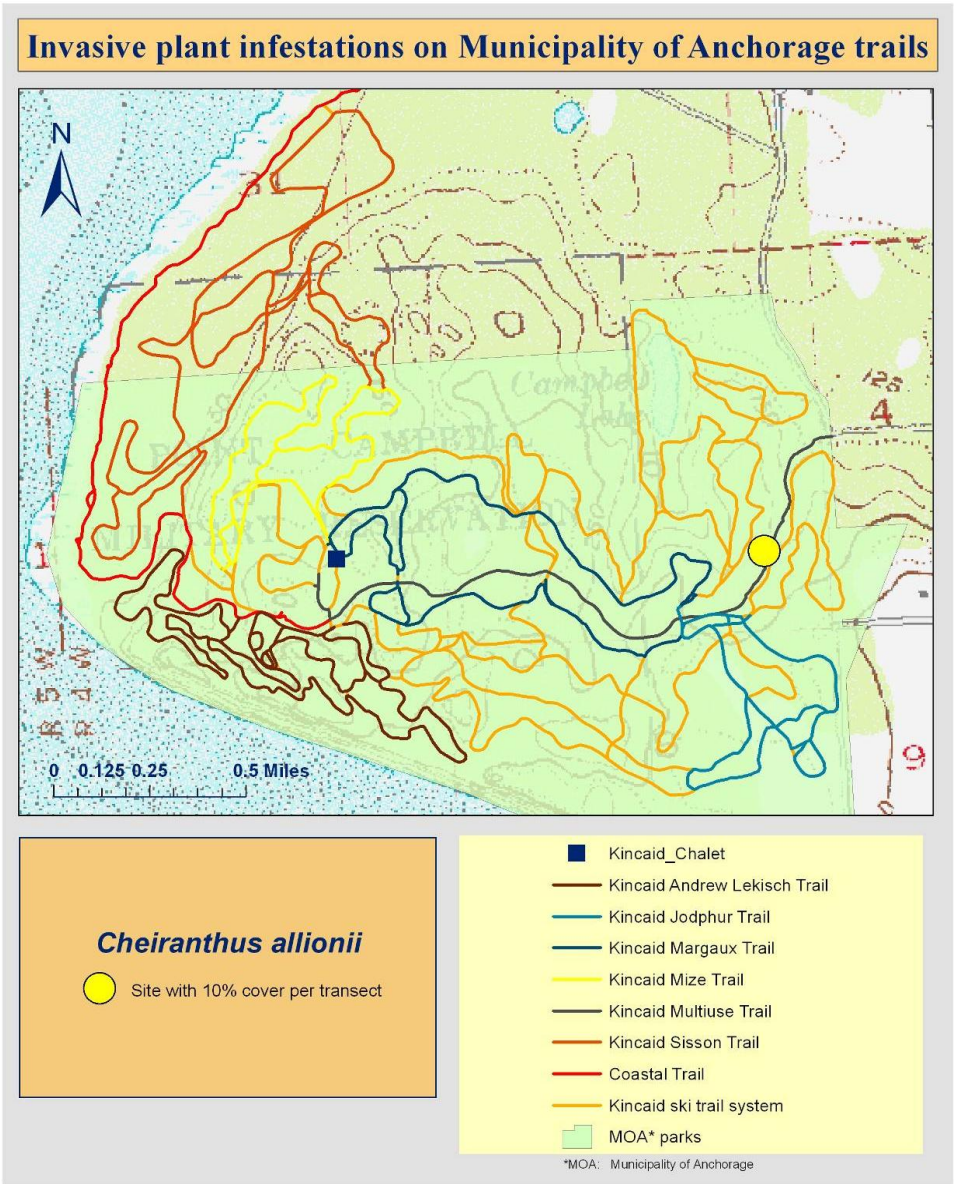
It is currently thought that these species will not re-seed or grow for more than one season in Alaska (Holloway and Rutledge 2009), thus we do not recommend that this species receive priority for control actions. However, we do encourage MOA trail crews to **monitor areas that have been revegetated using these kinds of wildflower seed mixes** (*e.g.* multi-use trail in Kincaid Park, salmon habitat restoration site by Westchester Lagoon) to check that native plants gradually grow back and replace species like the *Cheiranthus allionii*, *Lychnis chalcedonica* , and *Nemophila menziesii*.

Distribution

Distribution map of exhaustive species and outlier plots at which *Cheiranthus allionii* (NR, Siberian wallflower) was recorded. Small (1-5 stems), discrete populations of *Cheiranthus allionii* were observed along the newly constructed Multi-Use Trail in Kincaid Park.



Map showing the percent cover of *Cheiranthus allionii* (NR, Siberian wallflower) relative to all other species within infested exhaustive species plots in Kincaid Park.



Cirsium arvense (76, Canada thistle)

Species biography

Cirsium arvense flowering head (native thistles have much broader flowering heads)

Despite its common name, Canada thistle is native to Eurasia, occurring in Europe, parts of North Africa, and Asia, extending all the way to China and Afghanistan (Jacobs *et al*. 2006). This species was introduced to North America from Europe in the 1600's as a contaminant of grain seed, and within a century was listed noxious by some of the east coast states. *Cirsium arvense* is a highly invasive perennial species belonging to the sunflower family. The plant reproduces by seed and vegetatively. The **seeds can remain viable in the soil for up to 20 years** and belowground this species forms a **well developed horizontal root system**, where each root can form a new plant (Minnesota DNR 2003).

This species **displaces natural vegetation** by competing for moisture, light, and nutrients, releases allelopathic compounds that are toxic to other species, **attracts pollinators** (distracting them from native wildflowers), and is known to **harbor other pest species** (*e.g.* insects) (AKEPIC 2005, Virginia Department of Conservation and Recreation 2006).

In the Lower 48, *Cirsium arvense* grows in most soil conditions and prefers full sun. It is found in open disturbed areas such as roadsides, ditch banks and pastures but will also invade natural barrens, glades, savannas, meadows and dunes. Once established this species **spreads quickly through horizontal roots which can spread 18 feet in one season, sending up new shoots every 3 to 6 inches** (Virginia Department of Conservation and Recreation 2006, Minnesota DNR 2003). It has been declared a **noxious weed in 43 states** and is one of the most tenacious agricultural weeds (USDA, NRCS 2009). Finally, given its thorny habit, this species **degrades the quality of recreation sites** when it establishes in high-use areas.

Control and management recommendations

This species should be given **top priority for control and eradication** efforts. Because of its extensive root system and its ability to reproduce from small root fragments, complete eradication of *Cirsium arvense* usually takes persistent control over several years. The key to effective control is to apply and/or combine cultural, mechanical, biological, and chemical practices that will gradually exhaust the nutrients stored in the root systems of *Cirsium arvense* (Jacobs *et al*. 2006).

Cirsium arvense can be controlled by **mechanical**, **chemical**, or **biological** methods. The following recommendations are drawn from a combination of sources, namely, the Virginia Department of Conservation and Recreation (2006), the Minnesota DNR (2003), and Jacobs *et al.* (2006).

- Manual: For **light infestations**, pulling or hand-cutting can be effective if done **several times each season to starve underground** roots and stems. In general, though, hand pulling alone will not be effective, especially given this species' vigorous capacity for underground vegetative reproduction. Therefore, pulling should be done **in combination with othe**r cultural, biological, and chemical practices to reduce the competitive ability of *Cirsium arvense*.
- Mechanical control: Mowing *Cirsium arvense* in early spring when root reserves are lowest may result in the greatest reduction of the weed. **Repeated pulls** or mowing should be done several times per growth season to weaken roots. Mowing must be done **when flower buds are just about to open** as this will prevent seed set and will starve the root starch reserves. In Minnesota, mowing around summer solstice prevented re-growth during that year (Jacobs *et al.* 2006).
- Chemical control: Long-term herbicidal suppression of *Cirsium arvense* is most efficient when one gets **the right toxic level** of the appropriate active ingredient in **as much of the root system as possible**. To do this, the **appropriate herbicide** needs to be applied, it needs to be applied to **enough leaf area to absorb sufficient** amounts of the herbicide, and it needs to be applied **at a time when the herbicide is mostly translocated** and distributed in the roots. It is important to avoid mixing fast-acting contact herbicides with the systemic product. Herbicides should be applied either when most of the *Cirsium arvense* plants in the population are **in the bud stage or to fall re-growth**. At the bud stage, leaf area for herbicide coverage and absorption is maximized, and root reserves are at their lowest. In the fall, translocation of the herbicide to the roots is the greatest (Jacobs *et al*. 2006). **Individual** *Cirsium arvense* **plants** can be treated in pastures, rangelands, and non-crop areas with a **wick applicator or hand sprayer to reduce non-target effects**. Research has shown that aminopyralid (Milestone®), clopyralid (Transline®), and picloram (Tordon 22K®) provide similar suppression of *Cirsium arvense* in pastures and rangelands when applied at label rates and when the herbicides are translocated to roots. Formulations of clopyralid plus 2,4-D (Curtail®) and clopyralid plus triclopyr (Redeem®) are also labeled to control *Cirsium arvense*.
- Biological control: stem weevil, bud weevil and stem gall fly are commercially available

Any of the above listed methods are most effective when combined with others as follow-up treatments. **Seeding the treated areas with plants that emerge early** in the spring is recommended in any case, as these would compete with *Cirsium arvense* emerging shoots.

Distribution

Distribution map of exhaustive species and outlier plots at which *Cirsium arvense* (76, Canada thistle) was recorded. *Cirsium arvense* was observed along **Campbell Creek trail**, and growing in the **plant islands in the Kincaid Chalet parking lot**. Both areas must be targeted for control work.

Coronilla varia (NR, purple crownvetch)

Species biography

Coronilla varia was introduced from Europe and southeast Asia during the 1950s as groundcover, bank and slope stabilizer along roads and waterways, and as green fertilizer crop (Minnesota DNR 2003).

Coronilla varia could be mistaken for *Trifolium hybridum* (alsike clover) due to its white and pink, globular inflorescences. However, *Coronilla varia* lacks the trifoliate leaf structure of clovers, and instead has pinnately compound leaves similar to *Vicia cracca* (bird vetch), although it lacks the tendril that is diagnostic of *Vicia cracca*.

This legume spreads aggressively via both **vegetative and sexual reproductive** strategies: it can resprout from **rhizome** fragments and also reproduces readily from seed. **Seeds remain viable** in the soil for **long periods of time** (over **15** years), leading to the formation of **seed banks**. Once established, shade intolerant *Coronilla varia* tends to **overgrow other plants** in order to access sunlight. Furthermore, as a member of the pea family it is able to fix atmospheric nitrogen, thus effectively fertilizing the soil and facilitating invasion by other weedy species that often thrive in nitrogen-rich soils.

According to the Wisconsin DNR (2004), *Coronilla varia* **constitutes a serious management threat** once it has established, yet it continues to be used for erosion control, roadside planting, and soil rehabilitation. *Coronilla varia* is also **very toxic to horses** (and presumably smaller animals), provoking paralysis or even death (Wisconsin DNR 2004). Although the Chester Creek Trail (where this species was detected) is closed to equestrian use, the greenbelt system is contiguous with trails that do allow horses such as the Tour of Anchorage multi-use trail.

Given its ability to reproduce vegetatively and sexually, to form large seed banks, its climbing growth habit, and tolerance to a wide range of climatic zones (zones three to seven), we believe ***Coronilla varia*** **is likely to have a similar invasiveness ranking in Alaska to *Vicia cracca*** (bird vetch), which is currently ranked at 73 points.

Control and management recommendations

For the above reasons, **this species should receive top priority for control and eradication** work. A variety of control methods can be effective at controlling or even eradicating *Coronilla varia*, with maximum effectiveness occurring when methods are used in combination. The information provided below was obtained from the Virginia DCR (2006).

Mechanical control:

- **Mowing a few times per growth season** (once in early spring, and after that, if possible, once every month) is effective at **controlling the spread** of this plant. This should be repeated **over a number of years** to ensure that any plants coming up from the seedbank are also extirpated

Chemical control:

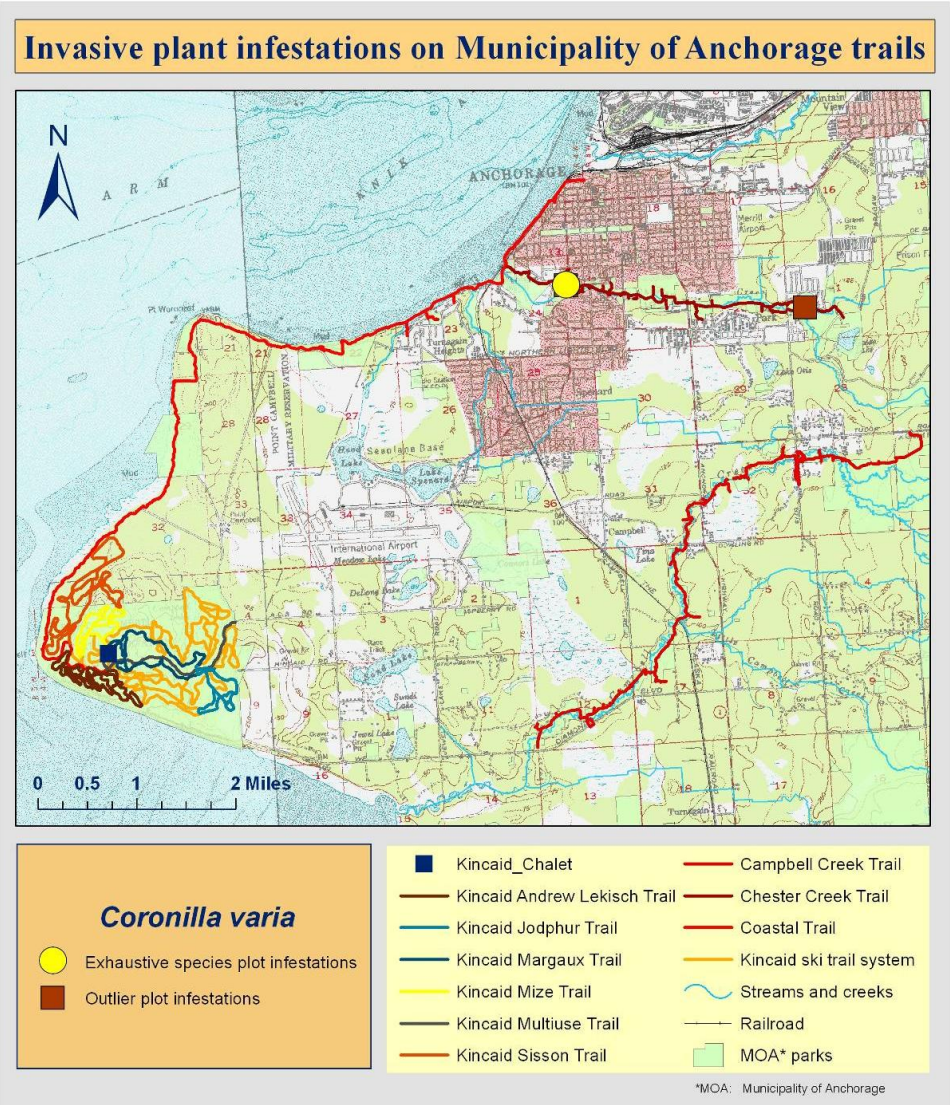
- A **follow up treatment with glyphosate herbicide**, once in the **Fall**, and once again the **next Spring**, could eliminate plants that have regenerated from underground parts or resprouted from seed
- **Spot spraying** affected areas, (after re-greening from a burn or mowing), with clopyralid+surfactant+dye is also effective

Distribution

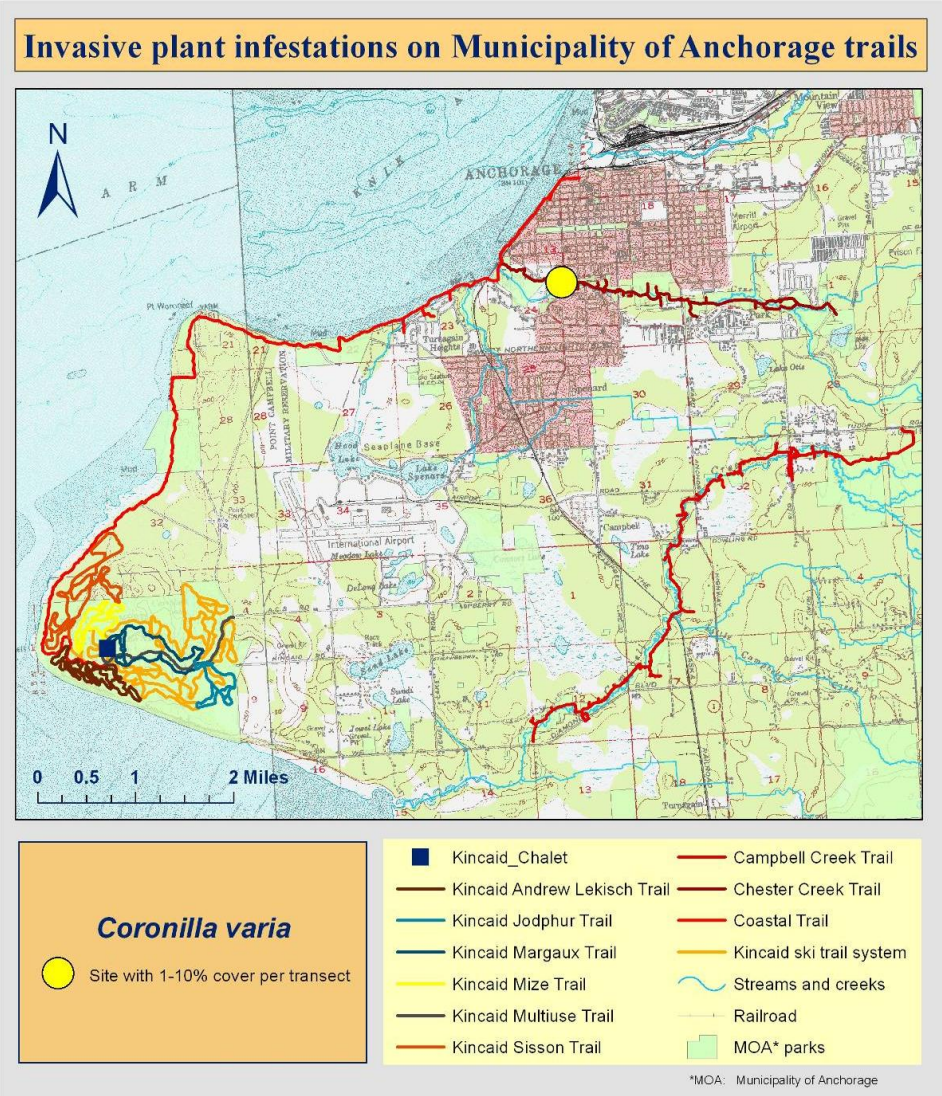
In 2008 a large population of *Coronilla varia* was observed growing east of the intersection of Chester Creek Trail with Spenard Road, right along the area where Spenard Road merges with the Minnesota Bypass. In 2009 we also noted the presence of large clumps of *Coronilla varia* in the ditch that runs parallel to Hillcrest Drive right after the point where it branches off from Minnesota Drive. An additional population of *Coronilla varia* was detected at the east end of Tikishla Park, also along the Chester Creek Trail.

Approximate location and extent of *Coronilla varia* infestations known to occur near Westchester Lagoon (the red circle marks the location of the large and continuous population by the intersection of the trail with Spenard Road, while the dashed bracket shows the location of the medium sized, dispersed *Coronilla varia* clumps spotted in the ditch off of Hillcrest Drive in 2009).

Distribution map of exhaustive species and outlier plots at which *Coronilla varia* (NR, purple crown-vetch) was recorded.



Overview map showing the percent cover of *Coronilla varia* (NR, purple crown-vetch) relative to all other species within infested exhaustive species plots.



Crepis tectorum (54, narrow-leaved hawksbeard)

Species biography

Crepis tectorum **only reproduces by seed**, but **each plant is capable of producing over 49,000 seeds** (Royer and Dickinson 1999), allowing this species to rapidly colonize disturbed and open areas.

Although it is most commonly found along roadsides and in waste areas, *Crepis tectorum* is **one of two non-native plants that have invaded native vegetation affected by the 2004-2005 burns along the Dalton Highway** in interior Alaska (Cortés-Burns *et al.* 2008). The other invasive species that was observed spreading into these lightly burned areas was *Melilotus alba* (81), which is considered to be a very aggressive non-native species in Alaska. More recently it has been recorded in native fireweed-Canada bluejoint meadows near Rohn Cabin, on the Iditarod Trail. Given its aggressive behavior in interior Alaska, this species merits monitoring and control despite its low rank.

Crepis tectorum (left) and *Hieracium umbellatum* (right) can be distinguished by the arrangement of their involucral bracts. *Crepis* spp. involucral bracts are arranged in distinct rows (two lengths) whereas *Hieracium* spp. has multiple-length involucral bracts that overlap. In addition, *Crepis tectorum* has deeply lobed leaves, leaf bases that clasp at the stem, and a basal rosette of leaves (withering early in the season). By contrast, *Hieracium umbellatum* lacks a basal rosette of leaves, has a short woody rhizome, and lance-shaped leaves.

Control and management recommendations

Crepis tectorum is becoming increasingly frequent in the Anchorage Bowl area, and has been found growing in relatively undisturbed parts of the Hillside area and along trails in the Chugach foothills, including Rabbit Creek trail and other Chugach State Park trails (Cortés-Burns *et al.,* pers. obs.).

We recommend that **small, isolated infestations located in areas** that are otherwise **relatively weed-free be targeted for eradication** work. Eradication is an unrealistic goal for **larger populations** or for **small but semi-continuous** infestations located in more high-use and urbanized areas; for these, we suggest that **best management practices be implemented** (*e.g.* trail maintenance activities in these areas should avoid taking machinery that has been used in infested areas to weed-free areas without first cleaning it).

Populations **growing on non-human altered soils** as well as all **small** (1-50 stems) **infestations** can be removed by **repeated** cycles of **hand-pulling**. As plants can resprout easily from the stump, the entire plant must be removed **before seed set**. All plants must be bagged and removed from the site. However, Fairbanks-based Agricultural Research Station weed scientist Steve Seefeldt (2007) suggests that *C. tectorum* is **best controlled using chemical methods**, as hand pulling can be inefficient because seedlings are hard to find and do not pull up easily.

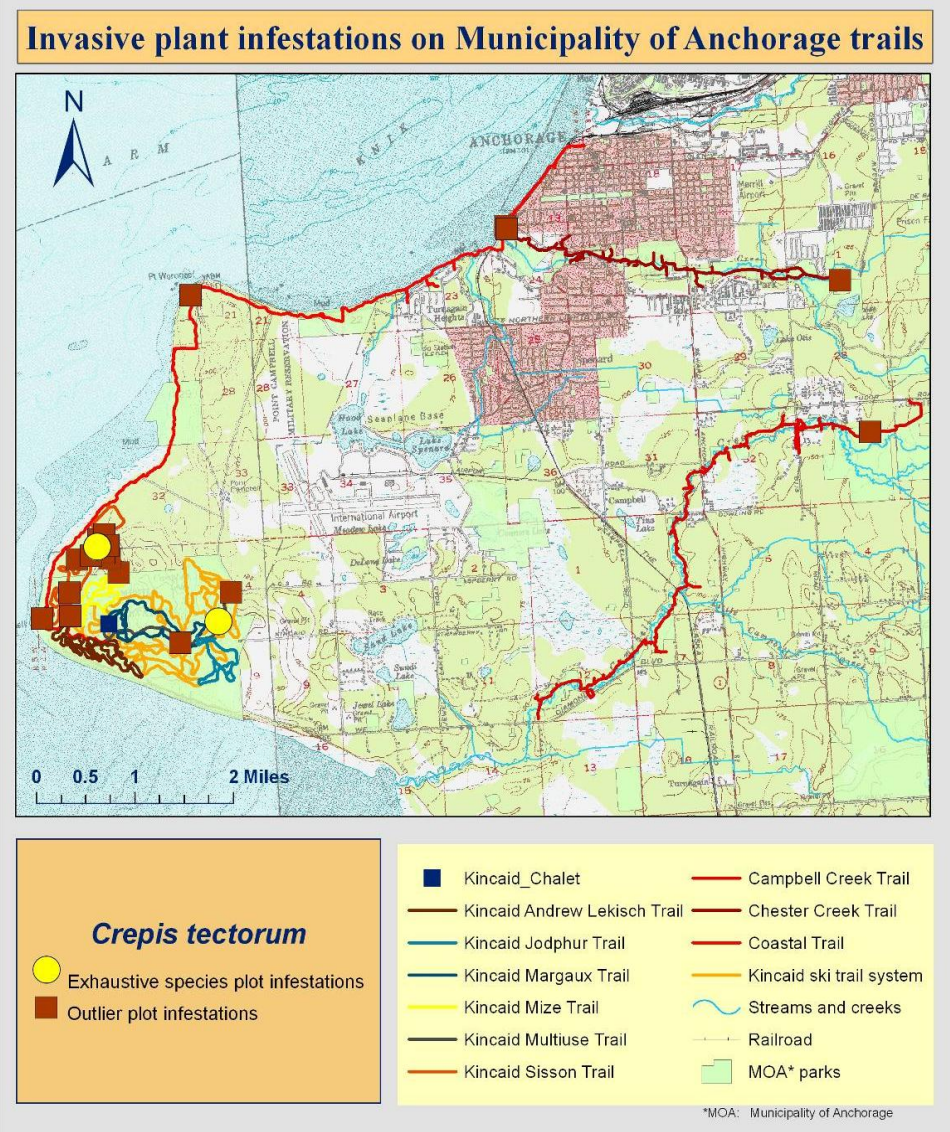
Where the **infestations persist**, or for **larger populations** growing on altered ground, **herbicide application** (glyphosate) is recommended. The infestation area, plus a 50 foot buffer, should be treated with metsulfuron-methyl (Ally) at 1 oz per acre. Glyphosate will kill most of the broadleaf vegetation that it is sprayed on, but grasses will not be harmed. **Annual monitoring will be necessary** to confirm that no new plants have established. The area within at least a 200 yard radius and any disturbed areas within a half mile should be scouted for new plants (Seefeldt 2007).

Control recommendations for *Crepis tectorum* in Alaska (Seefeldt 2007)

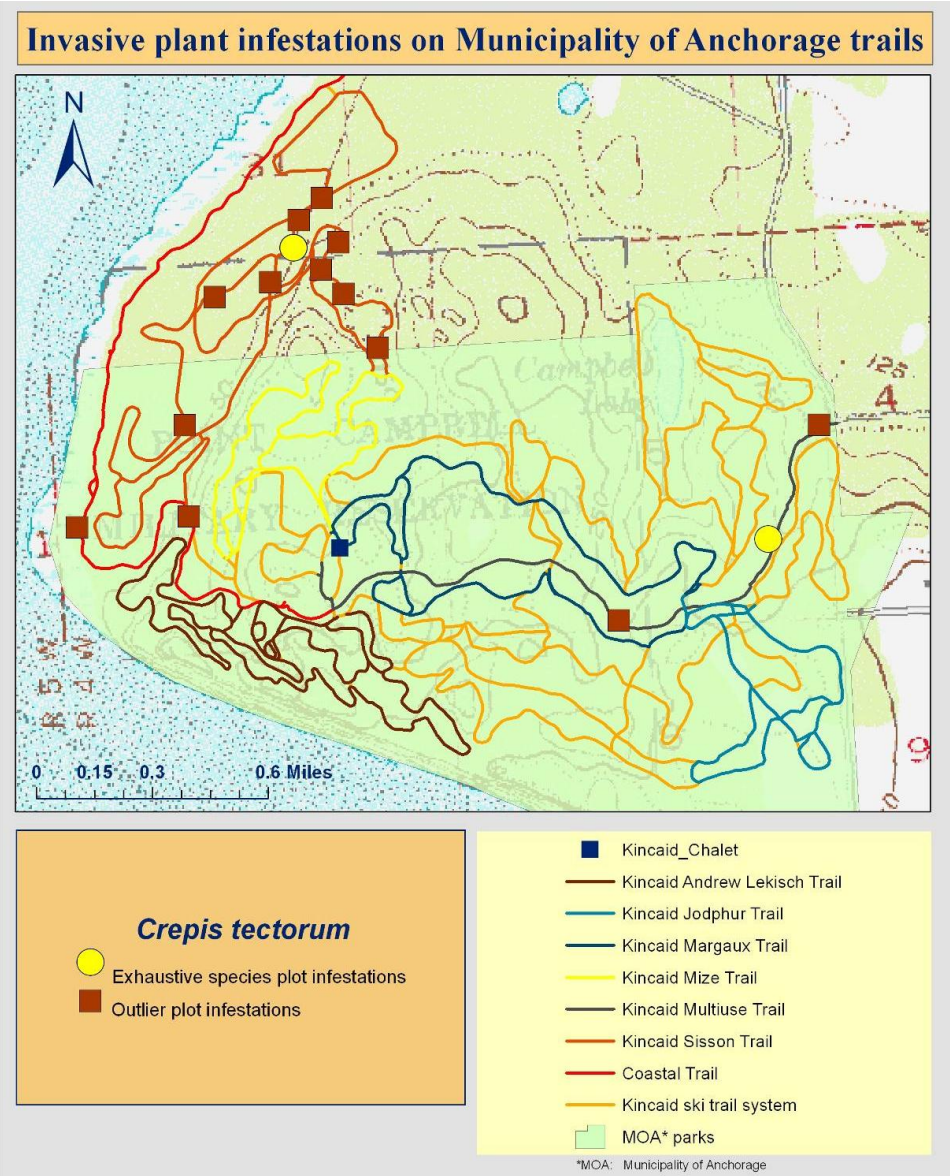
Crepis tectorum	**Human-disturbed site (*e.g.* material source areas)**	**Naturally-disturbed and unaltered sites**
Small infestation	• Hand pull, including underground parts if possible • Bag and remove plants • Monitor for 1 year – if unsuccessful, start herbicide application	• Hand pull, including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

Distribution

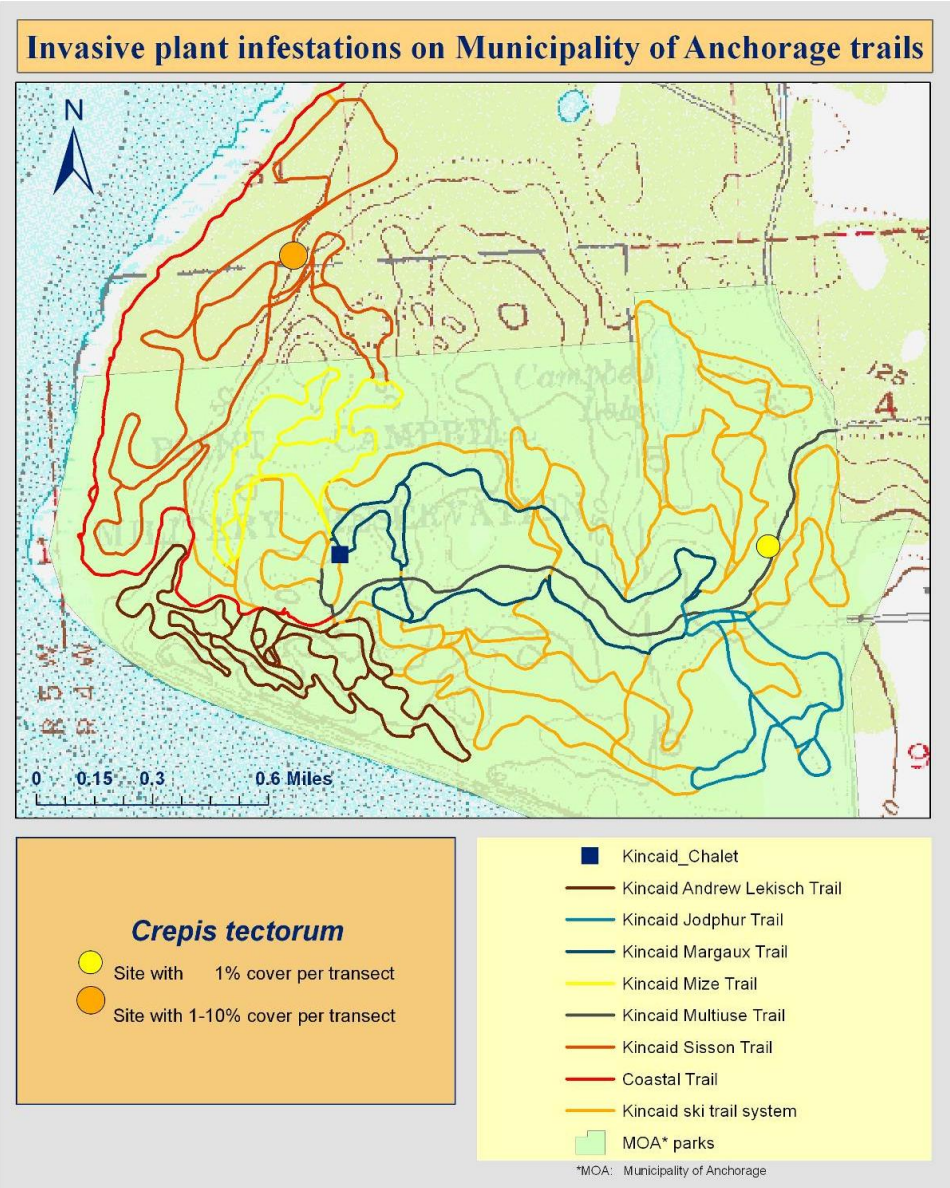
Distribution map of exhaustive species and outlier plots at which *Crepis tectorum* (54, narrow-leaved hawksbeard) was recorded.



Distribution map of exhaustive species and outlier plots at which *Crepis tectorum* (54, narrow-leaved hawksbeard) was recorded in Kincaid Park.



Map showing the percent cover of Crepis tectorum (54, narrow-leaved hawksbeard) relative to all other species within infested exhaustive species plots in Kincaid Park.



Euphrasia nemorosa (NR, common eyebright)

Species biography

Euphrasia nemorosa was found growing along the middle of the trail on the **Sisson Loop in Kincaid** where trampling is the main source of disturbance. Given its distribution (open, disturbed sites with some exposure of mineral soil) this species likely **occupies a similar ecological niche to that of low-aggressive non-native** *Matricaria discoidea* (34, pineapple weed), *Plantago major* (44, common plantain), and *Polygonum aviculare* (45, prostrate knotweed), all of which are also common invaders of sparsely vegetated soils disturbed by trampling.

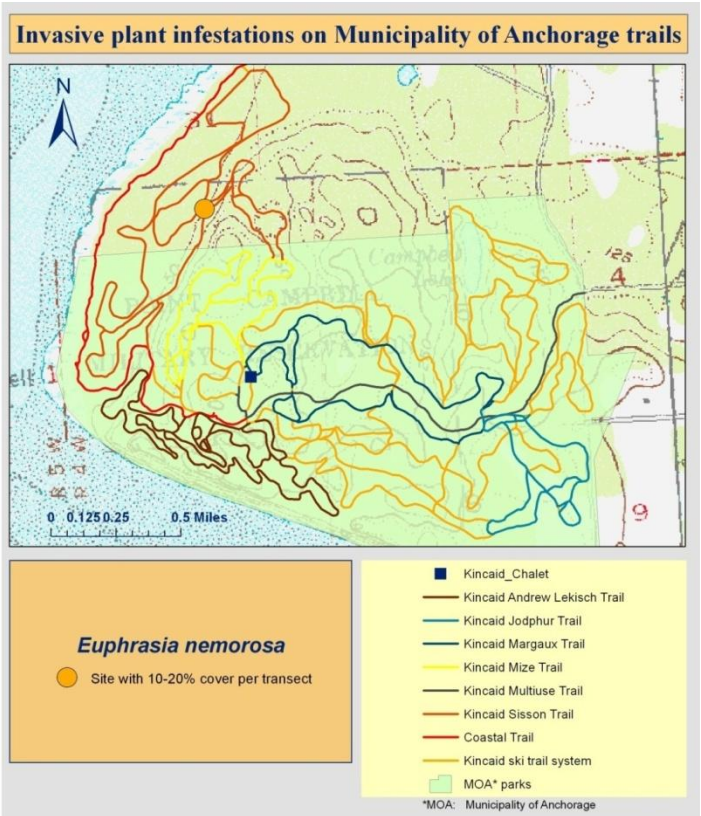
Euphrasia nemorosa
© Lindsey Koepke. United States, WA, Pierce Co., Mount Rainier National Park, SR123. June 28, 2005.

Control and management recommendations

Although **we do not suggest it be prioritized** for control, this species could be eradicated manually, as repeated **hand pulling** of *Euphrasia nemorosa* plants at infested sites in Klondike Gold Rush National Park has proven moderately effective (AKEPIC 2005).

Distribution

Euphrasia nemorosa was only known from SE Alaska until this survey was conducted. The common eyebright infestations observed along the Sisson Loop (which are especially prevalent in the first section of the trail, where it branches off from the Mize Loop) in Kincaid Park constitute the first records of this species in south central Alaska.



Map showing the percent cover of *Euphrasia nemorosa* (NR, common eyebright) within infested exhaustive species plots in Kincaid Park.

Erucastrum gallicum (NR, dog mustard)

Species biography

Erucastrum gallicum was introduced from central Europe and is now fairly common in the eastern United States, and is also being tracked in some Canadian provinces, including British Columbia (Klinkenberg 2009).

Control and management recommendations

Although it is a **weedy non-native species, it does not appear to be aggressively invasive** in states and provinces with similar climatic-ecological characteristics to those of Alaska. We therefore do **not recommend that this species be targeted for eradication** over others that are clearly more aggressively invasive.

Erucastrum gallicum growing at the main entrance to Kincaid Park (left), inside a flower pot/bed, alongside other invasive plants like *Linaria vulgaris.* Right: *Erucastrum gallicum*'s distinctly creamy yellow colored flowers and pinnately divided

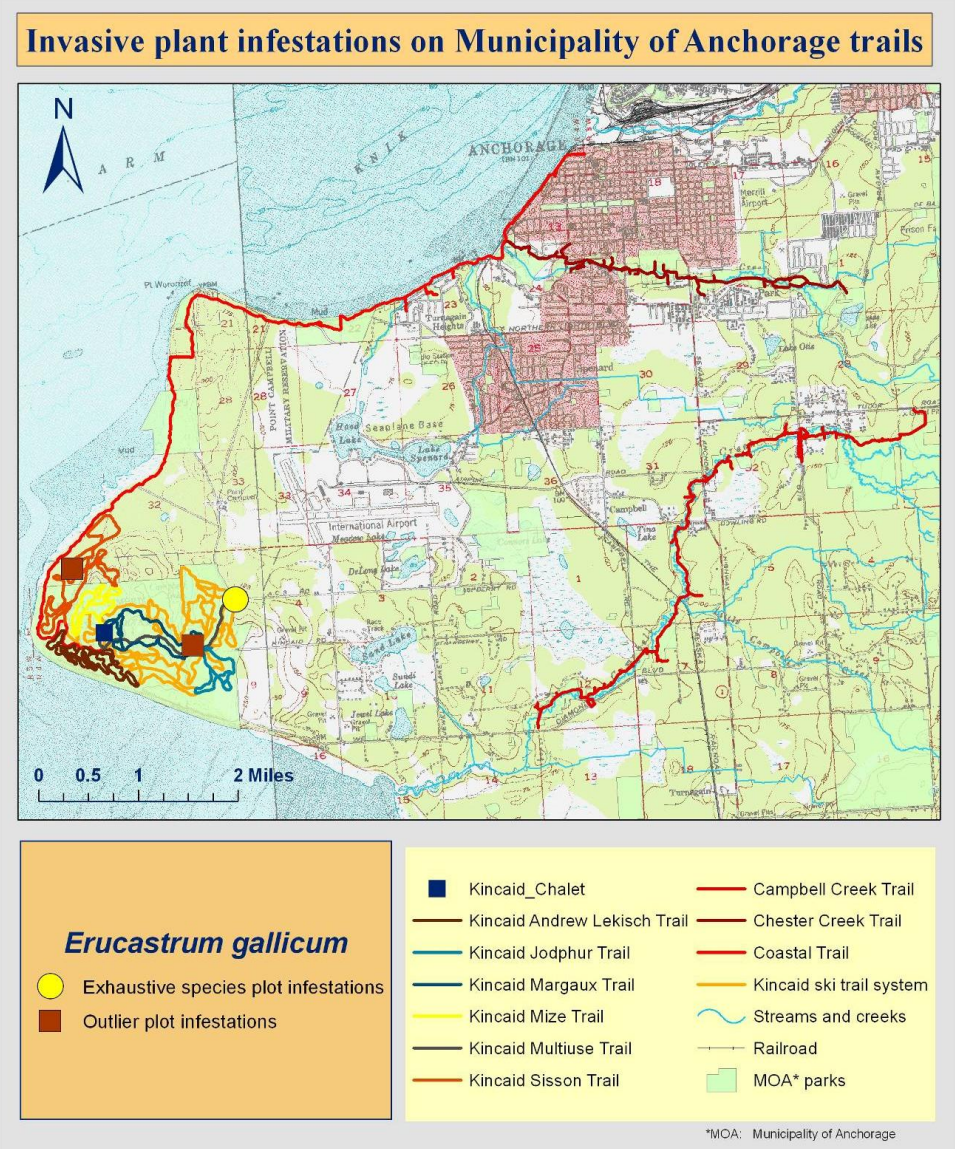
Distribution

Although this is not one of the most frequently encountered exotic species in Alaska, *Erucastrum gallicum* has already been recorded at various sites within the Anchorage Bowl (*e.g*. Campbell Tract, Dempsey ice arena, and Merrill Field Airport; see EDDMaps for all records collected in the state through 2007).

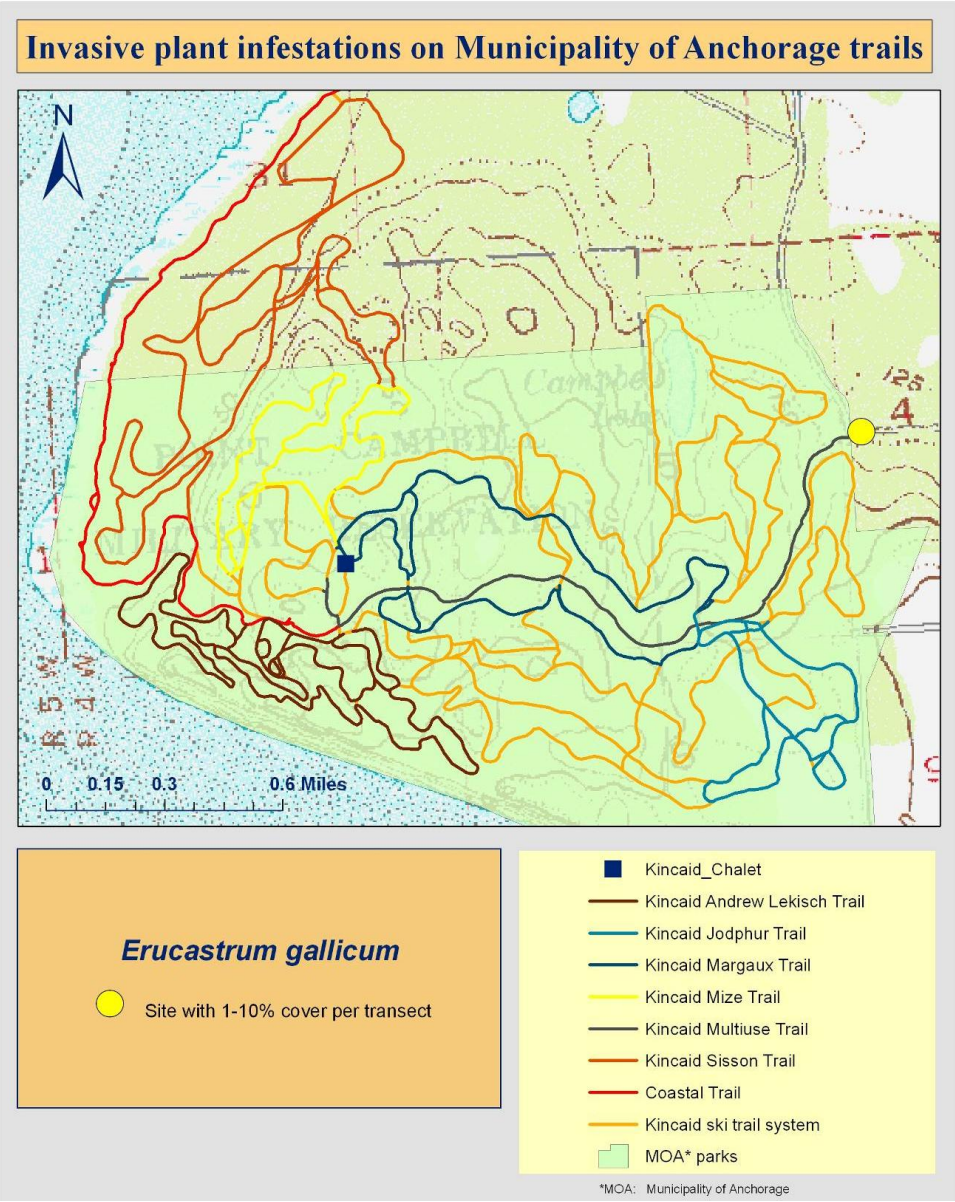
During the 2008 MOA trail surveys it was only reported from Kincaid Park, where it was seen in three areas:

1. At the plant islands by the entrance sign to the park on Raspberry Road
2. At the gravel extraction area on the Sisson Loop, which marks an invasive plant species 'hotspot' (N 61.16513109°, W -150.0592448°)
3. At the intersection of Margaux's Loop with the Raspberry Road bridge, at the north end of the bridge

Distribution map of exhaustive species and outlier plots at which *Erucastrum gallicum* (NR, dog mustard) was recorded.



Map showing the percent cover of *Erucastrum gallicum* (NR, dog mustard) relative to all other species within infested exhaustive species plots in Kincaid Park.



***Galeopsis tetrahit* s.l.** (40, bristle-stemmed and split-lip hempnettle)

Species biography

The two morphological traits typically used to distinguish *Galeopsis bifida* and *G. tetrahit* (hempnettles, 40) are flower size (smaller in the case of *Galeopsis bifida*) and the shape of the lower corolla lip margin (cleft in *G. bifida*). Other differences have been claimed, but there is no consensus among experts on their validity. Furthermore, *Galeopsis bifida* and *G. tetrahit* are considered separate species by Kartesz (ITIS 2009, www.itis.gov) but considered varieties of *Galeopsis tetrahit* by a number of authors, including Hitchcock *et al.* (1984).

During the 2008 surveys we commonly observed intergradations of the two distinguishing traits when looking at flowers from a single plant, and were therefore unable to differentiate the two taxa in the field. As funds become available for taxonomic revisions, AKNHP botanists intend to collect a large number of hempnettle specimens from across the state and conduct a study to try to determine if there are any morphological traits that allow for a systematic distinction between these two taxa. In the interim, we refer to these two entities as a single taxonomic unit: the *Galeopsis tetrahit* species complex, or *Galeopsis tetrahit* s.l.*

Galeopsis tetrahit s.l. (general plant morphology photo, right, © Carl Farmer, 16 Jul 2003 Portree, Isle of Skye).

Large and dense infestations of *Galeopsis tetrahit* s.l. were recorded in areas that had undergone excavation work in the past few years (*e.g.* the soil storage site that has been excavated in association with the airport runway extension next to the Coastal Trail, disturbed areas of the Sisson Loop, and along the Multi-use Trail in Kincaid). However, some infestations were also observed moving off the human footprint into adjacent native vegetation (*e.g.* outlier populations along the Multi-use and Chester Creek Trails). The presence and abundance of *Galeopsis tetrahit* s.l. in relatively undisturbed native vegetation indicates that this species complex merits monitoring and control despite its low rank.

* s.l.: sensu lato. Latin expression used by taxonomists when referring to a particular taxonomic unit (species, genus, etc.) in its wider circumscription.

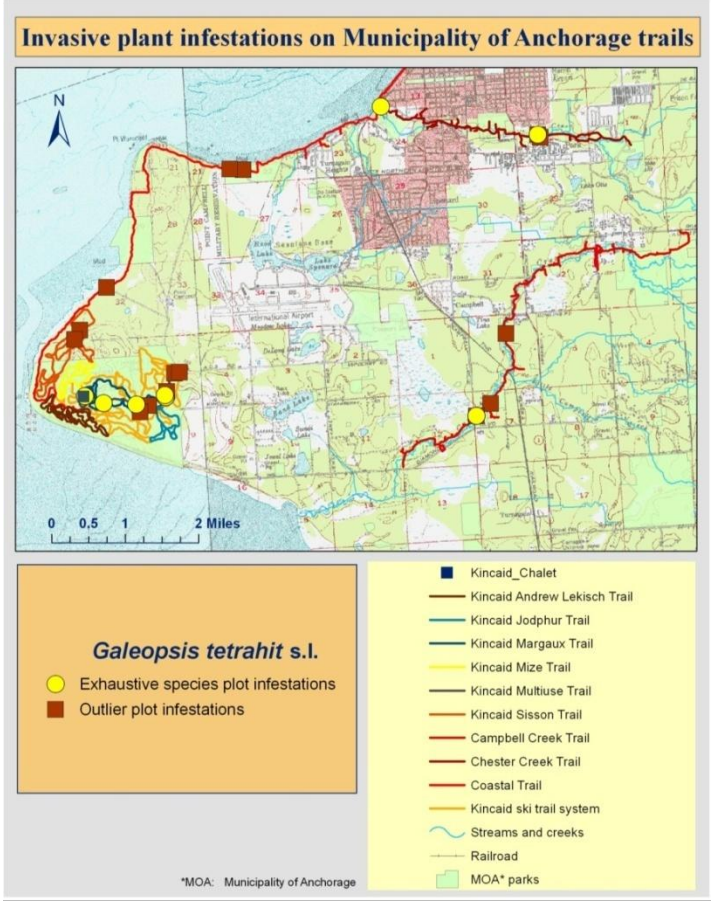
Control and management recommendations:

We recommend that this species be **monitored for changes in the extent and behavior** of the various infestations recorded along Chester and Campbell Creek trails, as well as along the Coastal Trail and in Kincaid Park. **Special attention** should be paid to the populations in the relatively weed-free areas, with **control** efforts being warranted for any **Kincaid Park infestations**.

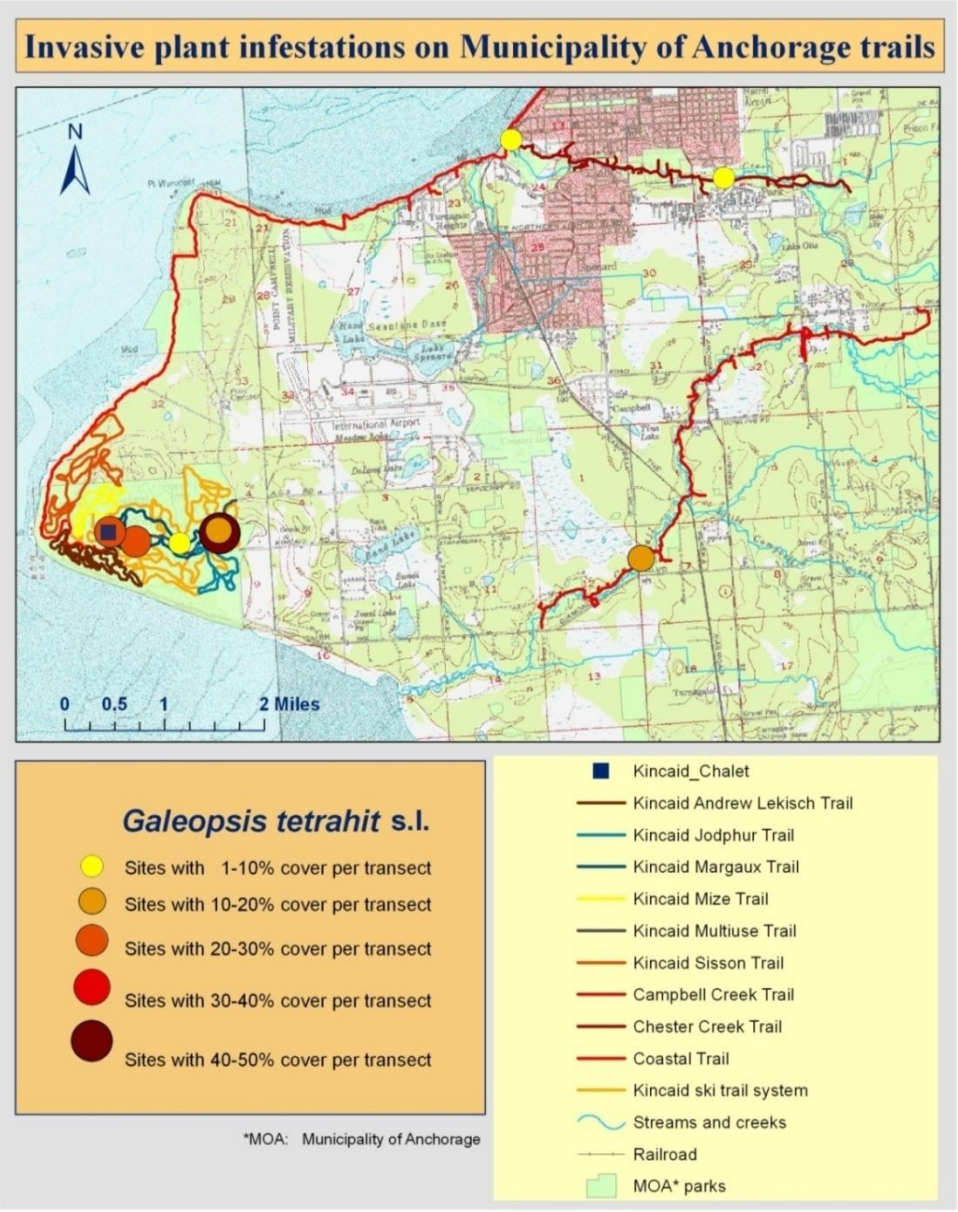
Galeopsis tetrahit s.l. plants **only reproduce by seed**, but the seeds can remain **dormant in the soil for several years** (AKNHP, Invasive Species of Alaska Biographies; http://akweeds.uaa.alaska.edu/pdfs/species_bios_pdfs/Species_bios_GABI.pdf). Both taxa are reportedly **difficult to eradicate**, so the management recommendation in this case is to **avoid current infestations from spreading, and preventing** new areas from becoming infested (AKEPIC 2005).

Distribution

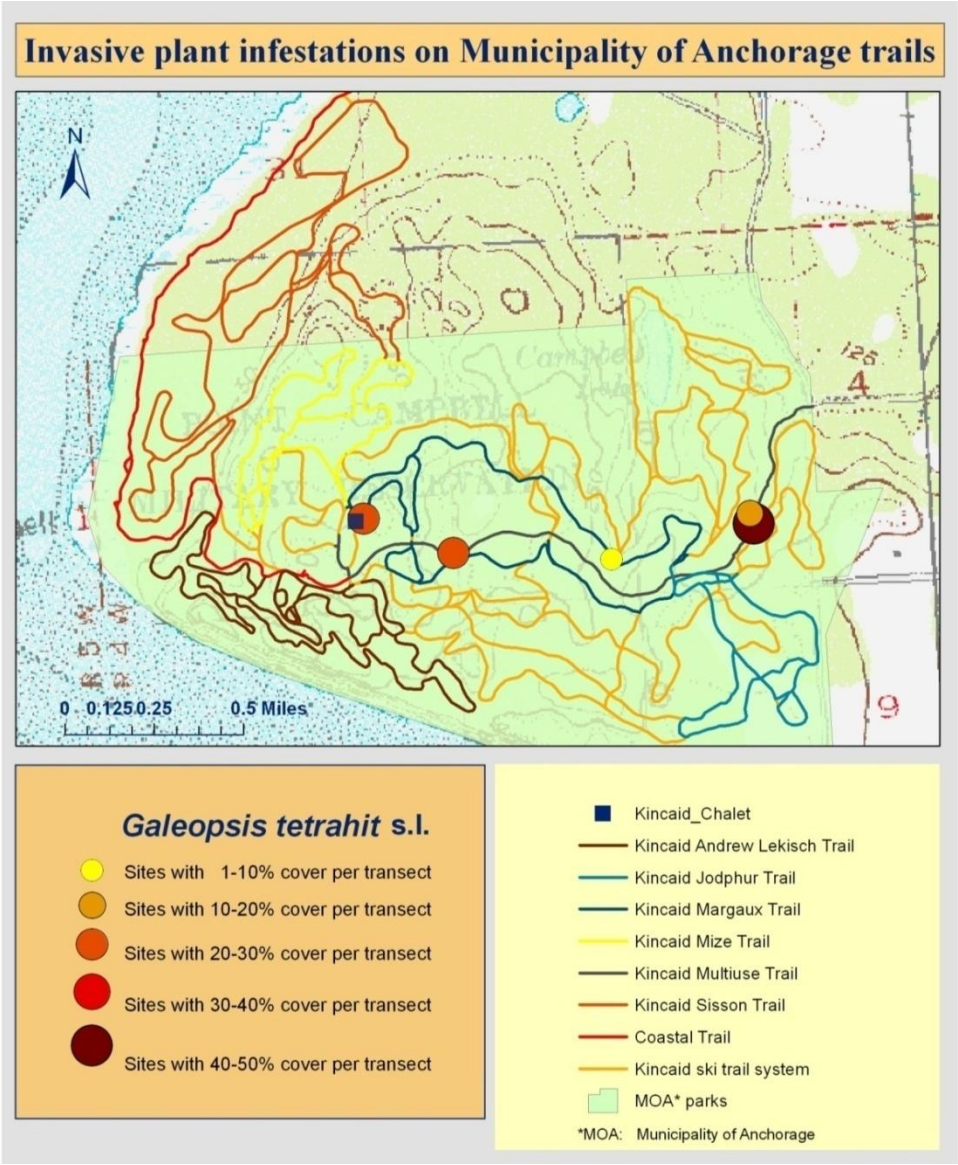
Distribution map of exhaustive species and outlier plots at which *Galeopsis tetrahit* s.l. (40, hempnettle) was recorded. Although *Galeopsis tetrahit* s.l. was recorded throughout the entire MOA trail system it was most noticeably abundant along the Multi-Use trail in Kincaid Park, and at the landfill site along the Coastal Trail.



Overview map showing the percent cover of *Galeopsis tetrahit* s.l. (40, hempnettle) relative to all other species within infested exhaustive species plots.



Map showing the percent cover of *Galeopsis tetrahit* s.l. (40, hempnettle) relative to all other species within infested exhaustive species plots in Kincaid Park.



Hieracium aurantiacum (79, orange hawkweed)

Species biography

Native to the mountains of northern and central Europe, *Hieracium aurantiacum* was first introduced in North America in 1875 as a garden plant (North Dakota Department of Agriculture 2003). *Hieracium aurantiacum* is a very effective invader because it can reproduce **sexually** by seed and **asexually** both by producing leafy **aboveground runners** (stolons) and by resprouting from **underground rhizome** fragments. Furthermore, **seeds** can remain **viable** in the soil for up to **seven years,** and **each plant** can produce **four to eight stolons** annually. *Hieracium aurantiacum* may also have an **allelopathic effect** on surrounding vegetation by exuding toxic chemicals into the soil.

Hieracium aurantiacum in flower, with one stem (in the middle) gone to seed.

Using these various strategies, this species is able to **effectively colonize an area**, and can quickly form large, dense patches that exclude native vegetation (North Dakota Department of Agriculture 2003). It is commonly observed invading clear cuts, meadows, forest openings, and roadsides, where it forms dense mats of basal rosettes that exclude native species, and also impacts ecological process by releasing allelopathic compounds and by **reducing soil moisture and nutrient** availability (AKEPIC 2005).

In the Lower 48 this highly aggressive plant has been listed as noxious by a number of states including Idaho, Minnesota, Colorado, Oregon, Washington, and Montana (USDA, NRCS 2009). In Alaska *Hieracium aurantiacum* is exhibiting the same aggressive behavior it has in the contiguous US, and **has proven to be very difficult to eradicate by any means other than by use of herbicides** (Seefeldt *et al*. 2007, Cortés-Burns 2009).

Control and management recommendations

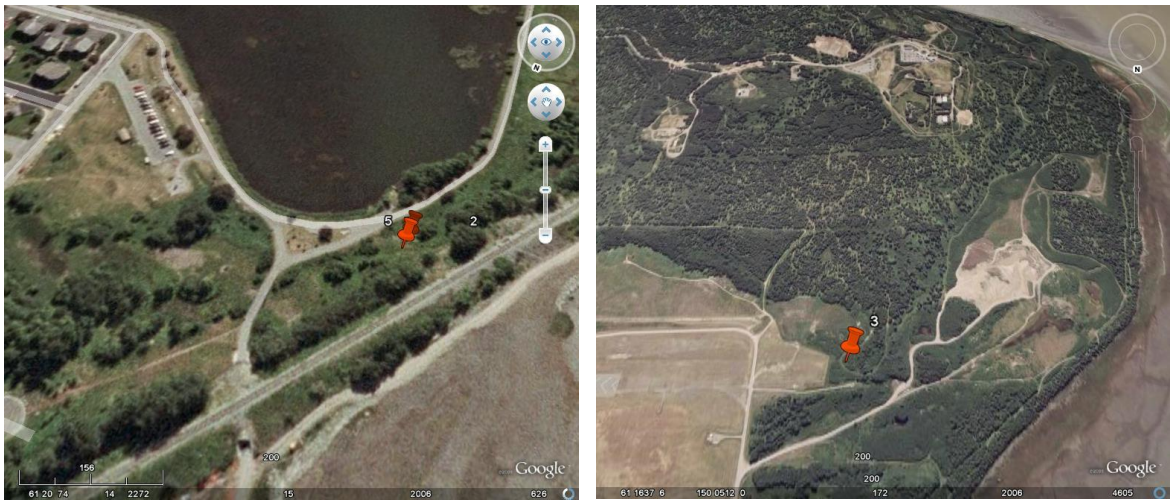
It is essential that any **orange hawkweed infestations be targeted for control and eradication**, and that controlled sites are monitored for at least five years.

Seefeldt and Carr (2007) have conducted a series of experiments to determine the effectiveness of hand-pulling and digging over chemical control methods on a large orange hawkweed infestation located along the airstrip in Talkeetna, Alaska. Their results indicate that **hand pulling was not effective** (mainly because of the difficulty of correctly extirpating all the underground parts) and th**at chemical treatments were required** to eliminate this species.

Given the high **aggressiveness** of *Hieracium aurantiacum* and the **longevity of its seeds**, Seefeldt and Carr (2007) recommended that controlled infestations be **monitored for multiple years following herbicide application** (preferably for a length of time similar to that of the species' seed viability, c. seven years). Herbicides (2, 4-D, picloram, and clopyralid are recommended) must all be applied early in the growing season when the plants are in the rosette stage to prevent flowering and seed production (North Dakota Department of Agriculture 2003).

However, if chemical treatments are **not possible at this point in time**, the infestations detected along MOA trails in 2008 should be **manually controlled early in the growing season**, when plants are still in the rosette stage, and be revisited throughout the summer to prevent re-sprouting and, especially, the production of flowering stems. If the plant is in flower, the flower head must be **cut off, bagged, and either incinerated or disposed** (preferably using black trash bags) into the regular trash, as hawkweeds **can form viable seeds after** they are **cut or dug up** (King County Noxious Weed Control Program 2005).

Ultimately, though, we **recommend herbicide application,** and long-term goals should aim to prevent the formation of a seed bank. The **infestation** detected along the connector to **Sisson's Loop in Kincaid Park**, in particular, should be given **top priority for control work,** as this park is still relatively weed-free and the chances of new introductions of this species into the park are smaller than they are along some of the other trails, like the Coastal Trail.

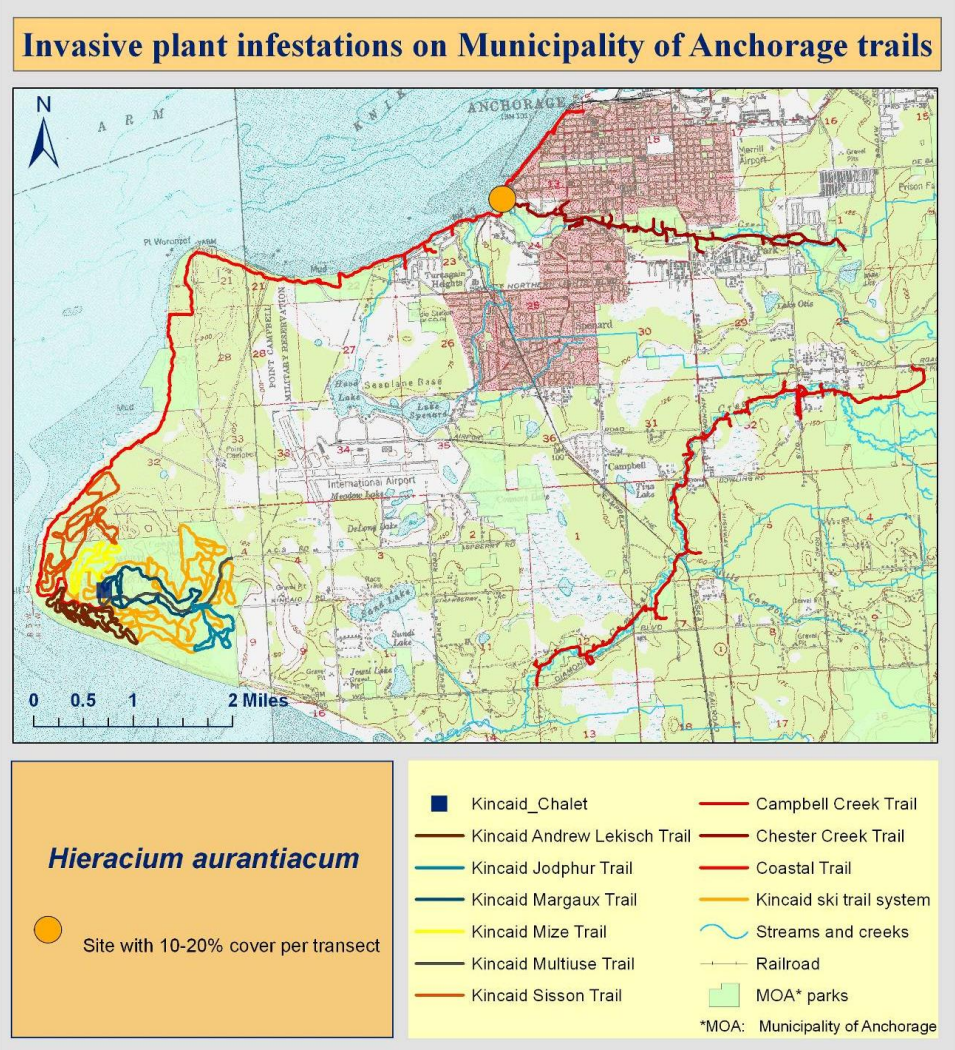


Locations of three small clumps of *Hieracium aurantiacum* by Westchester Lagoon (left) and of one small clump recorded as an outlier infestation on Arlene's Way, en route to the Sisson Loop, in Kincaid Park (right).

Distribution

Distribution map of exhaustive species and outlier plots at which *Hieracium aurantiacum* (79, orange hawkweed) was recorded.

Overview map showing the percent cover of *Hieracium aurantiacum* (79, orange hawkweed) relative to all other species within infested exhaustive species plots.



Hieracium umbellatum (54, narrow leaved hawkweed)

Species biography

We consider that this species may have a greater potential to invade new areas in Alaska than is captured by its current ranking because of its broad distribution and because it can resprout from rhizome fragments as well as spread by seed. In Alaska, *Hieracium umbellatum* infestations are generally associated with contaminated fill importation, and large populations have been recorded along roads and highways in the south-central, southeast, and interior regions.

Crepis tectorum (left) and *Hieracium umbellatum* (right) can be distinguished by the arrangement of their involucral bracts. *Crepis* spp. involucral bracts are arranged in distinct rows (two lengths) whereas *Hieracium* spp. have multiple-length involucral bracts that overlap. In addition, *Crepis tectorum* has deeply lobed leaves, leaf bases that clasp at the stem, and a basal rosette of leaves (withering early in the season). By contrast, *Hieracium umbellatum* lacks a basal rosette of leaves, has a short woody rhizome, and lance-shaped leaves.

Control and management recommendations

We **strongly recommend** that the **one infestation** found on Campbell Creek Trail be targeted for **eradication**, as it is still relatively small and this species has not yet become prevalent in the Anchorage Bowl (in contrast with *Crepis tectorum*).

Hand pulling and digging did **not prove** to be altogether **successful** when trial pulls were conducted by AKNHP botanists Helen Cortés-Burns and Lindsey Flagstad in 2007 on an infestation located on the Steese Highway. The only control method that is currently considered to be effective is **chemical**: control of patches can be achieved with the use of **Telar (chlorsulfuron)** at 2 oz per acre with a 0.25% of a non-ionic surfactant (Seefeldt 2007). A boom sprayer should be used to spray the entire infested area and the area within 50 feet of the patch. Spraying should happen **early in the**

summer before plants begin to flower. The sites should be **revisited** each year. The herbicide should control seedlings for several years. **The area** within at least a 50 yd radius and any disturbed areas within a half mile should be **scouted for new plants**.

Distribution

Hieracium umbellatum (54, narrow-leaved hawkweed) was only recorded at the start of the Campbell Creek Trail, shortly after entering the trail after the intersection with Dimond Boulevard.

Hieracium umbellatum (54, narrow-leaved hawkweed) was only recorded at the start of the Campbell Creek Trail, shortly after entering the trail after the intersection with Dimond Boulevard.

Leucanthemum vulgare (61, oxeye daisy)

Species biography

Leucanthemum vulgare is native to Europe (Polunin 1969). It was probably introduced to North America as an ornamental early in the twentieth century (Alvarez 2000). This visually appealing plant was brought into Alaska as a garden ornamental, and is it often sold commercially in seed packets labeled as wildflower seed. Unfortunately, *Leucanthemum vulgare* easily escapes cultivation and has invaded fields, roadsides, and disturbed areas, where it forms dense colonies that reduce the diversity of native species (AKEPIC 2005).

Leucanthemum vulgare
© William S. Justice

This perennial herb spreads through **abundant seed production** and, vegetatively, by rooting underground stems (**rhizomes**) (Griswold 1985). Seeds can remain **viable for up to 60 years**; thus, this species is capable of developing **seed banks** (Chippindale and Milton 1934). Although seeds have no special adaptations to aid dispersal, water, human and animal foot traffic, and cultivating and earth-moving machinery can carry seeds into new areas (Alvarez 2000).

Leucanthemum vulgare can grow in a wide range of environmental conditions, and flourishes in nutrient poor soils. It displaces native plant species, growing so densely it excludes other vegetation. *Leucanthemum vulgare* is also a host for several viral diseases affecting crops, including the yellow dwarf virus of potatoes (Parsons 1992).

Control and management recommendations

Leucanthemum vulgare infestations **are recommended for control work** due to the potential of this species to spread (wind dispersed seeds), displace native perennials, and out-compete many native species. Given its abundance in the Anchorage Bowl, we recommend **prioritizing small, isolated populations in relatively undisturbed areas for eradication work**, and **implementing best management practices** aimed at **containing** populations in areas that are more heavily infested or receive higher use and are therefore more susceptible to repeated introductions.

Leucanthemum vulgare is especially difficult to control or eradicate because of the long viability of its seed, its capacity to form large seedbanks, and its ability to resprout if not completely removed.

A combination of **hand removal and mulching** has been used to control *Leucanthemum vulgare* in the Golden Gate National Recreation Area (GGNRA). Below we summarize the instructions followed by the GGNRA to extirpate *Leucanthemum vulgare* infestations from the park [a more detailed account of this and other management options can be found at the California Invasive Plants Council website,

http://www.cal-ipc.org/ip/management/ipcw/online.php, which provides online access to the information provided by Alvarez (2000)]:

- Manual: Hand-pull small infestations (less than 0.25 acres) by using a small hand pick, and chipping around the base of the plant several inches deep to loosen the plant. Then lift the entire plant out intact without leaving any rhizomes behind. Check for rhizome fragments, since an entire plant can regenerate from them (Bossard *et al*. 2000).

- Mulching: For removing large infestations in GGNRA, heavy mulching has been found to be the **most successful non-chemical method**. Volunteers at the GGNRA successfully eliminated masses of mature and immature plants through the application of weed-free certified rice straw (Alvarez 2000). **One application 3-4 inches thick when compacted was successful** in two plant communities: coastal scrub and wetland. If any live plants are found under the straw, or any light can reach the soil, then another thick layer should be applied before flowering begins. Along edges that are difficult to mulch, **spot removal can be done by hand** (Alvarez 2000).

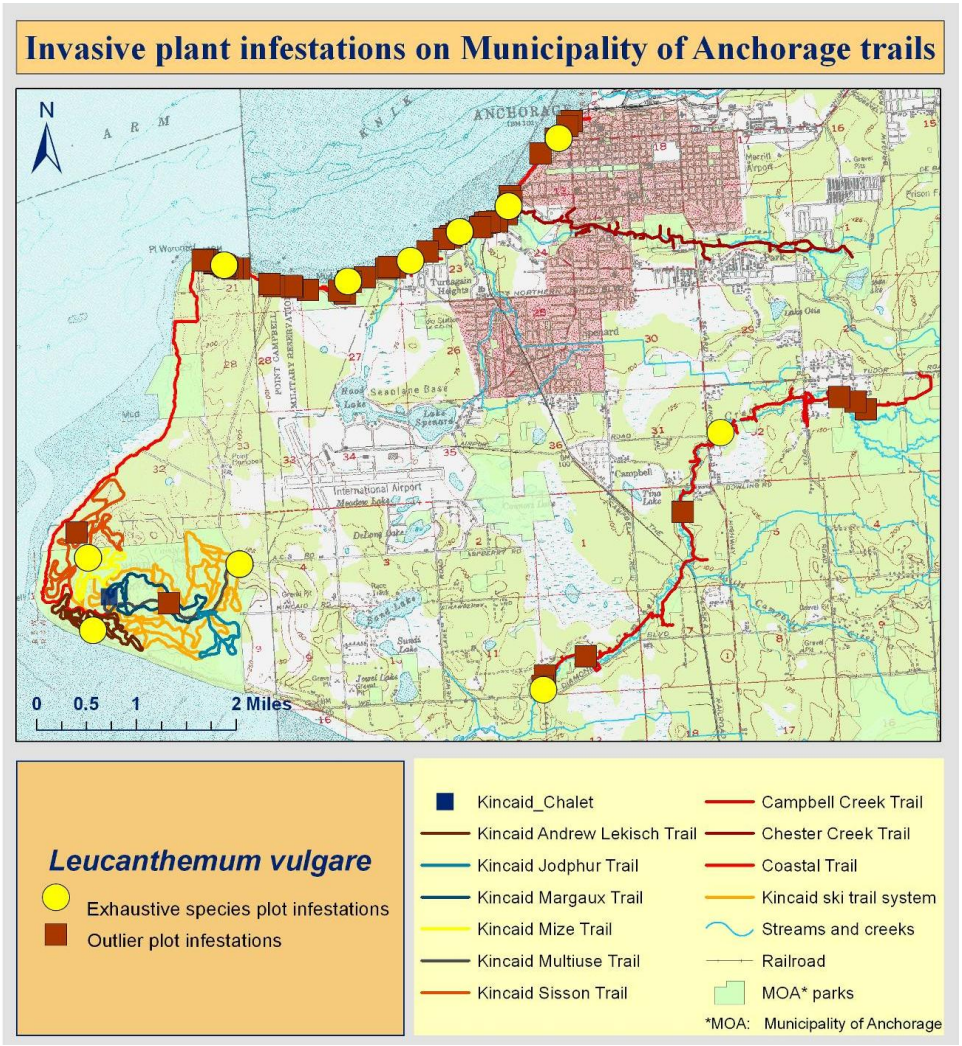
Mulching is effective because *Leucanthemum vulgare* is a prostrate plant except for its flower stalks. **Certified rice straw** was used to avoid introduction of weed seeds. Wood chips might also be effective if they are applied thickly enough (Alvarez 2000).

Alaska based Agricultural Research Station weed scientist Steve Seefeldt developed the following recommendations for eliminating *Leucanthemum vulgare* populations along the Dalton Highway:

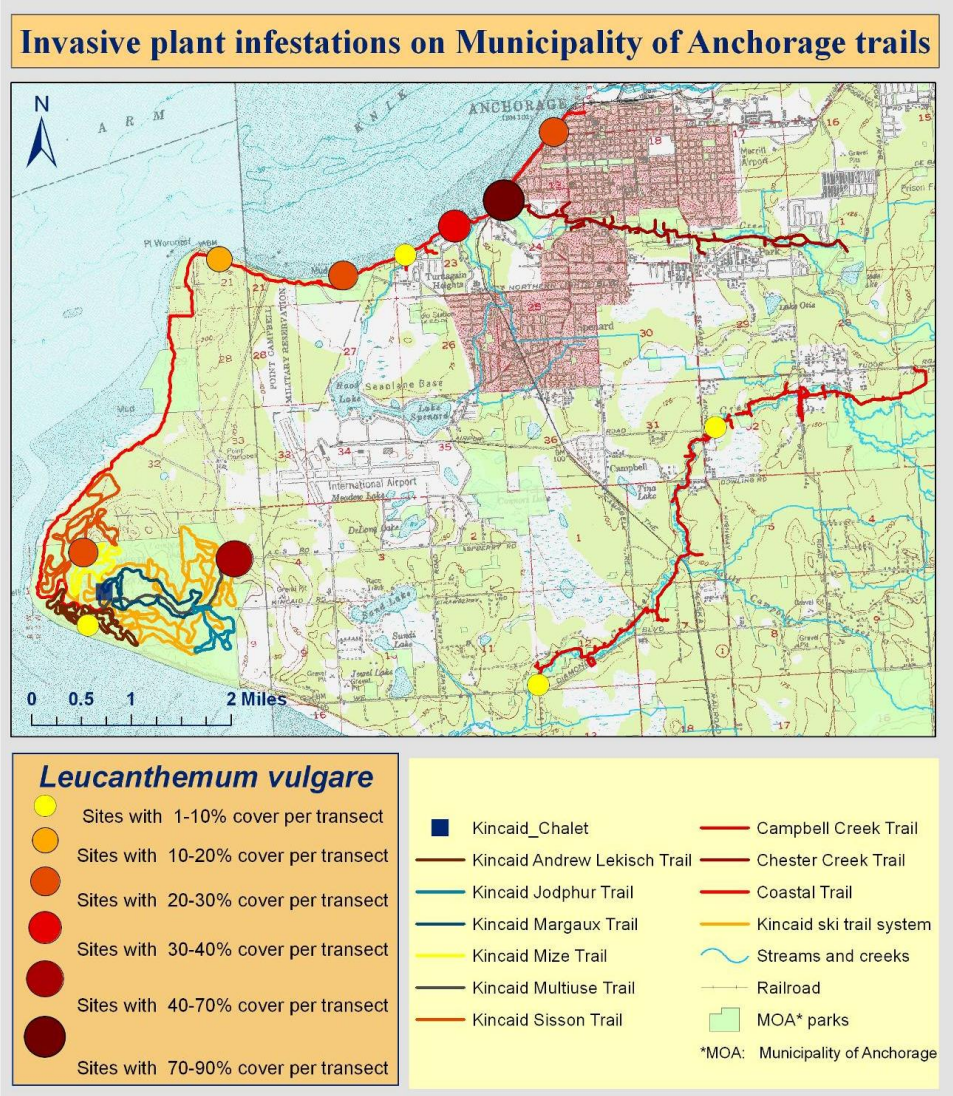
Leucanthemum vulgare	**Human-disturbed sites**	**Naturally-disturbed and unaltered sites**
Small or large infestations	• Start control one month after snow melts • Count and dig up plants; scout area for new plants • Revisit once a month • Follow up: spot spray plants – Suggested herbicides: Clopyralid, Imazapyr, metsulfuron methyl, or triclopyr – All are toxic to many native forbs and shrubs – do not apply this herbicide to riparian areas or to any bodies of water • Visit the site each year and repeat herbicide application or hand weed • Monitor for up to 5 years	• Start control one month after snow melts • Count plants. Cut or bag flowering heads, dig out plants and rosettes; scout area for new plants • Revisit once a month. • Fertilize to encourage growth of native species • Seed perennial native grasses into the treated area to suppress growth • Monitor for up to 5 years

Distribution

Distribution map of exhaustive species and outlier plots at which *Leucanthemum vulgare* (61, oxeye daisy) was recorded. *Leucanthemum vulgare* is common throughout the Anchorage Bowl, but is especially abundant along the Coastal Trail and at the entrance to Kincaid Park along Raspberry Road.



Overview map showing the percent cover of *Leucanthemum vulgare* (61, oxeye daisy) relative to all other species within infested exhaustive species plots.



Leucanthemum* x *superbum (NR, Shasta daisy)

Species biography

Unlike *Leucanthemum vulgare* (61), closely related *L*. x *superbum* is not thought to be very invasive, even though it does escape cultivation. *Leucanthemum* x *superbum* is a commonly cultivated garden flower that is **distinguished from *L. vulgare* by leaf shape**: *Leucanthemum* x *superbum* has lanceolate leaves whereas *L. vulgare* has spoon-shaped leaves.

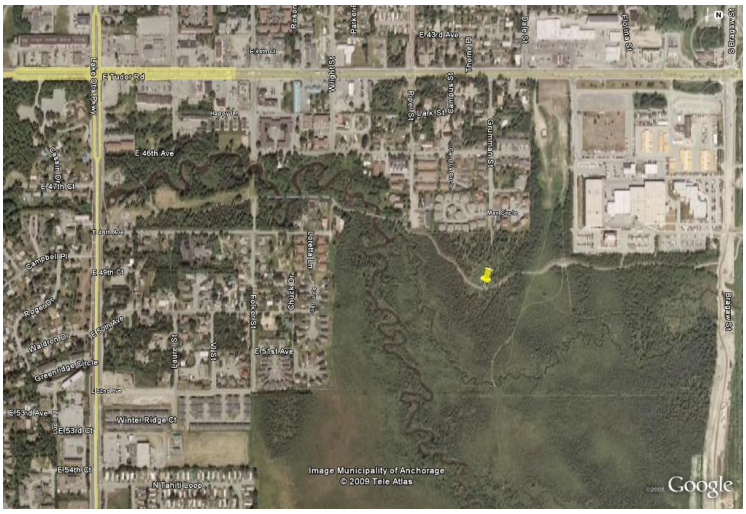
Leucanthemum vulgare (Oxeye daisy) has spoon shaped leaves that can be up to 10 cm long (left), while closely related, yet less aggressive, *Leucanthemum x superbum* (Shasta daisy) has lance-shaped leaves that can be up to 20 cm long (right).

Control and management recommendations

Unless populations of this species are found in areas that are distinctly **not near gardens**, we do **not recommend** that this species be **prioritized** for control and eradication work.

Distribution

Leucanthemum x *superbum* was observed on the east end of the Campbell Creek Greenbelt, probably as a garden escapee.



Leucanthemum x *superbum* was observed on the east end of the Campbell Creek Greenbelt.

Linaria vulgaris (61, common toadflax, butter and eggs)

Species biography

Linaria vulgaris is a short-lived perennial herb native to the steppes of southeastern Europe and southwestern Asia (Eurasia) (Jacobs and Sing 2006). It was introduced in North America from Europe as an ornamental in the mid-1600s (Holdorf undated). It has since escaped cultivation and naturalized in a number of US states, Canadian provinces, and parts of Mexico. It is commonly found in disturbed areas (gardens, roadsides, railroads, forest clearings) but has also colonized alpine meadows in some Lower 48 states. It is a designated noxious weed in Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Washington, and Wyoming (USDA, NRCS 2009). In Montana, despite being a designated noxious weed, it is still sold as an ornamental by nurseries and seed companies under the common name "butter-and-eggs" (Jacobs and Sing 2006). **It is likely still being sold in Alaska, also.**

The showy inflorescence of *Linaria vulgaris*

This plant is an **aggressive invader due to its high seed** production and ability to **reproduce vegetatively by rhizomes,** being able to grow from root fragments as short as half an inch. Once it establishes in an area, it spreads quickly, forming **large colonies that choke out native vegetation** (AKNHP online species biographies; http://akweeds.uaa.alaska.edu/). In addition, plants contain poisonous glycosides that can be **toxic to livestock**.

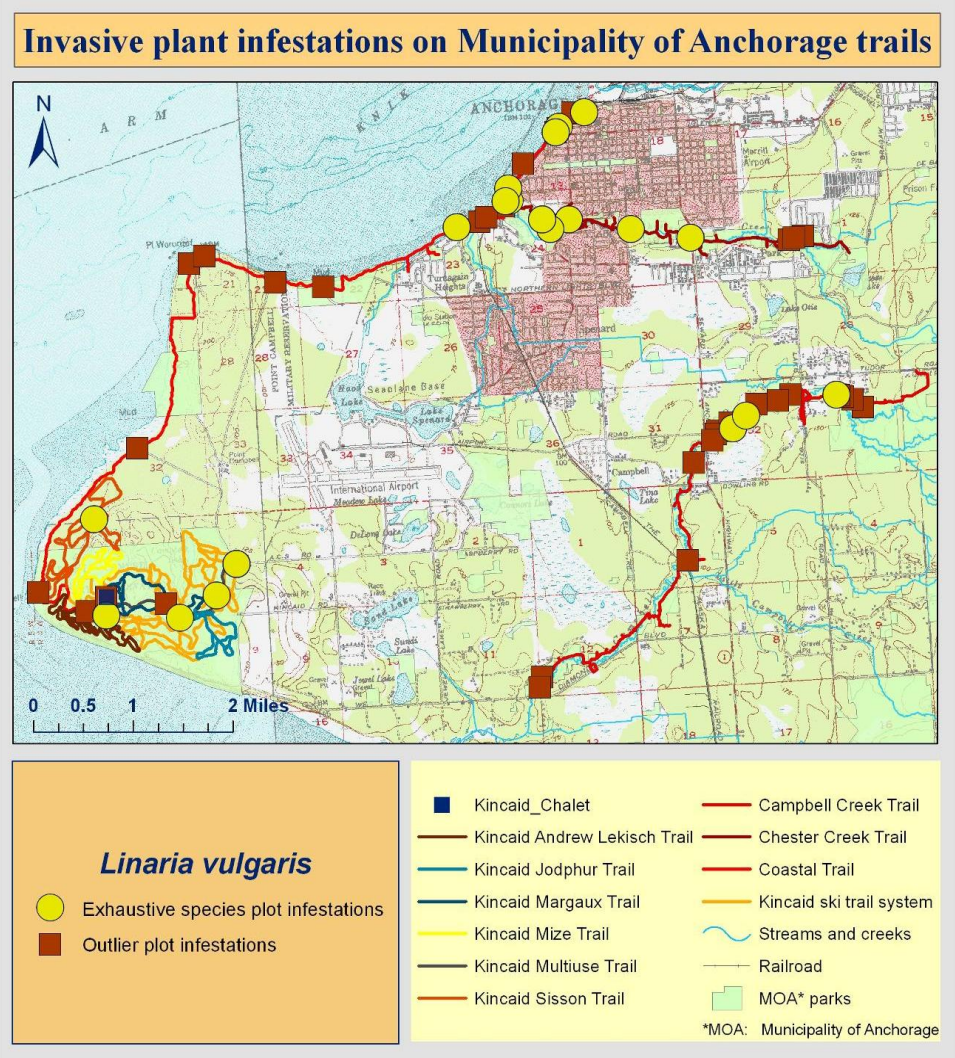
Control and management recommendations

We recommend that **small, outlier infestations in low-use areas** be targeted for **eradication**, while **larger populations** should be **contained** to the extent possible. Alaska based Agricultural Research Station weed scientist Steve Seefeldt provides the following recommendations for eliminating *Linaria vulgaris* populations along the Dalton Highway:

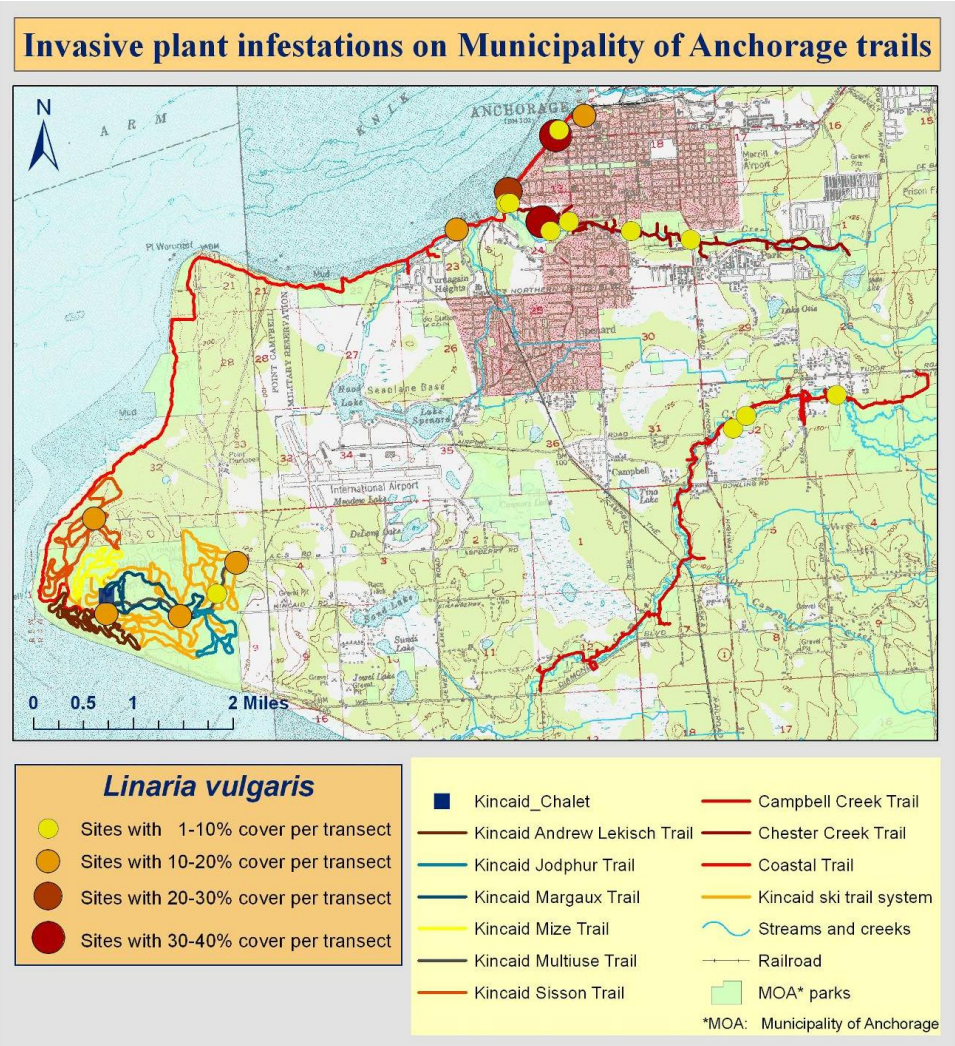
1. One **month after snowmelt**, **count and dig** stems up collecting as much of the rhizomes as possible
2. **Scout** the area for new plants
3. **Revisit** once a **month**
4. Encourage competition by **fertilizing** and **seeding** with native, perennial grasses
5. Alternatively, **spray plants before flower initiation with roundup** (glyphosate)
    - This herbicide will kill most of the vegetation that it is sprayed on
    - As roundup has no residual activity, surviving *Linaria vulgaris* rhizomes will re-sprout and the area will have to be revisited and possibly sprayed multiple times each year until eradication is achieved

Distribution

Distribution map of exhaustive species and outlier plots at which *Linaria vulgaris* (61, common toadflax, butter and eggs) was recorded.



Overview map showing the percent cover of *Linaria vulgaris* (61, common toadflax, butter and eggs) relative to all other species within infested exhaustive species plots.



Lolium perenne* ssp. *multiflorum (41, annual rye grass)

Species biography

Lolium perenne ssp. *multiflorum* is an annual or biennial grass native to Europe, which has been introduced throughout the temperate regions of the world as an agricultural species, but has escaped cultivation in many areas (California Invasive Plants Council: http://www.cal-ipc.org/ip/management/plant_profiles/Lolium_multiflorum.php) and now occurs throughout the United States, including Alaska and Hawaii, and in adjacent Canadian provinces (Carey 1995). *Lolium perenne* ssp. *multiflorum* **does not generally persist in cold ecosystems** such as in Alaska and does not tend to spread into adjacent undisturbed areas (Densmore *et al.* 1990). This species **regenerates readily by seed** and **tillers profusely** (Kannerberg and Allard 1967, Hellmers and Ashby 1958) making it unlikely for populations to form a substantial seedbank (Roberts 1981).

Lolium perenne* ssp. *perenne (NR, perennial rye grass)

Species biography

Lolium perenne ssp. *perenne* is a native of Eurasia and North Africa but has been introduced around the globe for forage, turf, and erosion control (Garry Oak Ecosystems Recovery Team http://www.goert.ca/documents/L.perenne.pdf). The large seeds of this species do not go dormant and therefore **do not form a persistent seedbank** (Grime 1979).

Lolium perenne* ssp. *multiflorum* was derived artificially from *Lolium perenne* ssp. *perenne although most authors recognize the two taxa as separate species or subspecies (Frakes 1973). *Lolium perenne* ssp. *perenne* is distinguished from *Lolium perenne* ssp. *multiflorum* by having **unawned lemmas, folded leaf blades in young shoots (rather than rolled) and ten or fewer florets per spikelet** (instead of 10-20). However, *Lolium perenne* ssp. *perenne* **readily hybridizes** with *Lolium perenne* ssp. *multiflorum* and hybrids may exhibit a range of characteristics from both species (California Invasive Plants Council: http://www.cal-ipc.org/ip/management/plant_profiles/Lolium_multiflorum.php) making it difficult to distinguish these two subspecies in the field (Terrell 2007). Due to this hybridization, the exact northern distribution of either subspecies is not well documented (Carey 1995).

Common ryegrass (*Lolium* spp.) is a commercial mixture of ryegrass species frequently used in revegetation projects, which is comprised mostly of *Lolium perenne* ssp. *multiflorum* but usually contains a substantial percentage of *Lolium perenne* ssp. *perenne* and annual-perennial hybrids (Wheeler and Hill 1957).

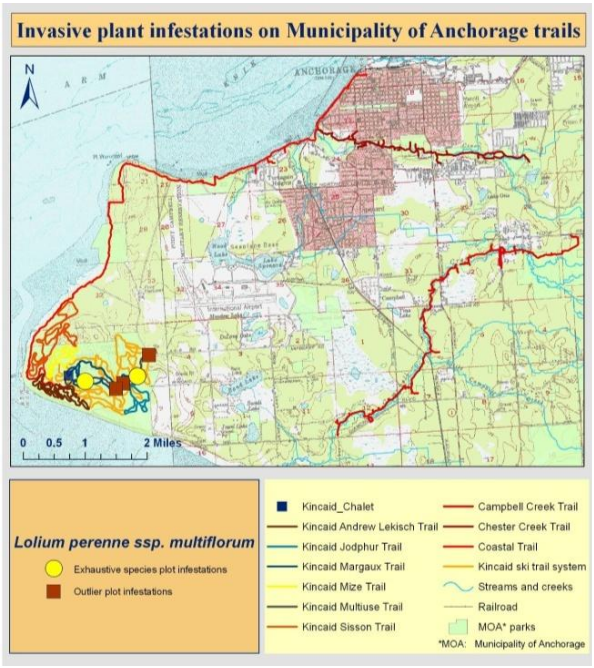
Control and management recommendations

Given their low invasibility and inability to form seedbanks, we **do not consider that this species group should be prioritized for control work**. However, the current infestations **should be monitored** for changes in their size or behavior, and best

management practices should be implemented to try to avoid future introductions of these species in trail and maintenance or development projects

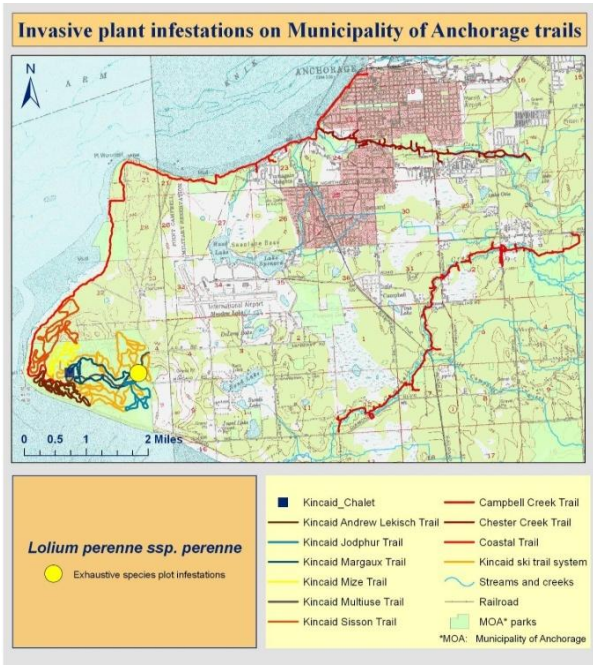
Manual removal by **hand pulling** can be effective in spring or early summer before the seed sets. However, this method is very labor intensive and is feasible only when patches are small. Efforts should be made to disturb the soil as little as possible. Populations too large for manual removal can be managed by cautious application of herbicides. (California Invasive Plants Council: http://www.cal-ipc.org/ip/management/plant_profiles/Lolium_multiflorum.php)

Distribution

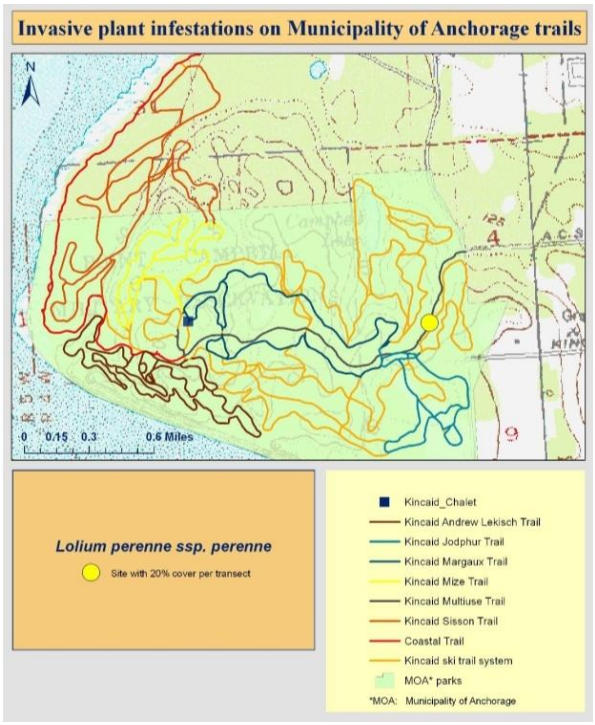


Distribution map of exhaustive species and outlier plots at which *Lolium perenne* ssp. *multiflorum* (41, annual rye grass) was recorded.

Map showing the percent cover of *Lolium perenne* ssp. *multiflorum* relative to all other species within infested exhaustive species plots in Kincaid Park.



Distribution map of exhaustive species and outlier plots at which *Lolium perenne* ssp. *perenne* (NR, perennial ryegrass) was recorded.



Map showing the percent cover of *Lolium perenne* ssp. *perenne* relative to all other species within infested exhaustive species plots in Kincaid Park.

Lychnis chalcedonica (NR, Maltese cross)

Species biography

This pink-family species is a common component in wildflower-type seed mixes and it is currently thought that it will not re-seed or grow for more than one season in Alaska (Holloway and Rutledge 2009). However, in Alberta (Canada) *Lychnis chalcedonica* has escaped flowerbeds and is moving up undisturbed slopes into native vegetation (Alberta Invasive Plants Council; www.invasiveplants.ab.ca).

Lychnis chalcedonica growing on the Upper Hillside © Helen Cortés-Burns

In 2007 large populations of *Lychnis chalcedonica* were observed **spreading out of gardens and yards in the Upper Hillside area into disturbed, yet native, vegetation** (Cortés-Burns pers. obs.). If this species were able to persist in the soil and germinate after a full year has passed since it was sown, it **could become a strong invader** and would be a candidate for control measures.

Control and management recommendations

We suggest that the **Multi-use trail be monitored** for this and similar annual forbs (*e.g. Cheiranthus allionii* and *Nemophila menziesii*) that are supposedly annual plants that do not persist in Alaska. If such species do produce seed that is viable for more than one year, then each species' reproductive biology should be researched, and adequate control methods should be implemented.

Distribution

A few, small (1-5 stems) of *Lychnis chalcedonica* populations were observed along the Multi-use Trail.

Medicago sativa* ssp. *falcata (64, yellow alfalfa)

Species biography

Native to Southwestern Asia and northern Africa, *Medicago sativa* ssp. *falcata* has been widely cultivated in North America (AKNHP online species biographies; http://akweeds.uaa.alaska.edu/), but has also become naturalized in many of the areas where it has been cultivated (Royer and Dickinson 1999). As a member of the pea family it is able to fix atmospheric nitrogen, which alters the natural nutrient status of the soil in favor of other native ruderal and non-native weedy species (AKEPIC 2005).

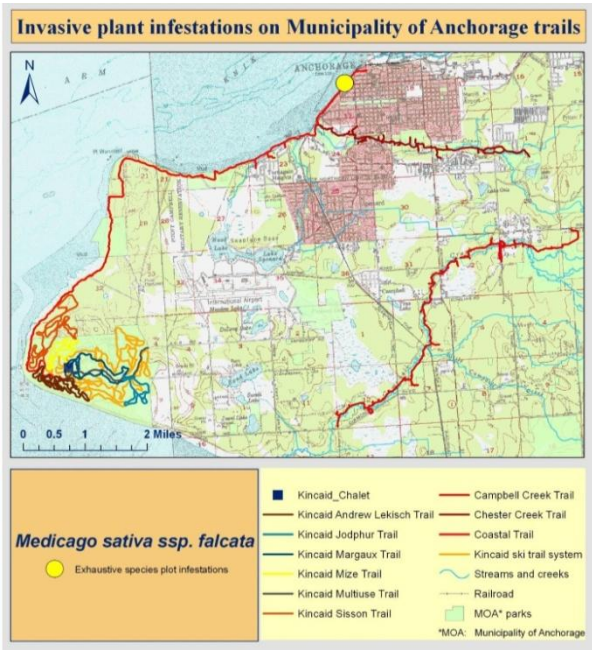
Medicago sativa ssp. *falcata* flowers (left, © Dzyubenko N. I., Dzyubenko E. A.) and sickle-shaped pods (right, © Thomas Schoepke, plant-pictures.com).

Control and management recommendations

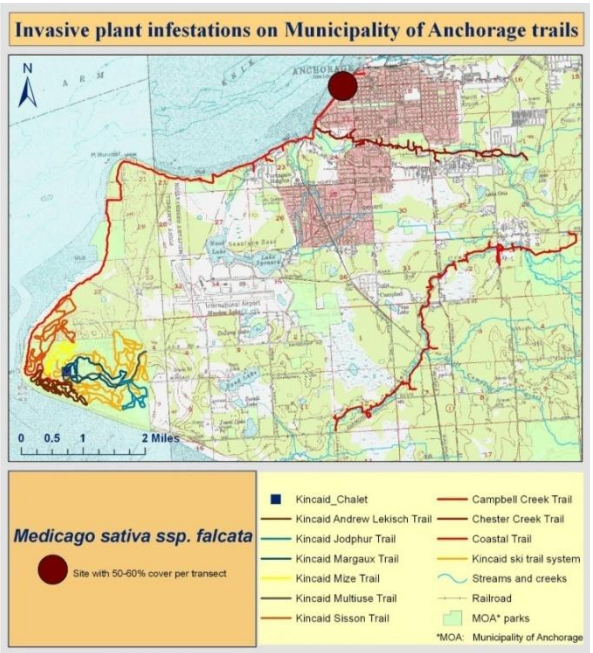
Medicago sativa ssp. *falcata* only reproduces by seed, and can be effectively controlled **by hand-pulling** prior to seed set (AKEPIC 2005). Controlled sites should be revisited throughout the summer to check for new seedlings that may come up from the soil. Herbicides are effective when applied immediately after the emergence of leaves (AKEPIC 2005).

Distribution

In Alaska, *Medicago sativa* ssp. *falcata* occasionally escapes cultivation and has been found along roadsides and railways in interior and south-central Alaska (see EDDMaps for all infestations recorded in AKEPIC, the statewide weeds database, through 2007). The one infestation observed on MOA lands in 2008 was on the Coastal Trail, growing along the trailside and ditch right after the first tunnel traveling from Elderberry Park to Westchester Lagoon, and constitutes the first recorded sighting of this species in the Anchorage Bowl area. A second, large infestation was spotted in 2009 along Chester Creek trail, by the staircase leading onto the trail between Arctic Boulevard and Bunker Street.



Distribution map of exhaustive species and outlier plots at which *Medicago sativa* ssp. *falcata* was recorded.



Overview map showing the percent cover of *Medicago sativa* ssp. *falcata* relative to all other species within infested exhaustive species plots.

Melilotus alba (81, white sweetclover)

Species Biography

Melilotus alba is arguably the **most invasive non-native species in Alaska**, and is quickly spreading and becoming established across the state. It prefers disturbed, fine-grained mineral soils where it readily establishes and often proliferates to monoculture. Although it only reproduces by seed, this species' seeds are able to **remain viable in the soil for over 20 years** (AKEPIC 2005), making it very hard to eradicate once it has become established and set seed.

Invasion of naturally- and human-disturbed areas such as **trails, graded roadsides, road-side dust shadows, and glacial river gravel bars** is common. The affinity of *Melilotus alba* for these environments is of special concern as these environments often form corridors along which the species' seeds can migrate. As a member of the pea family, *Melilotus alba* is able to fix atmospheric nitrogen which alters the soil nutrient status in favor of itself and other weedy species. *Melilotus alba* invades and degrades native ecosystems by overtopping and shading native plants, thereby reducing diversity. It has been observed moving off roadsides into undisturbed native vegetation along the Dalton Highway (Cortés-Burns *et al*. 2008) and is quickly spreading along glacial river gravel bars in southeast (Stikine) and interior (Nenana, and probably the Yukon River also) Alaska.

Melilotus alba infestations are common along roadsides in south-central and interior Alaska (Dalton Highway, 2007 (© Matthew Carlson).

Melilotus alba moving off the roadside areas into native, lightly burned sites on the Dalton Highway in 2007 (© Matthew Carlson).

Control and management recommendations

Due to the botanical and ecological similarity between *Melilotus alba* and *M. officinalis* the following control methods are applicable to either species. *Melilotus alba* is a biennial forb that is notoriously difficult to eradicate because it **produces copious seed** (up to 350,000 per plant) that remain viable in the soil for many decades (Rutledge and McLendon 1996), and it is able to quickly spread by wind-dispersed seed. **Large populations should be contained or reduced,** while **isolated, small populations should be the highest priorities for eradication work**.

All sites must be treated before flowering occurs, and in all cases **long-term control** programs are necessary to guarantee that the seedbank is depleted (Densmore *et al.* 2001). **Small populations** growing on altered ground, infestations growing within 500 feet of a **waterway**, and plants that have invaded **native vegetation** are best extirpated mechanically by **hand-pulling**; both the roots and root crown must be removed. Control work must be carried out as soon as possible, when the **soil** is still **moist** but **before flowering** (June), included to prevent the formation of a large seed bank (Seefeldt 2007). A **second session** of hand-pulling is also recommended **in the fall** (Cole 1991). Nonetheless, hand-pulling can disturb the soil, which may result in another flush of plants; for this reason the **site should be revisited every other week** following a hand-pulling treatment. Cut *Melilotus alba* plants regenerate and flower quickly, so **cutting is not recommended** (Seefeldt 2007).

Use of **herbicides** is recommended for reducing or eliminating medium to large populations **growing on human-altered soils that are not close to waterways**. Herbicides **provide almost complete control** of *Melilotus alba* plants. If herbicides are applied, the **area within 50 feet of the infestation should also be treated** to prevent success of any dispersed seeds. The type of herbicide used depends on the infested environment (Seefeldt 2007):

- Wetland areas: spot spray with Imzapyr (Habitat) and Roundup (Rodeo)
- Roadsides: Chlorsulfuron (Telar), Imazapyr (Arsenal), 2,4-D, Dicamba (Banvel), Metsufuron-methy (Escort), and Sulfometuron-methy (Oust)
- In Alaska plants have been found to be very sensitive to Telar (2 oz per acre with 0.25% non-ionic surfactant). It controls seedlings for several years because it is actively taken up by the roots, as do several of the above herbicides (Habitat, Arsenal, and Oust).

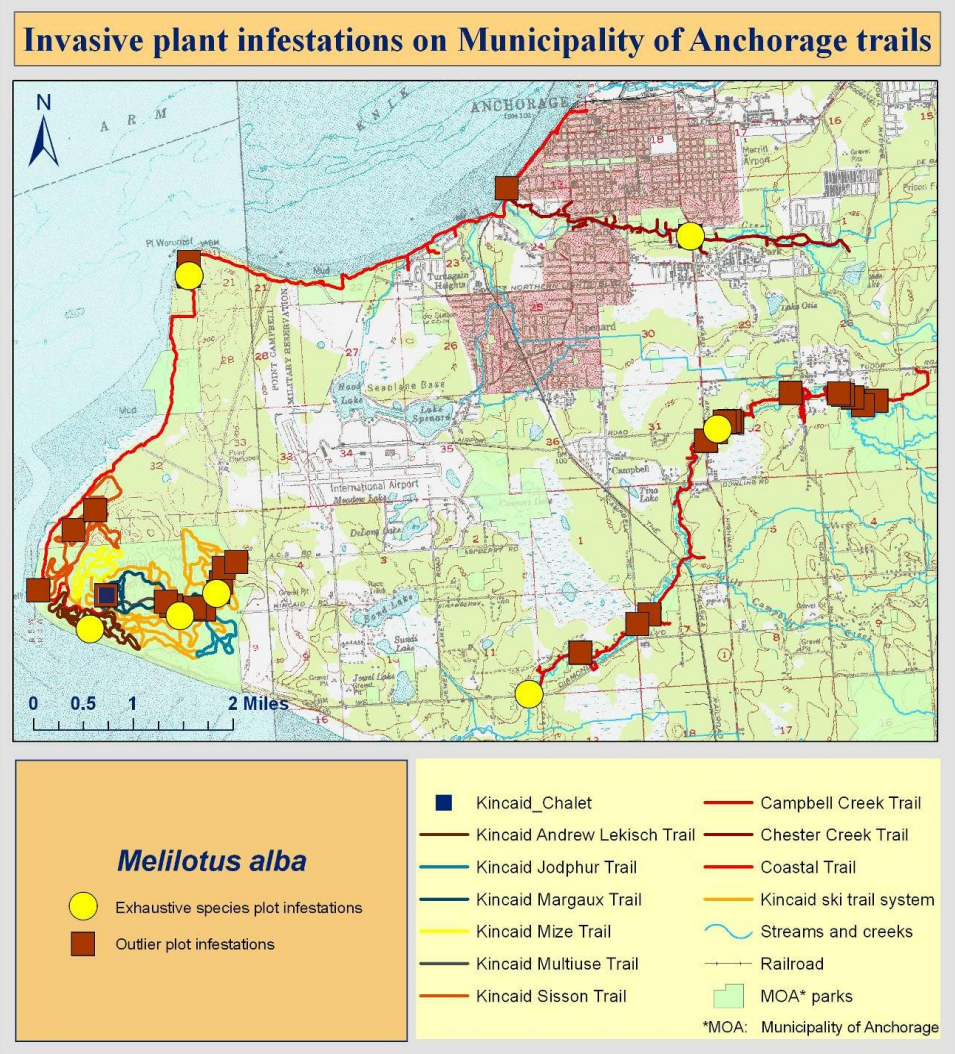
For those populations that have **moved off the human footprint** into naturally disturbed sites but that are **still close to an anthropogenically** altered area, and are **not close to a waterway**, **spraying with a soil-active herbicide such as Telar** to kill seedlings is suggested (Seefeldt 2007). An area 20 feet around the infestation should also be sprayed to control isolated individuals or any newly germinating seeds. Controlled sites should be **revisited every year** before plants go to seed and retreated if seedlings are found (Seefeldt 2007).

Summary of control recommendations provided for *Melilotus alba* and *M. officinalis* growing along the Dalton Highway in Alaska (Seefeldt 2007).

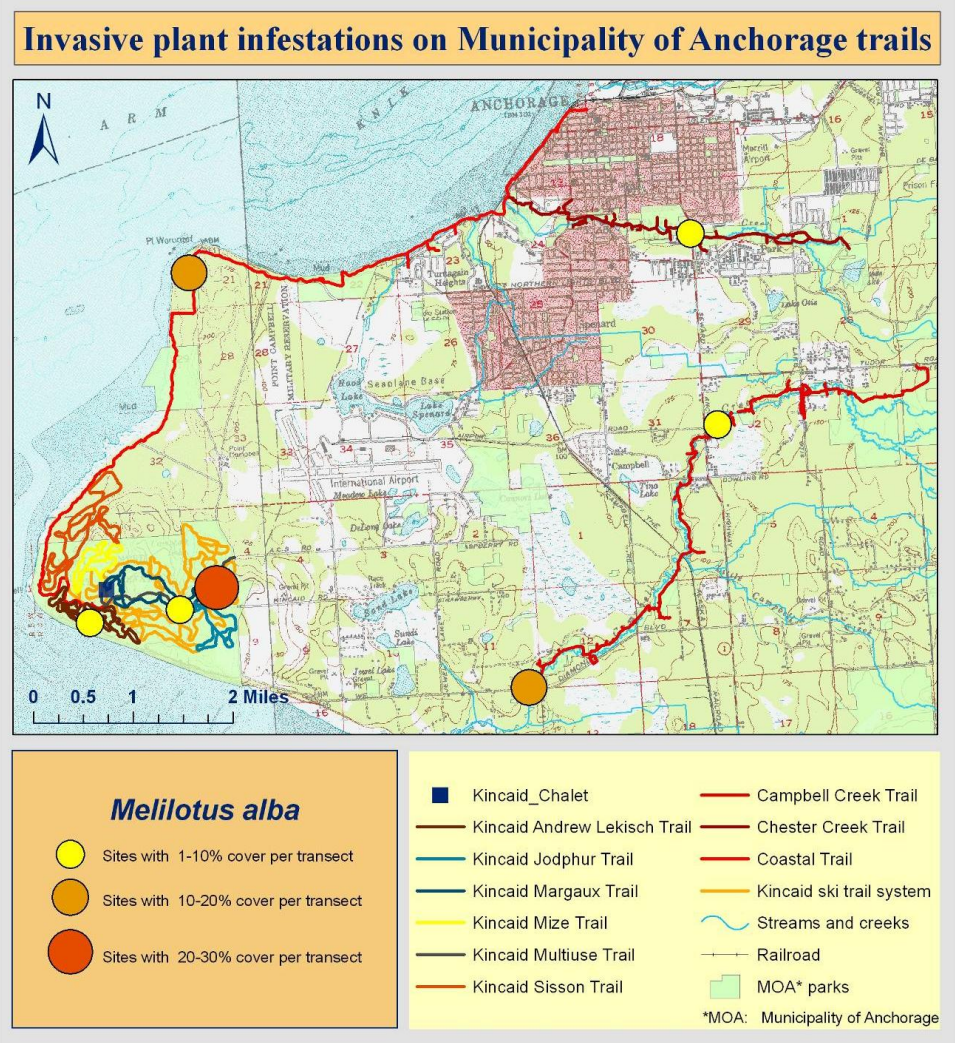
Human-disturbed site	Naturally-disturbed and unaltered sites
1. **Small populations and infestations near waterways**: a. Hand pull, roots included, when soil is moist and before flowering (June). Revisit every 2 weeks. Additional pull in the Fall. 2. **Medium to large populations that are not close to waterways**: a. Spray infestation + 50 ft radius with selected chemical (different herbicides for different types of habitat/location) b. Monitor annually	1. **Infestations growing near waterways or >150ft from human-altered sites**: a. Hand pull, roots included, when soil is moist and before flowering (June). Revisit every 2 weeks. Additional pulls may also be conducted in the Fall. 2. **Infestations growing on naturally disturbed sites, <150ft from human altered sites, and not near waterways**: a. Spray infestation + 20 ft radius with Telar b. Monitor annually

Distribution

Distribution map of exhaustive species and outlier plots at which *Melilotus alba* (81, white sweetclover) was recorded.



Overview map showing the percent cover of *Melilotus alba* (81, white sweetclover) relative to all other species within infested exhaustive species plots.



Melilotus officinalis (69, yellow sweetclover)

Species biography

Melilotus officinalis is morphologically and ecologically very similar to closely related *M. alba* (see description of ecological impacts for *M. alba*), to the extent that a few authors consider them to be one single taxonomic unit (*e.g.* USDA, NRCS 2009). However, in Alaska, *Melilotus officinalis* appears to be much less aggressive than its white counterpart and is more restricted both in its range as well as in the types of habitats it is found in (restricted, mainly, to roadsides and similar high-use areas).

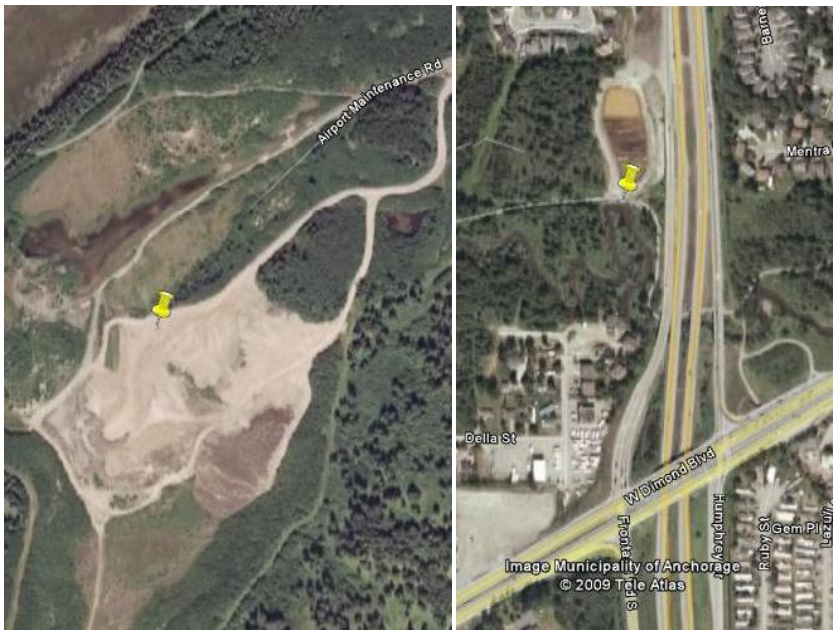
Melilotus officinalis
© Patrick J. Alexander

Control and management recommendations

See preceding *Melilotus alba* section for recommended control methods. Both white and yellow sweetclovers should be given top priority for eradication and/or containment efforts.

Distribution

Melilotus officinalis was recorded twice in the study area, once along a disturbed section of the Sisson Loop and once on the Campbell Creek Trail just west of the Minnesota Drive underpass.



Melilotus officinalis was recorded twice in the study area, once along a disturbed section of the Sisson Loop (left) and once on the Campbell Creek Trail just west of the Minnesota Drive underpass (right).

Persicaria lapathifolium (47, curlytop knotweed)

Species biography

Persicaria lapathifolia is a morphologically variable species complex with more than two-dozen infraspecific taxa described in the New World and Old World, with at least some of these being taxonomically questionable entities [Hinds and Freeman (1997), Consaul *et al*. (1991), Yang & Wang (1991)]. We follow the information provided by the PLANTS database (USDA, NRCS. 2009), and consider that *Persicaria lapathifolia* is native to the Lower 48 but exotic in Canada and Alaska (USDA, NRCS 2009; Hultén 1968; Welsh 1974).

This species can be confused with closely related *P. maculosa*, which is considered alien to all of North America, and is also quite widespread. The couplet used by Hinds and Freeman (1997) to separate *P. maculosa* (and other elements) from the *P. lapathifolia* species complex follows:

Outer tepals with **anchor-shaped veins**; tepals 4(-5); inflorescences **mostly arching or nodding**	*Persicaria lapathifolia*
Outer tepals **without anchor-shaped veins**; tepals 5; inflorescences **mostly erect**, rarely nodding	*Persicaria maculosa* (and others)

Persicaria lapathifolia reproduces only by seed, and grows in disturbed sites, roadsides, gardens, and waste grounds. In its native range this species grows on the edges of ponds, lakes, streams, and wet fields (DiTomaso and Healy 2003). In the Anchorage Bowl area it is becoming increasingly present in areas that have undergone recent anthropogenic disturbance.

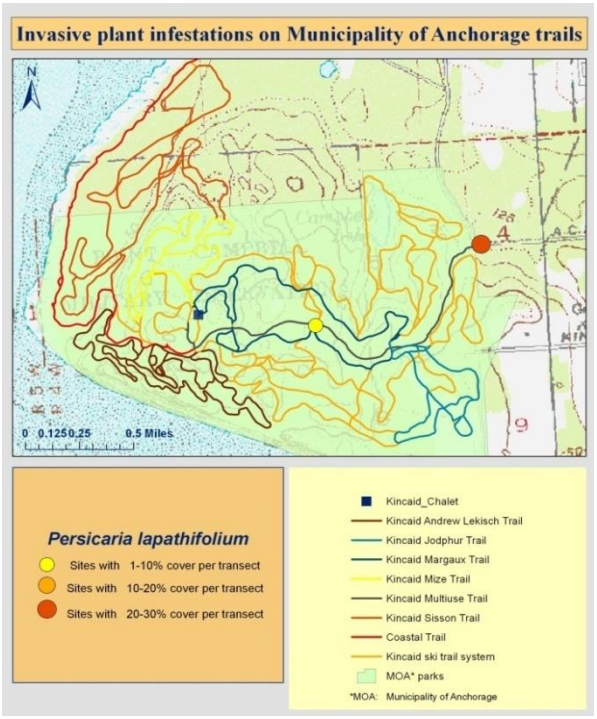
Control and management recommendations

This species **reproduces only by seed**, and therefore hand-pulling and mowing can control populations. Improving the drainage will discourage these weeds from reestablishment (DiTomaso and Healy 2003).

Distribution

As of 2007, there were only three records of *Persicaria lapathifolia* in AKEPIC, the statewide weeds database. However, surveys conducted in the Anchorage Bowl area in the past two years have revealed that this species is more prevalent than the database indicates, having found it in disturbed sites in Campbell Tract as well as in Kincaid Park (Cortés-Burns, pers. obs.).

Distribution map of exhaustive species and outlier plots at which *Persicaria lapathifolia* was recorded.



Map showing the percent cover of *Persicaria lapathifolia* relative to all other species within infested exhaustive species plots in Kincaid Park.

Phalaris arundinacea (83, reed canarygrass)

Species biography

Phalaris arundinacea is an **aggressive invader of wet habitats**. Once it becomes established, it spreads quickly via its rhizomatous system forming dense and impenetrable mats (Coops *et al*. 1996; Kätterer and Andren 1999), which exclude most native species. The density of such stands encourages silt deposition and retards natural erosion which **alters water flow** thereby changing the structure of the ecosystem. Invasion is promoted by soil disturbance and plants can establish from fragments transported downstream (AKEPIC 2005). A very **high annual seed yield** (Baltensperger and Kalton 1958; Østrem 1988) and period of **seed dormancy** (Vose 1962; Landgraff and Junttila 1979) result in the **formation of seed banks**, which make populations difficult to eradicate even after removal of the above and below ground parts of germinated individuals.

Phalaris arundinacea is a tall grass which often has pinkish inflorescences and leaf blades coming out of the stem at right angles (example circled in red).

This species has been planted throughout the US since the 1800s for forage and erosion control and stabilization, and despite its drastic impacts on native wetlands and riparian ecosystems, it continues to be used for erosion control across the US. One must note that this species is not completely non-native to North America. A few wild populations predate the introduction of the European non-native genotypes, but these populations did not appear to be aggressive (Merigliano and Lesica 1998). In Alaska, Hultén (1968) identified a few populations of ostensibly native reed canarygrass around hot springs of the interior. However, in recent years a more aggressive form of this species has started to show up in disturbed sites in interior (as far north as Wiseman), south-central, and southeast Alaska. The invasive form has been found growing as a contaminant in sites that have undergone road or railroad construction (with fill importation) or where other types of anthropogenic, mechanical substrate alteration have taken place.

Control and management recommendations

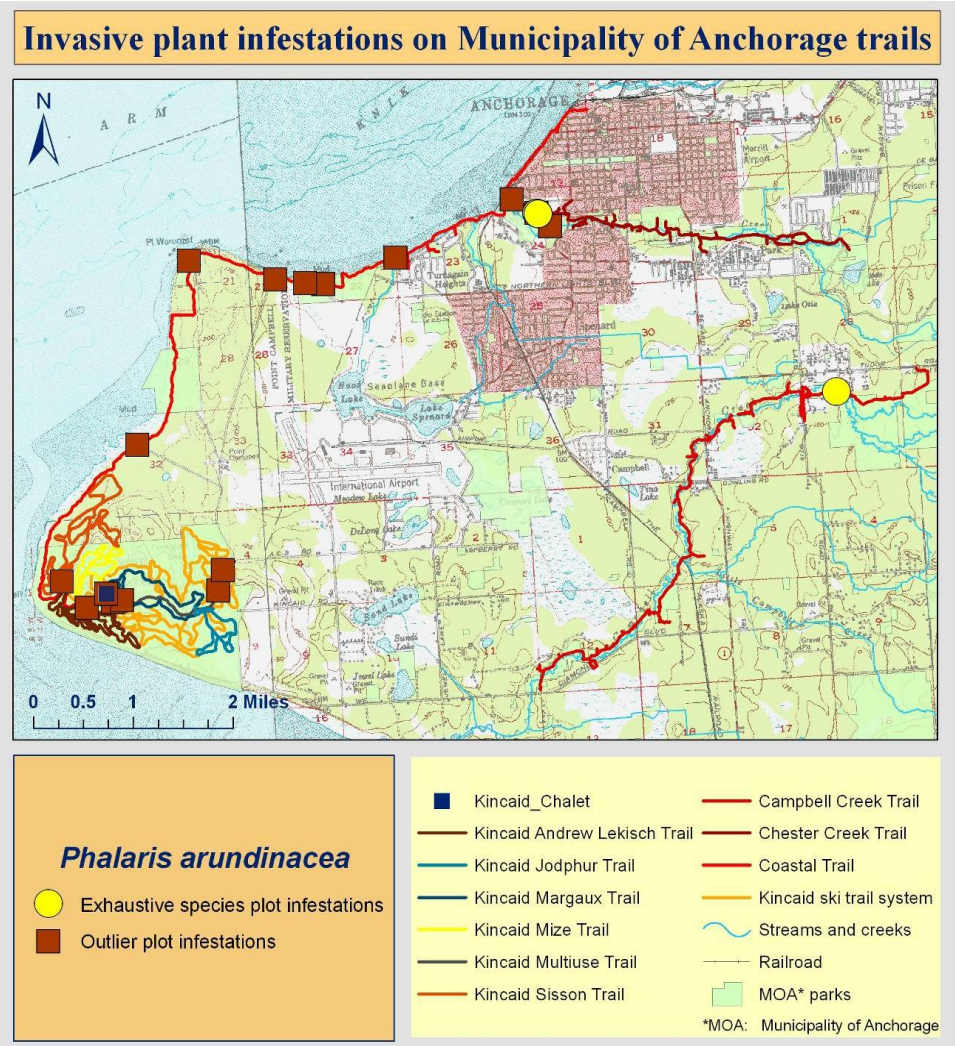
Most of the *Phalaris arundinacea* infestations recorded along MOA trails are relatively small and isolated, and are surrounded by native vegetation, so they can therefore be successfully eradicated. The infestations at Westchester Lagoon and Point Woronzoff, on the other hand, will be hard to extirpate and a lot of consistent, long-term effort will be needed to reduce the size of these populations. Given the aggressiveness of this species in the Lower 48, and the speed with which it is spreading around town, we still recommend that any *Phalaris arundinacea* infestation be prioritized for control work, with top priority given to the smaller, more discrete infestations.

Timing is crucial in the success of any control method: mowing, burning or herbiciding with grass-specific chemicals once *Phalaris arundinacea* has achieved some growth in the late spring will reduce or eliminate seed development, and starve the plant of its rhizome reserves at a time when they are already being depleted. Control work must be conducted regularly and often for a minimum of four to five years. Sites with diverse vegetation at the onset of management tend to respond more positively to treatments than monotypic stands (Apfelbaum and Sams 1987).

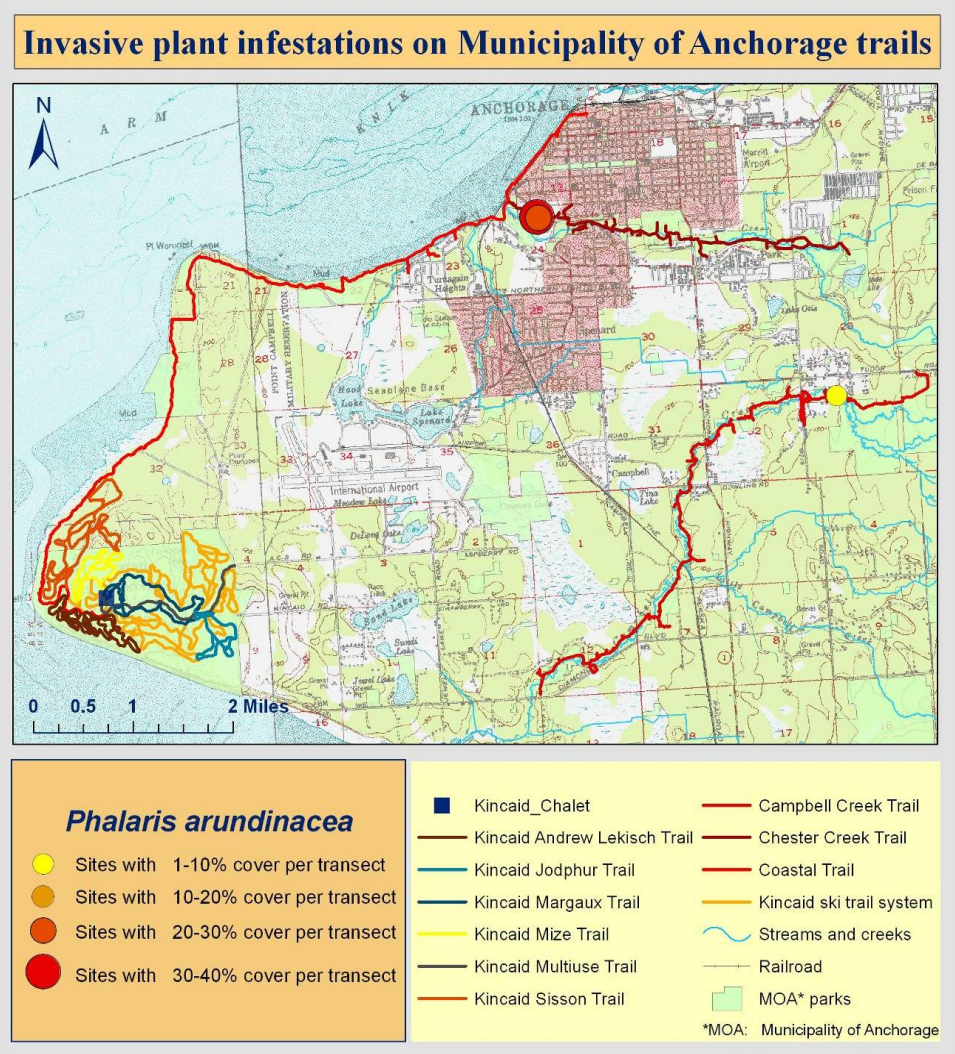
Gino Graziano, currently the Invasive Weeds and Agricultural Pest Coordinator for the Department of Natural Resources, has been working on developing a management plan for *Phalaris arundinacea* in the Kenai (see: http://www.uaf.edu/ces/cnipm/docs/8thAnnual/1100-Graziano-RCG-r.pdf). We recommend MOA foresters coordinate with Mr. Graziano (Gino.Graziano@Alaska.gov) when developing a set of control and eradication methods for this species in the Anchorage Bowl.

Distribution

Distribution map of exhaustive species and outlier plots at which *Phalaris arundinacea* (83, reed canarygrass) was recorded. *Phalaris arundinacea* is now a dominant species around Westchester Lagoon and the pond at Point Woronzoff. It is also becoming frequent along the Coastal Trail, and infestations have also been recorded along the Chester and Campbell Creek trail. Kincaid Park had an unexpectedly high number of small populations, mostly confined to the Multi-Use trail, one at the stadium, and other around the Chalet.



Overview map showing the percent cover of *Phalaris arundinacea* (83, reed canarygrass) relative to all other species within infested exhaustive species plots.



Prunus padus (74, European bird cherry)

Species biography

Prunus padus © 2004 Ben Legler

This highly aggressive ornamental tree has become established as a tall shrub layer and appears to be outcompeting native willow and alder species in the Anchorage Bowl area as well as lower strata of native vegetation (Cortés-Burns pers. obs.). *Prunus padus* forms dense monospecific stands along Chester Creek Trail and is also prevalent throughout Campbell Creek Trail. Furthermore, this species is known to be spreading eastward up the Chester and Campbell Creeks to more remote areas of Anchorage and the Chugach State Park. Although currently in lower numbers, this species has also been observed spreading along the Coastal trail, and in spring 2009 one tree was observed (flowering) on the Lekisch trail in Kincaid (Cortés-Burns, pers. obs.).

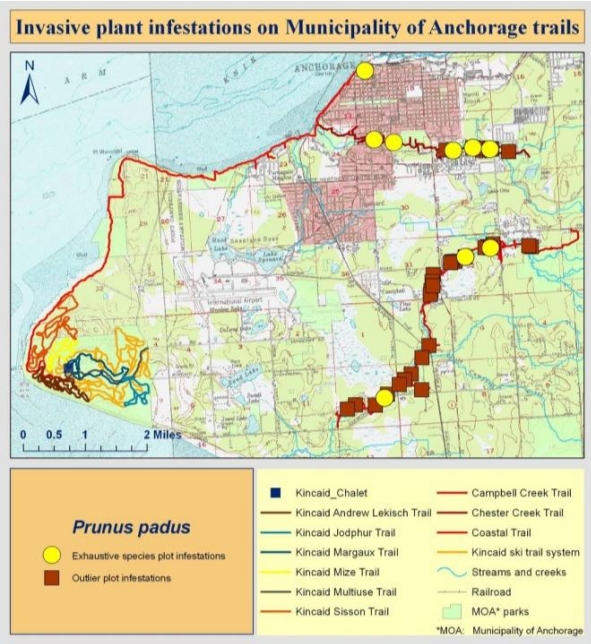
Prunus padus berries are very bitter-tasting to humans, but loved by birds (AKEPIC 2005). In Anchorage, at a minimum waxwings and rusty blackbirds have been seen eating the cherries in the fall, thus assisting in the long distance dispersal of this species along the creek corridors and to other areas of the state.

The impacts of *Prunus padus* on native ecosystems are unknown. However, its ability to form dense monospecific stands along creeks, with a consequent reduction in light and in the availability of high-quality willow forage, could **impact the moose population** by reducing the amount of preferred foraging vegetation. Moose browsing marks have been observed on bird cherry trees along the Chester and Campbell Creek, but it is unknown whether this species' bark is as palatable and whether it has similar nutritional contents as the native shrubby species moose tend to browse on. The effects of this species and its **leaf litter on streams** and their **associated invertebrates** and juvenile **salmon** are currently being investigated by graduate student Dave Roon at the University of Alaska Fairbanks (see http://fhm.fs.fed.us/posters/posters09/ecological_effects_bird_cherry.pdf for a poster presentation summarizing his project).

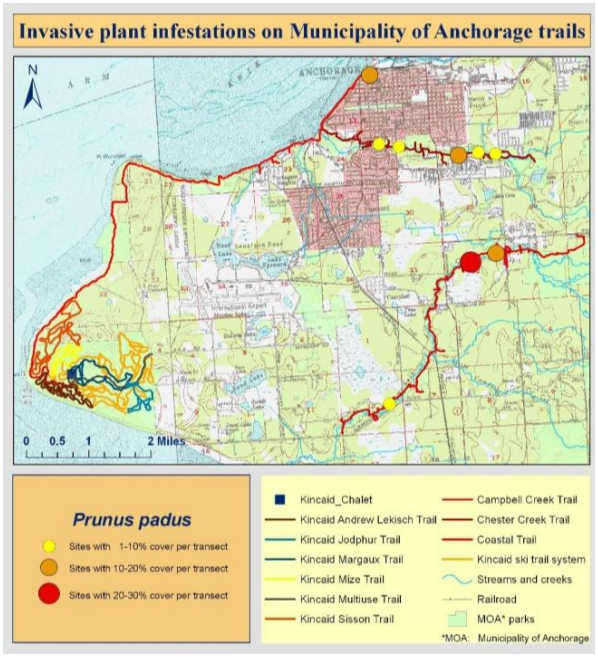
Control and management recommendations

AKNHP botanists and ecologists have been funded by the US Forest Service (State and Private) through the Anchorage Parks Foundation to investigate the population ecology of the European bird cherry, and propose control methods based on the findings of their work. We have finished the field-work required to address some basic questions on the ecology, reproductive biology, and age structure of bird cherry stands throughout MOA trails and plan to write up the results during winter 2009/2010.

Distribution



Distribution map of exhaustive species and outlier plots at which *Prunus padus* was recorded.



Overview map showing the percent cover of *Prunus padus* relative to all other species within infested exhaustive species plots.

Prunus virginiana (NR, chokecherry)

Species biography

Prunus virginiana was recorded at eight different sites along the Campbell Creek Trail. This non-native tree species, which much like *Prunus padus* (74), was introduced into Alaska as an ornamental, and was originally thought to be less invasive, has already escaped cultivation and become naturalized along the city's greenbelts (although to a lesser extent than *P. padus*). It could **therefore be as invasive as *Prunus padus***, which is rapidly changing the structure and composition of the vegetation along the Chester and Campbell Creek corridors, forming, in some sections, pure stands with few or no native species in the canopy or understory. There are **two traits that help distinguish** *Prunus virginiana* from *P. padus*:

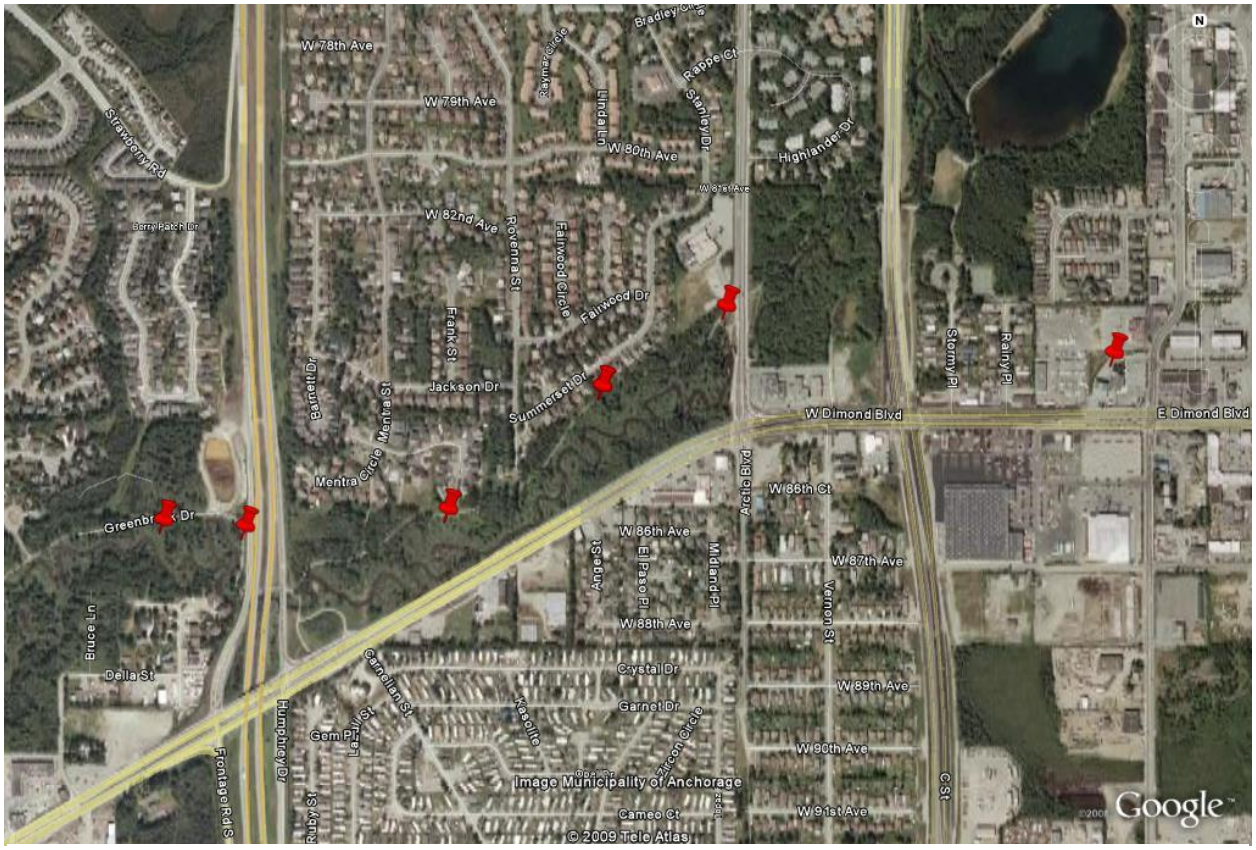
- In early spring (May), when these species are in flower, the **hypanthium** of *Prunus virginiana* is **hairless** whereas the hypanthium of *Prunus padus* is **pubescent**
- Later in the summer, the **foliage** of *Prunus virginiana* turns **dark red**, whereas the leaves of *Prunus padus* **remain green** throughout the growing season

Prunus virginiana. The leaves of this species turn red shortly after the flowers senesce, whereas the leaves of closely related, and ostensibly more aggressively invasive, *Prunus padus* remain green throughout the entire growth season. Campbell Creek Trail (© Susan Klein).

Control and management recommendations

We recommend that *Prunus virginiana* populations be monitored but that control efforts remain focused on the *Prunus padus* infestations for now. However, if any *Prunus virginiana* trees are found in areas that are not close to other *Prunus* spp. trees, in remote and largely weed-free areas, their eradication would be warranted. We expect that any control options that AKNHP develops for *Prunus padus* would be applicable for *Prunus virginiana*, but currently none have been investigated.

Distribution



Prunus virginiana was detected at six locations along the Campbell Creek Trail

Rosa rugosa (NR, rugosa rose)

Species biography

Rosa rugosa is native to Eastern Asia, but has been introduced as an ornamental into both North America and Europe. In northern Europe (Denmark, Finland, and Norway) this salt-tolerant species has escaped cultivation and is invading coastal habitats, where it can effectively colonize dune environments and replace native vegetation (Weidema 2006). It has also been recorded escaping cultivation in Connecticut (Brand 2001). Given its capacity to colonize coastal habitats in other countries at similar latitudes, it is important that the current distribution of this species be characterized to help track its possible expansion and impacts throughout the Anchorage Bowl.

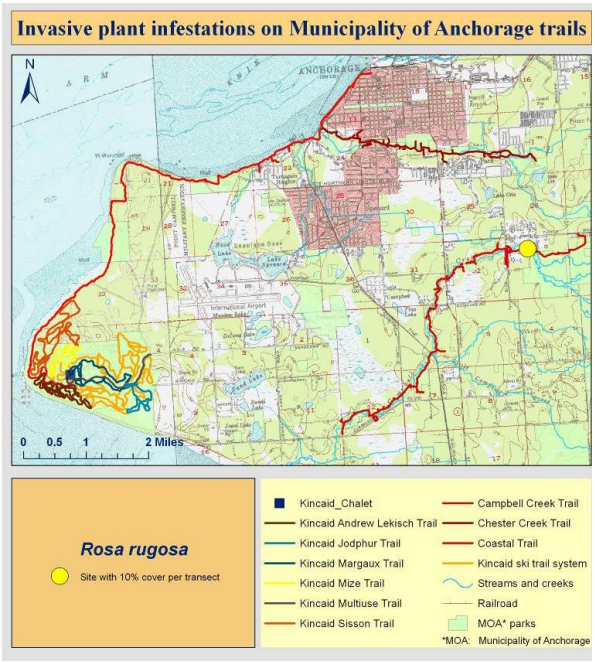
Rosa rugosa

Control and management recommendations

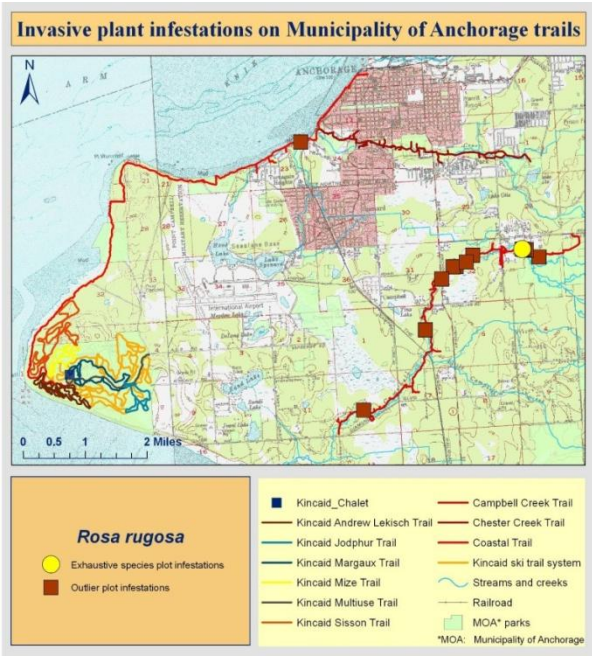
This species reproduces both **by seed and by rhizomes.** Therefore, to eradicate an infestation plants must be **completely dug out**, as rhizomatous fragments are able to resprout. We recommend that MOA crews **continue to inventory parks and trails for additional infestations**, and **monitor their behavior**. If the existing populations expand, and are seen replacing native vegetation or occupying a diversity of habitats, control work would be warranted.

Distribution

This horticultural shrub was observed along stretches of the Coastal Trail near Westchester Lagoon and on the Campbell Creek Greenbelt.



Overview map showing the percent cover of rugosa rose relative to all other species within infested exhaustive species plots



Distribution map of exhaustive species and outlier plots at which rugosa rose was recorded.

Sonchus asper (NR, spiny sowthistle)

Species biography

All three species of *Sonchus* (*S. arvensis*, *S. asper*, *S. oleraceus*) that are known from Alaska are non-native with yellow, ray-flowered inflorescences, similar to the common dandelion. Unlike dandelions, *Sonchus* spp. have leaves on the flowering stalks, and the leaves have spiny margins. *Sonchus asper* was observed in trace amounts at **Point Woronzoff** and **Westchester Lagoon** and as a large infestation at the **landfill** site located between Point Woronzoff and Kincaid Park. It is thought that this species is at least as aggressive as *Sonchus arvensis* ssp. *uliginosus*, which has an invasiveness ranking of 64.

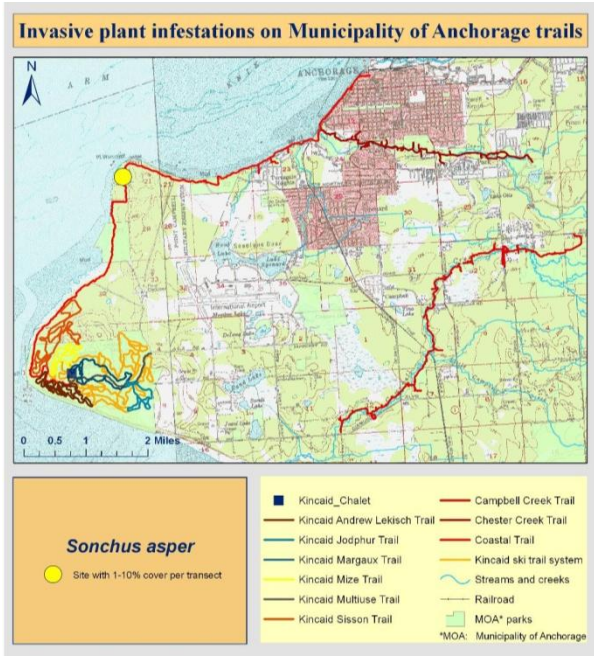
Left photo (© Helen Cortés-Burns, 2008): a large population of *Sonchus asper* (spiny sowthistle). Right photo (© Carl Farmer 2002, www.plant-identification.co.uk): *Sonchus asper* differs from closely related, and also invasive, *Sonchus arvensis* (perennial sowthistle) by not having a woody stem (stems are soft, hollow) and by having leaf auricles (base of leaf) that are distinctly recurved, as opposed to rounded.

Control and management recommendations

The two smaller infestations of *Sonchus asper* located at Point Woronzoff and Westchester Lagoon should be eradicated. The larger population at the landfill site should be targeted for containment, and if possible, eradication. There are no tested control methods for *Sonchus asper*; however, methods developed for *S. arvensis* are applicable as they are developed for a more persistent rhizomatous species. Hand-pulling has been shown effective for smaller populations such as those found at Point Woronzoff and Westchester Lagoon. We recommend mowing or burning to reduce seed production and root reserves for the large population at the landfill site. These types of mechanical treatments should occur prior to flowering and be repeated for several years (Lamb and Heutte 2007).

Distribution

Distribution map of exhaustive species and outlier plots at which *Sonchus asper* was recorded.



Overview map showing the percent cover of *Sonchus asper* relative to all other species within infested exhaustive species plots.

Vicia cracca (73, bird vetch)

Species biography

Vicia cracca

This perennial vine has pinnately compound leaves that end in **tendrils**, allowing it to climb over native vegetation, **reducing light availability** and eventually smothering the native plant layer below (it is capable of smothering herbs, forbs, and shrubs). Furthermore, as a member of the pea family, *Vicia cracca* is able to fix atmospheric nitrogen, increasing the nutrient availability of the soil it grows in thereby facilitating the establishment of other weedy (native and not) species. *Vicia cracca* can **spread vegetatively by rhizomes**, and also produces **large amounts of seed**, which can remain viable for up to five years in the soil. However, *Vicia cracca* **cannot resprout after cutting** (AKEPIC 2005).

Control and management recommendations

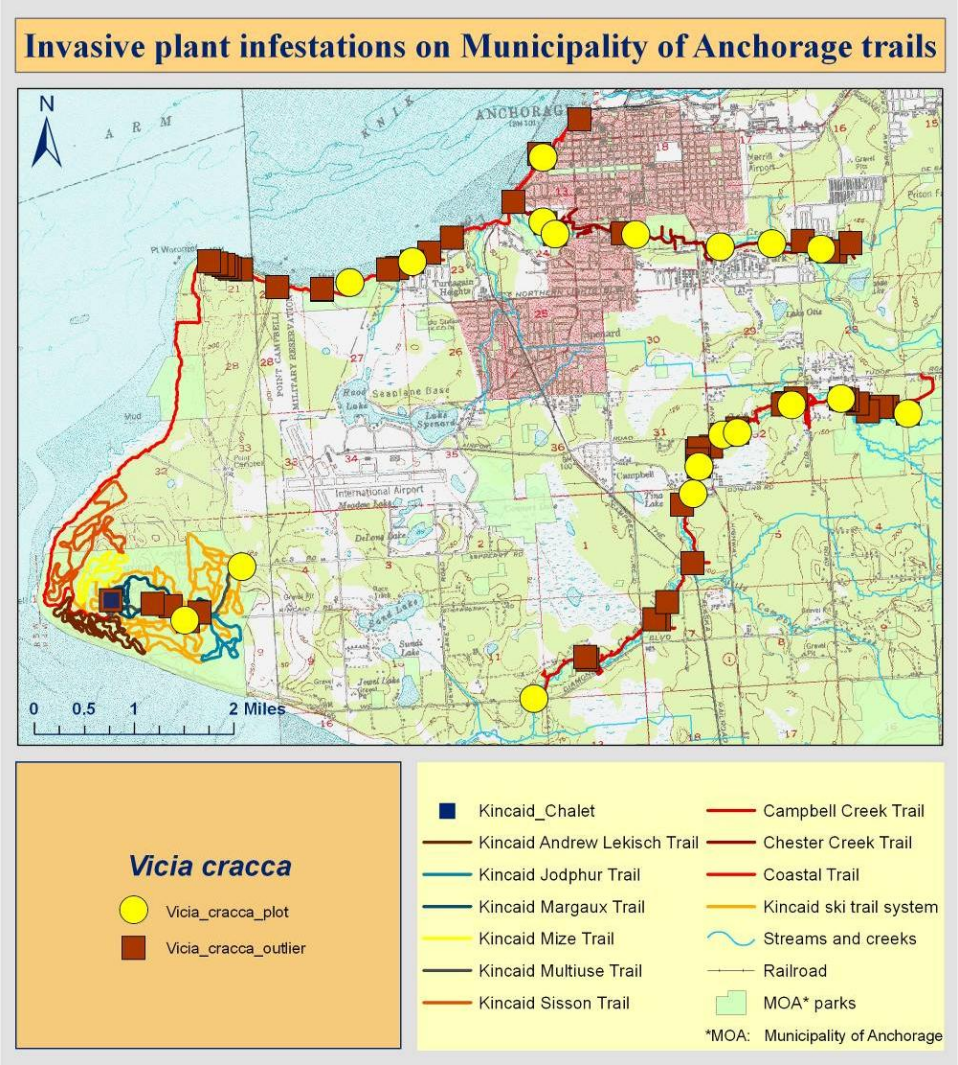
Vicia cracca is an ecologically damaging species that can form dense mats covering short (<3 ft tall) native vegetation, can climb over shrubs such as alder and willow, and can alter native ecosystem processes because it is a nitrogen-fixer and can therefore change the natural soil nutrient status. Complete eradication of all populations recorded, as well as additional monitoring work, should be a priority for Municipality trails.

It is recommended that sites be **visited before flower initiation** (early to late July), and that **plants be mown near the base** of their stem or hand-pulled (Seefeldt 2007). Because *Vicia cracca* is able to reproduce vegetatively from rhizome fragments, as well as from seed **removal work must include above and below ground parts** when time and size permits. The site should be **revisited every six weeks** and the treatment repeated **until the end of the growing season**. The area within at least a 50 yard radius and any disturbed areas within a half mile should be scouted for new plants (Seefeldt 2007). *Vicia cracca* **seeds can remain viable in a seed bank for up to five years,** so any infestations should be treated and monitored for at least that amount of time, to guarantee the depletion of the seed bank (Seefeldt 2007; Nolen 2002).

If plants still remain after five years of mechanical control, they can be **sprayed** while they are actively growing and before flowering with one pint/acre of **clopyralid** (Transline) with an approved adjuvant (0.25% v/v) to kill the adult plants. This would probably **not be appropriate** in the case of the **large** *Vicia cracca* **infestations** (500-1000+ stems) (Seefeldt 2007).

Distribution

Distribution map of exhaustive species and outlier plots at which *Vicia cracca* (bird vetch, 73) was recorded.



Overview map showing the percent cover of *Vicia cracca* (bird vetch, 73) relative to all other species within infested exhaustive species plots.