United States
Department of
Agriculture

Forest Service
Alaska Region
R10-TP-143
August 2008

Invasiveness Ranking System for Non-Native Plants of Alaska



Cover Photos: (large photo) White sweetclover growing in a burned area near Fairbanks. (Small photos left to right) Narrowleaf hawksbeard, Hempnettle, and Orange hawkweed.

Invasiveness Ranking System for Non-Native Plants of Alaska

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Abstract

Alaska is beginning to experience increased non-native plant establishment, spread, and devaluation of its lands. In response to this increasing threat, we developed a ranking system to evaluate the potential invasiveness and impacts of non-native plants to natural areas in Alaska. This ranking system is designed to be a robust, transparent, and repeatable procedure to aid land managers and the broader public in identifying problematic non-native plants and for prioritizing control efforts. Numerous ranking systems exist, but none are suited to predicting negative impacts to natural systems in Alaska. We created a ranking system that incorporated components from other systems, in which species are ranked by a series of questions in four broad categories: ecosystem impacts, biological attributes, distribution, and control measures. In addition, we include a climate screening procedure to evaluate the potential for establishment in three ecogeographic regions of Alaska. As additional information becomes available, the ranks may change over time. Here we present background and justification for this system and include the ranks of 113 non-native species that are in the state or are likely to be introduced in the future.

Key words: Alaska, invasive plants, invasiveness ranking, natural lands conservation, weed risk assessment

Introduction

The control of invasive, non-native plants is of increasing concern in ecosystem management across the world (Pimentel 2002). The invasion of non-natives into intact ecosystems is recognized by scientists and land managers as one of the primary causes of biodiversity loss, ranking second only to outright habitat loss (Pimm and Gilpin 1989, U.S. Congress 1993, Myers 1997, Stein et al. 2000). More than just the native biodiversity is threatened, however; the introduction of invasive non-natives threatens community structure and composition and ecosystem processes (Cronk and Fuller 1995, Walker and Smith 1997, Cox 1999). Not all non-native species are equally harmful. Most non-native species that are introduced are poorly adapted to their new environments and are unable to establish viable populations. Of those that can establish, only a small subset proceed to invade native ecosystems. Additionally, most introductions involve relatively few individuals and small populations of any species are much more susceptible to extirpation (see Taylor and Hastings 2005). Establishment is highly dependent on ecological and climatic conditions. As resources for managing invasive plants are limited, the need to evaluate and rank non-native species is a primary concern before expensive management is attempted, so that the most threatening species may be addressed first (Wainger and King 2001).

Focusing management efforts on those species that have the capacity for rapid expansion in natural settings yet are currently at low population sizes should be of highest concern (D'Antonio and Meyerson 2002). Eradication effort rises exponentially with infestation size, and elimination of non-natives is most likely to be successful in infestations smaller than 100 acres (Prather, et al. 2005). In particular, we recognize the need to evaluate the invasiveness of non-native plants in the context of their current and possible ecoregional distributions. This need to identify which species have the greatest potential for establishment and spread was highlighted as a necessary action in a strategic plan for noxious and invasive plant management in Alaska (Hébert 2001).

Non-Native Plants in Alaska

Alaska, the Yukon Territory, Northwest Territories, Nunavut, and northern British Columbia have remained relatively unaffected by the negative consequences of non-native plant establishment that has plagued most regions of the world. However, Alaska is at the cusp of facing serious ecological problems associated with introduced plants in both natural and human-altered landscapes (Carlson and Shephard 2007). While most non-native plant populations in Alaska are small and largely restricted to anthropogenically disturbed areas, a number of introduced plant species have begun to threaten intact biological communities and impact ecological conditions (Carlson and Shephard 2007, Conn et al. in press).

A total of 157 non-native plant taxa have naturalized (i.e., form self-perpetuating populations) in Alaska; an additional 136 non-native taxa are apparently ephemeral (Carlson and Shephard 2007). The naturalized taxa represent roughly 14 percent of the total flora (Carlson and Shephard in press and see Hultén 1968), with new non-native species recorded every year. This is not a particularly high percentage relative to most other states, for example 18 percent of California's flora (Hickman 1993), approximately 20 percent of Oregon's flora (Kaye pers. comm.), and 49 percent of Hawaii's flora, (Randall and Hoshovsky 2000) are non-native. Additionally, most non-native plants in Alaska are restricted to the small area of anthropogenic disturbance. Alaska has a population density of only 0.39 people per square kilometer, relative to the national average of 29 per square kilometer. The majority of infestations occur along the road network, despite the low densities of one kilometer of road per 68 square kilometers of land; the national average is one to 1.6 and the state with the second lowest density of roads is Nevada with 1 to 4 kilometers of road per square kilometer of land (State of Alaska 2004). Additionally, introductions and infestations of non-native plants on agricultural lands are not as serious a concern as in other regions since only 0.009 percent of Alaska's land is devoted to agriculture.

Despite a lower overall presence of non-native plants and reduced opportunities for introduction by humans in Alaska, a few species are showing alarming signs of spreading into natural areas. In particular, *Melilotus alba*, white sweetclover, has become a dominant plant in previously sparsely vegetated river bars in interior, south-central, and southeast Alaska. While the long-term effects of this species on large glacial river flood plains is not known, it is apparent that rare native plants, habitat for fish and wildlife, and the natural hydrology are threatened. Other species such as *Bromus tectorum*, *Caragana arborescens*, *Centauria bierbesteinii*, *Hieracium aurantiacum*, *Impatiens glandulifera*, *Phalaris arundinacea*, *Polygonum xbohemicum*, and *Polygonum sachalinense* are particularly threatening, known to cause ecological and economic damage in other states, and are increasing in abundance (Shephard 2004, Carlson and Lapina 2004, Lapina and Carlson 2004, Brown 2005). The increasing impact of non-native plants is cause for concern since Alaska is the most ecologically pristine state in the U.S. and the state's economy is partially dependent on natural resources that could be degraded, such as forests, fisheries, and wildlife.

The majority of non-native plants, however, do not seem to be causing significant damage in natural ecosystems. This is a commonly observed pattern (Williamson 1996). Many of these plants, such as *Chenopodium album*, *Poa annua*, and *Stellaria media*, have been present in the state for decades or centuries, are widespread, and would be difficult to eradicate. These species generally occur at low densities on only the most anthropogenically disturbed sites, and have few known or anticipated negative impacts.

The most problematic groups of non-native plant species are those with poorly understood and intermediate impacts and those newly arriving to the state. Because it is difficult to anticipate these species' effects on Alaskan ecosystems there is often confusion among land managers as to which species require control. Additionally, some species that are not particularly problematic in other states are strikingly invasive in Alaska, such as *Caragana arborescens*, *Elymus sibiricus*, *Melilotus alba*, *Prunus padus*, and *Vicia cracca*. Unfortunately, few data are available for ecological and community effects of most species in Alaska or similar ecosystems elsewhere. The impacts of moderately invasive species and those not present in Alaska are often not well understood yet could still affect natural systems and interfere with land management goals. Building the capacity to rank those species not currently present in the state and those in the state but fall between the two extremes of invasiveness is important and largely prompted our efforts to develop a ranking system for Alaska.

Invasiveness ranking background

A wide variety of invasiveness assessment models have been produced in the last decade. These assessment models generally share a series of questions evaluating spatial characteristics, known or potential impacts on resources of value (e.g., biodiversity, agriculture, water resources, or aesthetics), biological characteristics, and ease of control. Scores are given for each question and totaled to produce a final evaluation. Within this basic structure a variety of approaches have been taken, from those including the history and activity of species in specific sites (Hiebert and Stubbendieck 1993) to those explicitly including positive and negative economic impacts (Robertson et al. 2003). The value of the individual ranking systems is clearly related to the particular aims and context of researchers, and it is unreasonable to expect a single system to be effective in all contexts. For reviews of ranking systems see Groves et al. (2001) and Williams and Newfield (2002).

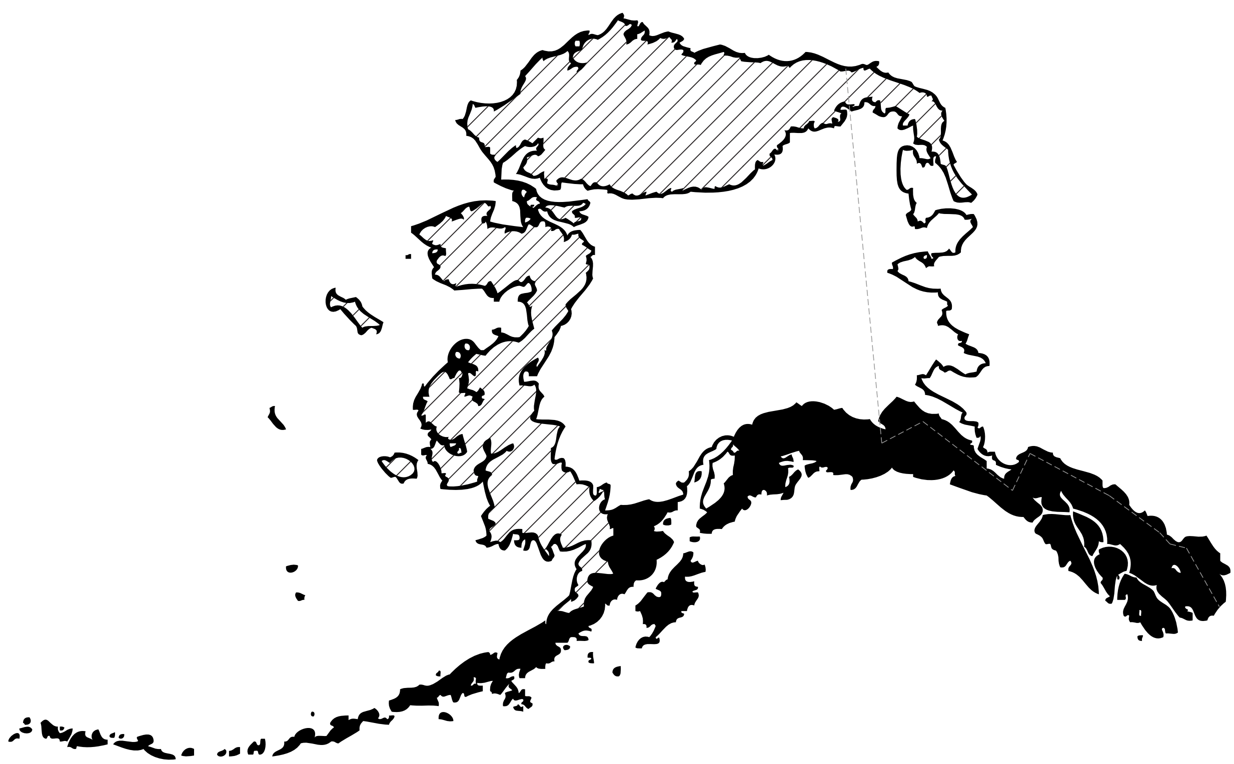
It should be noted that despite a large interest in attempting to predict invasiveness from plant traits, the reasons for the success of some introduced species and failure of others have remained largely mysterious (Williamson and Fitter 1996). Further, the success of invasions appears to be very context specific (D'Antonio 1993) and one cannot predict future conditions from the initial spread (Mack 1996). Despite this, there are a number of traits that are correlated with the probability of invasion (cf. Darwin 1859, Baker 1974, Forcella and Wood 1984, Rejmanek and Richardson 1996, Hodkinson and Thompson 1997, Pysek 1997, Rejmanek 1999, Rejmanek 2001), with the behavior of the species in other regions as one of the most valuable characteristics.

Overview and aims

The authors, representing numerous state and federal agencies met under the recognition for the need to prioritize non-native species management in the state. Our aim was to create a transparent, repeatable, and robust ranking system in which we could evaluate both the likelihood of a non-native species establishing in Alaska's natural systems and its consequences to the ecology and community. We recognized six components as necessary for the ranking system.

1. The ranking system must have a screening procedure to evaluate the probability of species establishment in three ecogeographic regions of the state based on its worldwide range. The ecogeographic regions are Pacific maritime, Interior-boreal, and Arctic-alpine (based on Nowacki et al. 2001, figure 1).
2. The evaluation of consequences must be focused on impacts to the ecological functioning and community of natural systems that dominate the state (rather than to evaluate impacts to agriculture, anthropogenically disturbed landscapes, or economic sectors).
3. The system must maintain the flexibility to evaluate both species present in the state and those that may be transported to the state in the future.
4. Species should be evaluated relative to one another rather than assigning species to particular classes of invasiveness.
5. The ranking system should be based on clear documentation for all questions, but also allow for species to be evaluated when some information is lacking.
6. The outcomes of the system must be in accordance with current knowledge and understanding (Hiebert 1997, Pheloung et al. 1999, Williams and Newfield 2002).

Figure 1. Ecogeographic regions of Alaska (Nowacki et al. 2001).



Black represents Pacific maritime, white represents Interior-boreal, and hatched represents the Arctic-alpine ecoregions. The dashed gray line represents the Alaska-Canada border.

Our goals were to inform land managers of the relative dangers of each species and to create a tool to be used in conjunction with site and distributional information to prioritize control actions. For examples, see Treatment Prioritization Tool (AKEPIC 2005) and Invasive Plant Treatment Guide: National Wildlife Refuges in Alaska (ENSR 2006). We understand that each land management agency has its own priorities and resources, and the ranking system must be designed to be flexible in its incorporation in decision making plans.

Methods

We reviewed existing non-native plant invasiveness ranking systems to identify those components that would be included as attributes in the design of a system for natural lands in Alaska (see Williams et al. 2003). We evaluated four systems: "Ranking Invasive Exotic Plant Species in Virginia," developed by Virginia Department of Conservation and Recreation (Heffernan et al. 2001); "Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands," developed by California Exotic Pest Plant Council (Warner et al. 2003); "Weed Risk Assessment System," prepared by the Australian Quarantine and Inspection Service (Pheloung et al. 1999); and the "Southwest Exotic Species Ranking System" (Hiebert and Stubbendieck 1993). After reviewing available literature, species biographies were produced for 12 species to be used as a standard reference for the four systems, thereby reducing variation among reviewers due to alternative information. The species were chosen to encompass a broad range in their known levels of impact to natural ecosystems in Alaska and other regions, the amount of literature available for the species, and their distribution and abundance in the state (Table 1). This exercise was designed to highlight strengths and weaknesses of each of the systems and the components that were critical for Alaska.

Table 1. Species and general attributes used in evaluation of invasive species ranking systems

Species	Amount of Information Available in the Literature	Perceived Invasiveness to Alaskan Wildlands	Alaskan Distribution
Bromus tectorum	well documented	highly invasive	widespread, low abundance
Chenopodium album	well documented	weakly invasive	widespread, high abundance
Crepis tectorum	moderately-well documented	moderately invasive	widespread, low abundance
Descurainia sophia	moderately-well documented	weakly invasive	widespread, low abundance
Hieracium aurantiacum	well documented	highly invasive	localized, variable abundance
Leucanthemum vulgare	moderately-well documented	moderately invasive	widespread, variable abundance
Linaria vulgaris	moderately-well documented	moderately-highly invasive	widespread, variable abundance
Matricaria discoidea	well documented	weakly invasive	widespread, low abundance
Melilotus alba	moderately-well documented	highly invasive	widespread, high abundance
Polygonum cuspidatum	well documented	highly invasive	localized, high abundance
Sorbus aucuparia	poorly documented	moderately invasive	localized, variable abundance
Vicia cracca	moderately-well documented	moderately-highly invasive	localized, high abundance

The scoring from each system is very different, including both numerical and categorical ranks of different scales. To compare effective scales and variation within and among the systems and to gauge how robust the five systems, we standardized invasiveness scores by dividing scores of each species by that of *Polygonum cuspidatum*, a species perceived to be one of the most invasive to natural habitats in Alaska by the authors[1]. A discrete numerical system was created for nominal categorical systems (e.g., "not invasive" = 0, "low invasiveness" = 1, "medium invasiveness" = 2, etc.). Additionally we graphically compared levels of variation among the scores and assessors for three species commonly believed to represent different levels of invasiveness: high (*Polygonum cuspidatum*), intermediate (*Sorbus aucuparia*), and low (*Matricaria discoidea*). To allow comparisons among the species we standardized scores relative to the maximum score possible for each system.

Two of us (M.L. Carlson and I.V. Lapina) produced a draft ranking system that was evaluated in a similar manner to the four existing ones. Scores were given in response to a series of questions and used to calculate subcategory (i.e., ecology, biology, distribution, and control) and final scores. The results section discusses the format and justifications for the questions. We then modified the draft Alaska system with input from all authors. Additionally, we included a climate screening procedure that is described in the results section.

Similarities among the five systems in the ranks of the 12 test species were compared using hierarchical cluster analysis in SPSS Base 9.0. All invasiveness scores were standardized to the potential maximum for each system and squared Euclidean distances were used to generate the distance matrix for the cluster analysis.

To determine which sections (ecology, biology, distribution, and control) in the Alaska system had greater explanatory power, we explored the relationship of each of four section scores to overall invasiveness. We produced scores for all sections and overall invasiveness based on a consensus of the authors for all species. Spearman rank correlation coefficients were produced for all sections and overall invasiveness. Additionally, we removed the sectional component to invasiveness for each section comparison to avoid autocorrelation for this analysis (e.g., overall invasiveness–ecology score was used in comparing to the ecology score and overall invasiveness–biology score was used in comparing to the biology score). R^2 values were calculated for each sectional score relative to the corrected invasiveness. Not all questions in the sectional scores were answered and these scores were removed from the analysis.

Following the construction of the invasiveness ranking system for Alaska, we proceeded to rank 95 species present in Alaska and 18 potential future invaders. The species were chosen to encompass all perceived degrees of invasiveness and distributions in Alaska, including the species considered to be the most invasive already present in the state and the most threatening potential future invaders (the ranks are presented in Appendix B). Taxa that are believed to have been absent from Alaska prior to European contact are considered "non-native." We rank a few species that may have been present in the region for centuries in small populations (e.g., *Phalaris arundinacea* at hot springs sites in interior Alaska), but have recently expanded their ranges and abundances dramatically and are now most likely combinations of Eurasian and North American genotypes. We included notes on nativity for all species with questionable origins.

Short species biographies, initial scores, and documentation were produced based on literature reviews. For very similar congeneric species (e.g., *Rumex crispus*, *R. longifolius*, and *R. obtusifolius*), a single score was given to the group of species. Scores and documentation were then added or altered by the coauthors. Upon completion of the 113 scores the committee reevaluated each species relative to the others to ensure consistency in scoring, identify potential mistakes, and include new observations or documentation.

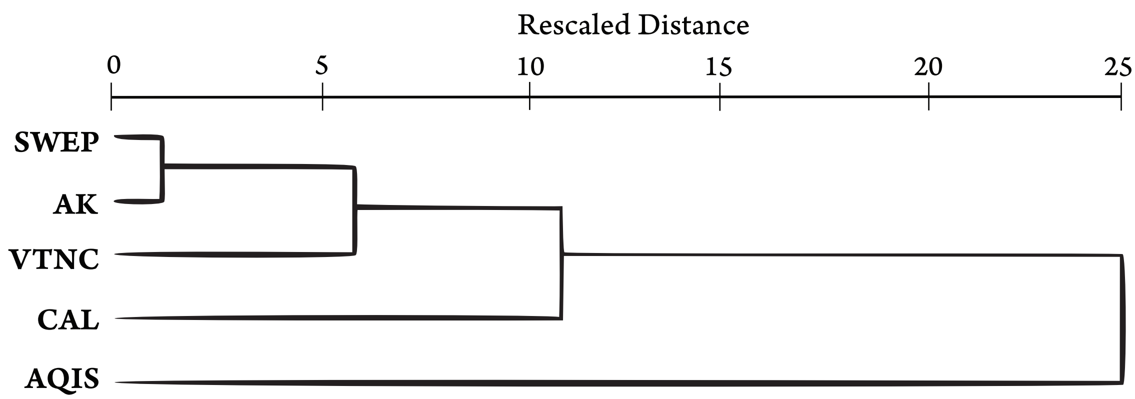
[1] Polygonum xbohemicum and P. sachalinense are more widespread in southeastern Alaska and appear to be more robust and ecologically threatening, but their documentation in the literature is weaker than P. cuspidatum. We expect that much of the literature has not distinguished among species and lumped the three taxa under P. cuspidatum (see Zika and Jacobson, 2003).

Results

The four existing systems, Invasive Exotic Plant Species in Virginia (Heffernan et al. 2001), California Exotic Pest Plant Council (Warner et al. 2003), the Australian AQIS Weed Risk Assessment System (Pheloung et al. 1999), and Southwest Exotic Species Ranking System (Hiebert and Stubbendieck 1993) all evaluate taxa in roughly similar categories of ecosystem alteration, community alteration, biological characteristics, and ease of control. The Virginia, California, and Southwest systems all require site specific data and are difficult to evaluate for broader regions. In addition to relying on biogeographical information, the California system requires population trend data that are not available for Alaska. For all systems, many characters that are traditionally associated with invasiveness, such as invasive elsewhere and breadth of native distribution are given little weight relative to less relevant characters. We recognized that none of the systems appear to handle unknown or ambiguous information well. For most systems missing information resulted in lower scores. Poorly known species should not be considered a *priori* to be less invasive. The scoring for the Australian and the California systems is not intuitive, requiring the use of look-up tables and scoring matrices. The outputs of most systems are categorical (i.e., high, medium, low invasiveness), resulting in an overly simplified rank and loss of potential information. No system used climatic or known habitat information to screen species from consideration; however, the Australian system does score species on suitability to Australian climates (2 points out of approximately 50 total points).

Overall, the existing systems and newly derived Alaska system were positively correlated in the relative ranks of the 12 test species (not shown). Despite the Southwest system's reliance on site data, its species ranks were very similar to those of the Alaska system (figure 2). The Virginia and California systems were more weakly clustered with the Alaska and Southwest systems. The most distantly related system to the others was Australian. The poor relationship among the Australian system scores and those of the other systems stems from a greater emphasis on agricultural impacts and specific ecological concerns (e.g., "causes a fire hazard") of the Australian system.

Figure 2. Dendrogram based on hierarchical cluster analysis representing similarities among five invasiveness ranking systems 12 non-native species ranks



Systems that ranked the same species most similarly are more closely joined (lower rescaled distance value). The cluster analysis used squared Euclidean distances in the distance matrix. SWEP = Southwest Exotic Species Ranking System, AK = Alaska Invasiveness Ranking System, VTNC = Invasive Exotic Plant Species in Virginia, CAL = California Exotic Pest Plant Council, AQIS = Australia Weed Risk Assessment System.

While the relative ranks of species among all of the systems were generally similar, there were numerous cases in which one species was ranked substantially differently between ranking systems (figure 3). For example, *Vicia cracca* was ranked very low in the California Exotic Plants system relative to the other systems. The Australian system tended to rank agricultural pest species, such as *Descurania sophia* and *Linaria vulgaris*, substantially higher than all the other systems.

Some of the systems resulted in much greater agreement in scores among assessors. The range in ranks among assessors was lowest for the Alaska system (ca. 0.05 for the three species in figure 4), relatively low in the Australian and Southwest systems (ca. 0.10 for these species), and high in the Virginia and California systems (as high as 0.80). In general, the broadly categorical systems (Virginia, California) resulted in greater variability among assessors (figure 4). The Australian system showed high consistency among assessors, but little effective range at distinguishing highly invasive species in natural ecosystems such as *Polygonum cuspidatum* from non-invasive species such as *Matricaria discoidea* (figure 4).

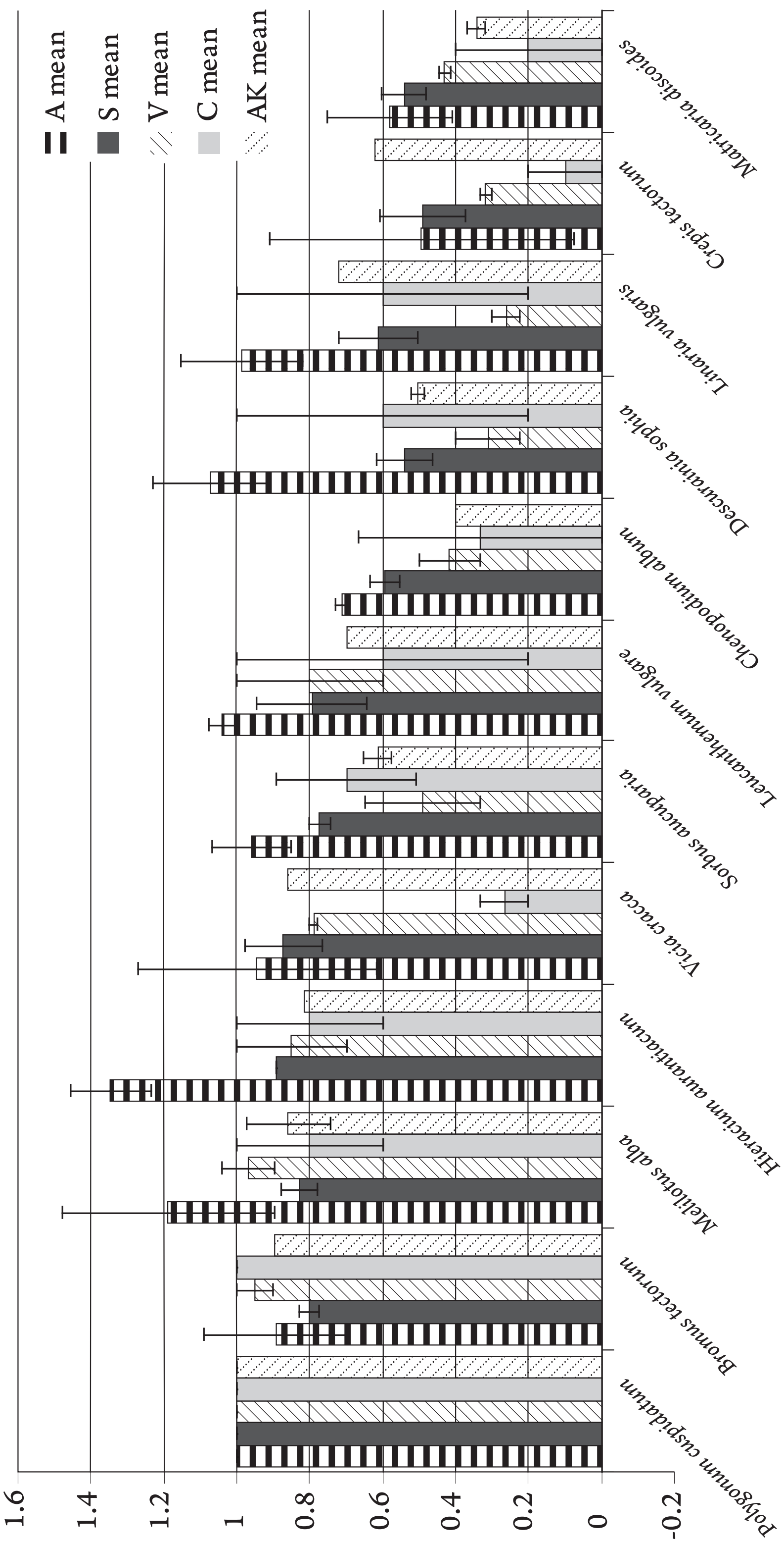
Outline of the Alaska Invasiveness Ranking System

The Alaska Invasiveness Ranking system is largely a hybrid of the four existing systems that we evaluated with some alterations and additions. In particular, we borrow many features from the Southwest Exotic Species Ranking System. Additionally, we include a climate screening procedure to eliminate species from consideration that are unlikely to establish in one of three bioclimatic zones in Alaska, numerical ranks, and a system for handling missing data. If a species passes the climate screening portion it is then evaluated in four subcategories: ecological impacts, biological characteristics and dispersal ability, distribution, and feasibility of control. Two authors (M.L. Carlson and I.V. Lapina) produced initial ranks and the remaining authors met as a committee to reach a consensus on ranks (nominal group techniques, see Hiebert 1997).

Climate screening:

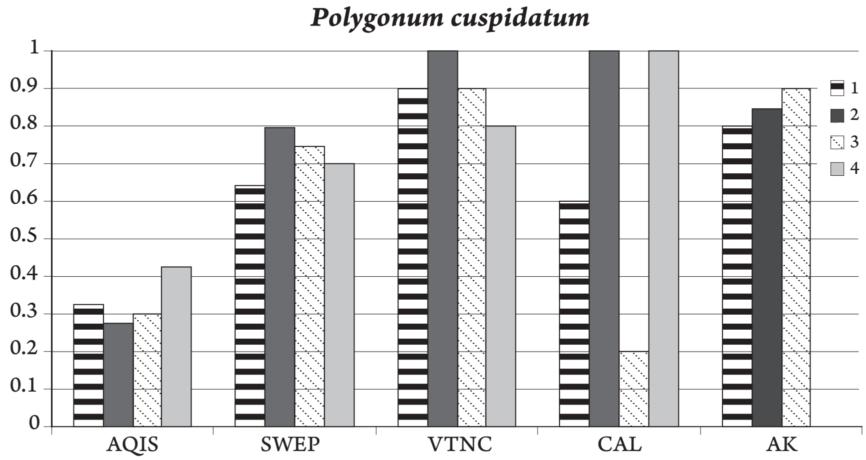
The first step in the climatic screening is to determine whether the species in question has been collected in the Pacific maritime, Interior-boreal, or Arctic-alpine ecogeographic regions of Alaska (see Unified Ecoregions: Nowacki et al. 2002). If the species has been collected in any of the three ecogeographic regions we record the general locations and sources of the information. If a species currently occurs in one or two of the three ecogeographic regions, we then run the climate matching program to determine if it is likely to spread to the other ecogeographic regions. We proceed with the ranking for species that have been collected in at least one ecogeographic region. If a species has not been collected in Alaska, but appears to have the potential to become established we research its current distribution, using floras and on-line databases, for high-latitude locations in Canada, Europe, Asia, South America, and Oceania. We then run the CLIMEX climate matching program to obtain percent similarity among weather stations where the species being evaluated is known to occur relative to three representative weather stations (Juneau, Fairbanks, and Nome) for each Alaskan ecogeographic region. We included the Anchorage weather station as an additional and more temperate Interior-boreal ecogeographic regional weather station for a number of species. Many introduced plants can invade greater environmental and climatic space than they do in their native range (Kriticos and Randall 2001, and see Lawton 1988), therefore we used a liberal cut-off for site similarity of 40 percent for accepting species (i.e., we ranked more species for Alaska than would predictably persist based on their native ranges).

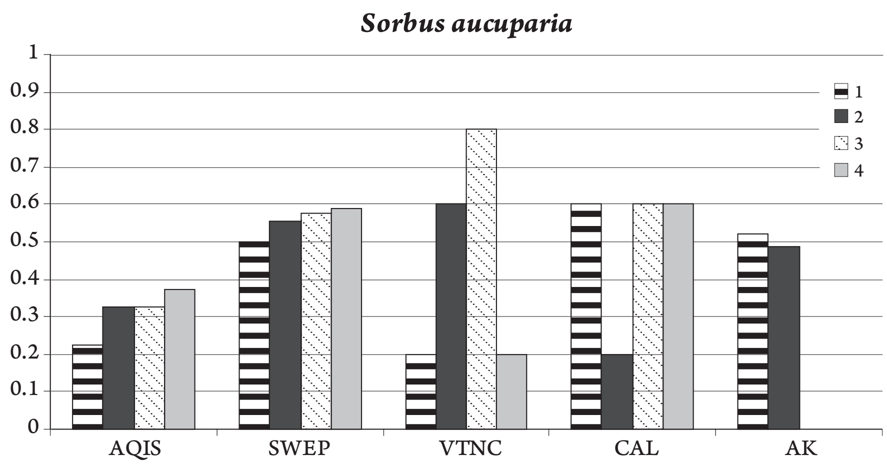
Figure 3. Mean scores of species relative to *Polygonum cuspidatum* for five different ranking systems

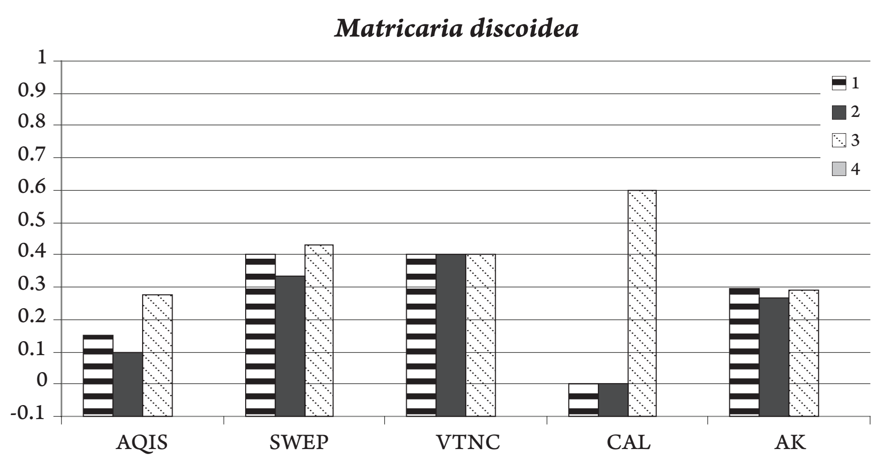


(A = Australia AQIS Weed Risk Assessment System, S = Southwest Exotic Species Ranking System, V = Invasive Exotic Plant Species in Virginia, C = California Exotic Pest Plant Council, AK = Alaska Invasiveness Ranking System). Species were ranked independently by two to five assessors. Standard errors are also included.

Figure 4. Ranks for *Polygonum cuspidatum*, *Sorbus aucuparia*, and *Matricaria discoidea* by four assessors (1-4), working independently for five ranking systems.







Scores were standardized by dividing by the maximum score possible for each system to facilitate comparisons. AQIS = Australia Weed Risk Assessment System, SWEP = Southwest Exotic Species Ranking System, VTNC = Invasive Exotic Plant Species in Virginia, CAL = California Exotic Pest Plant Council, AK = Alaska Invasiveness Ranking System.

The CLIMEX program compares long-term meteorological databases and produces a level of similarity given by a "match index." The match index is the product of four equally weighted components: mean monthly absolute maximum and minimum temperature indices, annual rainfall index, and monthly rainfall pattern index (see Sutherst et al. 1999 for more details). The 40 percent match index was determined to be an acceptable cut-off based on distributional patterns of non-native species known in Alaska and those the committee considered very unlikely to persist. For example, the invasive *Polygonum xbohemicum* is known from Juneau as well as Bergen, Norway (Lid and Lid 1994), which has 73 percent climate similarity with Juneau. To determine the lower limit of similarity we compared the climates of areas with species very unlikely to establish in Alaska. For example, *Acacia paradoxa* is a noxious species restricted to southern California, and similarities of its introduced range and reference sites in Alaska range from 9 to 20 percent. *Digitaria velutina* is an annual grass from Africa and temperate Asia, now introduced in Texas and considered a quarantine weed in California (USDA 2002); it is extremely unlikely to establish in Alaska, and climate similarities from known locations of this species to Alaskan reference sites range from 9 percent to 26 percent. For reference, the 40 percent climate similarity encompasses the extreme northeastern U.S. and the coastal Pacific Northwest with the Pacific maritime ecogeographic region. The Interior-boreal ecogeographic region of Alaska is linked to a number of stations in Montana, Wyoming, and North Dakota. The Arctic-alpine ecoregion shares 40 percent similarity or higher with a few stations in Montana, at Mount Washington in New Hampshire, and a number of northern Siberian stations.

If a species was either collected in one or more ecogeographic region or the climate matching exceeded 40 percent, we proceed with the ranking. A species receives the same statewide rank regardless of whether it is determined to establish in one, two, or all three of the ecogeographic regions, because the information used for ranking was rarely restricted in applicability to particular Alaska regions.

Invasiveness Ranking:

Following the climatic screening, species are then ranked based on scores for 21 questions grouped into four sections: ecological impacts (40 points), biological characteristics and dispersal ability (25 points), distribution (25 points), and feasibility of control (10 points). For each question a numeric score is given based on explicit guidelines. The score values for each question and section were determined based on documented importance in the literature and the authors' knowledge, opinions, and goals. Questions range from two to 10 points in value, and each question has a documentation section that presents the rationale and information sources for the question (see Appendix C).

The effect of non-native species on ecological impacts in natural systems in Alaska was the primary concern of the authors. Predicting impacts is more difficult than predicting the ability to establish and spread (Rejmanek 2001); however, preserving natural ecological and community condition is a core goal of most land management agencies in Alaska. Therefore we emphasized the ecological and community impacts with 40 percent of the total possible score. See Williamson (2001) for a discussion of predicting invasive species impacts.

Ecological Impact:

Four questions regarding the potential severity of ecological impacts were weighted equally with 10 points and are similar to questions used in the Virginia (Heffernan et al. 2001) and California ranking systems (Warner et al. 2003). The four questions and relative values of responses are presented in table 2.

Biological Characteristics and Dispersal Ability:

The Biological Characteristics section has nine questions worth two or three points each. The questions focus on characteristics associated with the potential ability of a species to spread, establish, and flourish in natural areas or otherwise associated with invasiveness. Table 3 shows this subsection of the ranking system with justifications for questions.

Distribution:

One factor widely recognized for predicting which species may become invasive is a history of invasion in other regions and the distribution of those invasions (Forcella and Wood 1984, Rejmanek 1995, 1996, 1999, 2001). This section is composed of five questions valued between four and six points. This subsection of the ranking system with justifications for questions is presented in table 4.

Feasibility of Control:

The smallest section of this ranking system, with three questions for 10 points total, is devoted to control feasibility. Species that are difficult to control pose a greater threat than those that can be easily eradicated, therefore considered more invasive. We do not weight this section heavily (10 percent of the total rank), however, we consider preventative measures and early eradication to be more urgent in Alaska than large-scale control efforts. The questions and their justifications are shown in table 5.

Overall Score:

Scores and the number of points possible are tabulated for each section. If insufficient information is present to respond to a question it is scored as "unknown" and the maximum potential points for that question are removed to obtain "points possible." The final invasiveness score is given as the relative maximum score, which is equal to the sum of scores from each section divided by the total possible. This has the advantage of evaluating species on information known rather than artificially depressing the scores of poorly understood species. To illustrate, a hypothetical species that receives maximum scores for all questions except that it has unknown ecosystem impacts (i.e., Question 1.1 with 10 possible points = "unknown") would score 90 points out of 90 possible, and its Relative Maximum Score would be 100. The lowest (least invasive) score possible is zero.

Table 2. Excerpt of the ecological section of the Alaska invasiveness ranking system

1. Ecological Impacts	
1.1. Impact on Natural Ecosystem Processes.	
A. No perceivable impact on ecosystem processes.	0
B. Has the potential to influences ecosystem processes to a minor degree (e.g., has a perceivable but mild influence on soil nutrient availability).	3
C. Has the potential to cause significant alteration of ecosystem processes (e.g., increases sedimentation rates along streams or coastlines, reduces open water that are important to waterfowl).	7
D. Likely to cause major, possibly irreversible, alteration or disruption of ecosystem processes (e.g., the species alters geomorphology; hydrology; or affects fire frequency, altering community composition; species fixes substantial levels of nitrogen in the soil making soil unlikely to support certain native plants or more likely to favor non-native species.).	10
U. Unknown	

1.2. Impact on Natural Community Structure.		
A.	No perceived impact; establishes in an existing layer without influencing its structure.	0
B.	Has the potential to influences structure in one layer (e.g., changes the density of one layer).	3
C.	Has the potential to significant impact in at least one layer (e.g., creation of a new layer or elimination of an existing layer).	7
D.	Likely to cause major alteration of structure (e.g., covers canopy, eradicating most or all layers below).	10
U.	Unknown	
1.3. Impact on Natural Community Composition.		
A.	No perceived impact; causes no apparent change in native populations.	0
B.	Has the potential to influences community composition (e.g., reduces the number of individuals in one or more native species in the community).	3
C.	Has the potential to significantly alters community composition (e.g., produces a significant reduction in the population size of one or more native species in the community).	7
D.	Likely to cause major alteration in community composition (e.g., results in the extirpation of one or several native species, reducing biodiversity or change the community composition towards species exotic to the natural community).	10
U.	Unknown	
1.4. Impact on higher trophic levels (cumulative impact of this species on the animals, fungi, microbes, and other organisms in the community it invades).		
A.	Negligible perceived impact.	0
B.	Has the potential to cause minor alteration.	3
C.	Has the potential to cause moderate alteration (minor reduction in nesting/foraging sites, reduction in habitat connectivity, interference with native pollinators, injurious components such as spines, toxins).	7
D.	Likely to cause severe alteration of higher trophic populations (extirpation or endangerment of an existing native species/population, or significant reduction in nesting or foraging sites).	10
U.	Unknown	

Showing the possible range of responses and values of impacts. For justifications of impact questions and categories see (Heffernan et al. 2001 and Warner et al. 2003).

Table 3. Excerpt of the biological section of the Alaska invasiveness ranking system

2. Biological Characteristics and Dispersal Ability		
2.1. Mode of reproduction . *Reproduction through vegetative propagules has been shown to increase successful invasions in higher latitudes (Pysek 1997).*		
A.	Not aggressive reproduction (few [0-10] seeds per plant and no vegetative reproduction).	0
B.	Somewhat aggressive (reproduces only by seeds (11-1,000/m^2).	1
C.	Moderately aggressive (reproduces vegetatively and/or by a moderate amount of seed, <1,000/m^2).	2
D.	Highly aggressive reproduction (extensive vegetative spread and/or many seeded, >1,000/m^2).	3
U.	Unknown	
2.2. Innate potential for long-distance dispersal (bird dispersal, sticks to animal hair, buoyant fruits, wind-dispersal). *Effective dispersal is known to be partially responsible for the success of many species in intact habitats (see Rejmanek and Richardson 1996).*		
A.	Does not occur (no long-distance dispersal mechanisms).	0
B.	Infrequent or inefficient long-distance dispersal (occurs occasionally despite lack of adaptations).	2
C.	Numerous opportunities for long-distance dispersal (species has adaptations such as pappus, hooked fruit-coats, etc.).	3
U.	Unknown	

2.3. Potential to be spread by human activities (both directly and indirectly – possible mechanisms include: commercial sales, use as forage/revegetation, horticulture, spread along highways, transport on boats, contamination, etc.).
Most non-natives rely on humans for transport and those that are regularly transported have a higher probability of escaping cultivation (Mack 2000, Kolar and Lodge 2001, Rejmanek 2001, Mack and Erneberg 2002).

A.	Does not occur.	0
B.	Low (human dispersal is infrequent or inefficient).	1
C.	Moderate (human dispersal occurs).	2
D.	High (there are numerous opportunities for dispersal to new areas).	3
U.	Unknown	

2.4. Allelopathic
Allelopathic weeds often have a competitive advantage and are more likely to cause longer term ecosystem and community alterations (see Pheloung et al. 1996).

A.	No	0
B.	Yes	2
U.	Unknown	

2.5. Competitive ability
The presence of these traits obviously improves the probability of establishment (see Pheloung et al. 1996).

A.	Poor competitor for limiting factors.	0
B.	Moderately competitive for limiting factors.	1
C.	Highly competitive for limiting factors and/or nitrogen fixing ability.	3
U.	Unknown	

2.6. Forms dense thickets, climbing or smothering growth habit, or otherwise taller than the surrounding vegetation.
The ability to form thickets or is taller than the surrounding vegetation is a trait shown to predict invasiveness elsewhere (Rejmanek and Richardson 1996, Goodwin, et al. 1999).

A.	No	0
B.	Forms dense thickets.	1
C.	Has climbing or smothering growth habit, or otherwise taller than the surrounding vegetation.	2
U.	Unknown	

2.7. Germination requirements.
Species that are able to germinate in the absence of natural or anthropogenic have a greater risk of establishing in intact communities.

A.	Requires open soil and disturbance to germinate.	0
B.	Can germinate in vegetated areas but in a narrow range or in special conditions.	2
C.	Can germinate in existing vegetation in a wide range of conditions.	3
U.	Unknown	

2.8. Other species in the genus invasive in Alaska or elsewhere.
Invasiveness is often associated with particular genera (e.g., Centauria and Bromus) and can be informative for a species in another region (Darwin 1859, Rejmanek 1999).

A.	No	0
B.	Yes	3
U.	Unknown	

2.9. Aquatic, wetland, or riparian species. *Aquatic weeds have a history of more problematic invasions (see Galatowitsch et al. 1999, Pheloung et al. 1999). Additionally, riparian habitats display high connectivity and tend to be of great conservation concern in Alaska, and we therefore rank those species with an intermediate value.*	
A. Not invasive in wetland communities.	0
B. Invasive in riparian communities.	1
C. Invasive in wetland communities.	3
U. Unknown	

Showing the possible range of responses and values of impacts. Justifications of questions are presented below each subsection in italics.

Table 4. Excerpt of the distribution section of the Alaska invasiveness ranking system

3. Distribution.	
3.1. Is the species highly domesticated or a weed of agriculture. *Cultivated species are generally planted in high volumes and bred for environmental conditions in novel regions, making the probability of escape into native habitats higher. An intermediate score is given to species that are common weeds of agriculture, since these species not only pose an economic impact, but have numerous opportunities to transition from the agricultural fields to bordering natural areas.*	
A. No	0
B. Is occasionally an agricultural pest.	2
C. Has been grown deliberately, bred, or is known as a significant agricultural pest.	4
U. Unknown	
3.2. Known level of ecological impact in natural areas. *This point concerns how similar habitats are to those in Alaska and the degree of the ecological impacts in other regions. This point is based on a question from the Southwest Exotic Plants system (Hiebert and Studdendieck 1993). Species that are known to have severe impacts to habitats similar to those found in Alaska are given the highest score, while those species whose impacts are severe for somewhat dissimilar habitats or whose impacts are less for similar habitats are given lower scores.*	
A. Not known to cause impact in any other natural area.	0
B. Known to cause impacts in natural areas, but in dissimilar habitats and climate zones than exist in regions of Alaska.	1
C. Known to cause low impact in natural areas in similar habitats and climate zones to those present in Alaska.	3
D. Known to cause moderate impact in natural areas in similar habitat and climate zones.	4
E. Known to cause high impact in natural areas in similar habitat and climate zones.	6
U. Unknown	
3.3. Role of anthropogenic and natural disturbance in establishment. *Species with a habit of invading natural areas are clearly more dangerous than those restricted to the anthropogenic footprint (see Rejmanek 2001).*	
A. Requires anthropogenic disturbances to establish.	0
B. May occasionally establish in undisturbed areas but can readily establish in areas with natural disturbances.	3
C. Can establish independent of any known natural or anthropogenic disturbances.	5
U. Unknown	

3.4. Current global distribution. *A species is given the highest score if it is known from at least continents and is known to invade subarctic or arctic habitats, an intermediate score if known from at least three continents, but not in subarctic to arctic habitats, and no points if known from two or fewer continents.*		
A.	Occurs in one or two continents or regions (e.g., Mediterranean region).	0
B.	Extends over three or more continents.	3
C.	Extends over three or more continents, including successful introductions in arctic or subarctic regions.	5
U.	Unknown	
3.5. Extent of the species U.S. range and/or occurrence of formal state or provincial listing. *The highest score is given to species that are known from 50 percent or more of U.S. states and formally listed as invasive or problematic in two or more states or Canadian provinces.*		
A.	0-5 percent of the states.	0
B.	6-20 percent of the states.	2
C.	21-50 percent, and/or state listed as a problem weed (e.g., "Noxious," or "Invasive") in 1 state or Canadian province.	4
D.	Greater than 50 percent, and/or identified as "Noxious" in 2 or more states or Canadian provinces.	5
U.	Unknown	

Showing the possible range of responses and values of impacts. Justifications of questions are presented below each subsection in italics.

Table 5. Excerpt of the feasibility of control section of the Alaska invasiveness ranking system

4. Feasibility of Control		
4.1. Seed banks *Species with seeds that are able to persist for greater than five years in the soil are given the highest score, since this requires a long-term investment in control (see Conn and Farris 1995).*		
A.	Seeds remain viable in the soil for less than 3 years.	0
B.	Seeds remain viable in the soil for between 3 and 5 years.	2
C.	Seeds remain viable in the soil for 5 years and more.	3
U.	Unknown	
4.2. Vegetative regeneration *Species in which small fragments of the plant are capable of regenerating plants or that are able to regrow from root stumps are notoriously difficult to eradicate.*		
A.	No resprouting following removal of aboveground growth.	0
B.	Resprouting from ground-level meristems.	1
C.	Resprouting from extensive underground system.	2
D.	Any plant part is a viable propagule.	3
U.	Unknown	

4.3. Level of effort required.
This question asks if the management of invasive populations requires no investment in human and financial resources (i.e., populations are ephemeral), moderate, or a major, long-term investment of human and financial resources.

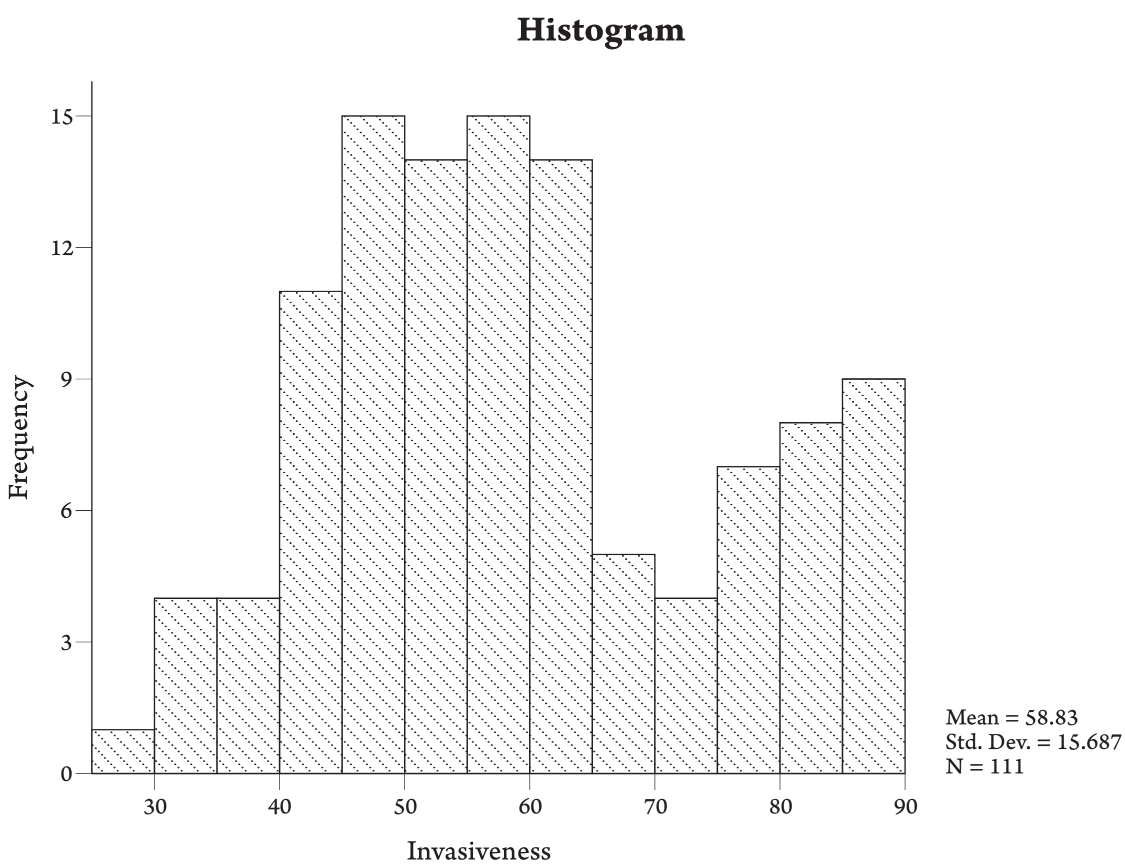
A.	Management is not required (e.g., species does not persist without repeated anthropogenic disturbance).	0
B.	Management is relatively easy and inexpensive; requires a minor investment in human and financial resources.	2
C.	Management requires a major short-term investment of human and financial resources, or a moderate long-term investment.	3
D.	Management requires a major, long-term investment of human and financial resources.	4
U.	Unknown	

Showing the possible range of responses and values of impacts. Justifications of questions are presented below each subsection in italics.

Alaska Invasiveness Ranking System Results

The invasiveness ranks of 113 species are summarized in Appendix A and completed ranking forms are presented in Appendix B. A total of 18 of these species are not recorded from Alaska and two of these (*Centaurea solstitialis* and *Crupina vulgaris*) were rejected from consideration in the climate screening phase. We did not rank all known naturalized non-native plants. We choose a selection based on those species that land managers were most concerned about. Some were perceived to be a threat, some were frequent occurrences and others were recent arrivals. It should be noted that the closely related *Centaurea melitensis* recently was observed as a seedling in an Anchorage greenhouse, and it reached sexual maturity after being repotted and placed outside (Nielsen pers.

Figure 5. Frequency distribution of invasiveness ranks for 113 species ranked in the Alaska system.



obs.), suggesting that establishment might be possible in Alaska despite climate matching of less than 40 percent with its habitats elsewhere.

The maximum score obtained was 90 for *Myriophyllum spicatum*, which has not yet been confirmed in Alaska. The minimum score was 27 for *Lepidium densiflorum*, which is a species largely confined to imported gravel substrates of road beds at low densities in Alaska. Thus this system displays a broad effective range. The mean score was 58.8 and median score was 57 (sd = 15.7). The distribution of scores is moderately bimodal with a greater frequency of high and intermediate scores (figure 5). When only species present in Alaska are included the distribution approaches normality ($p = 0.072$, $df = 99$, Kolmogorov-Smirnov test of normality).

Scores for each section (ecological impacts, biological characteristics and dispersal ability, distribution, and feasibility of control) were positively correlated with one another and the overall invasiveness score (table 6). Distribution and control section scores, however, were not significantly correlated. Ecological impacts and biological characteristics were the best predictors of the overall invasiveness ranking ($R^2 = 0.38$ and 0.51, respectively, after removing the contribution of these sections to the overall scores, figure 6).

Table 6. Spearman rank correlations among four sections of the Alaska invasiveness ranking system

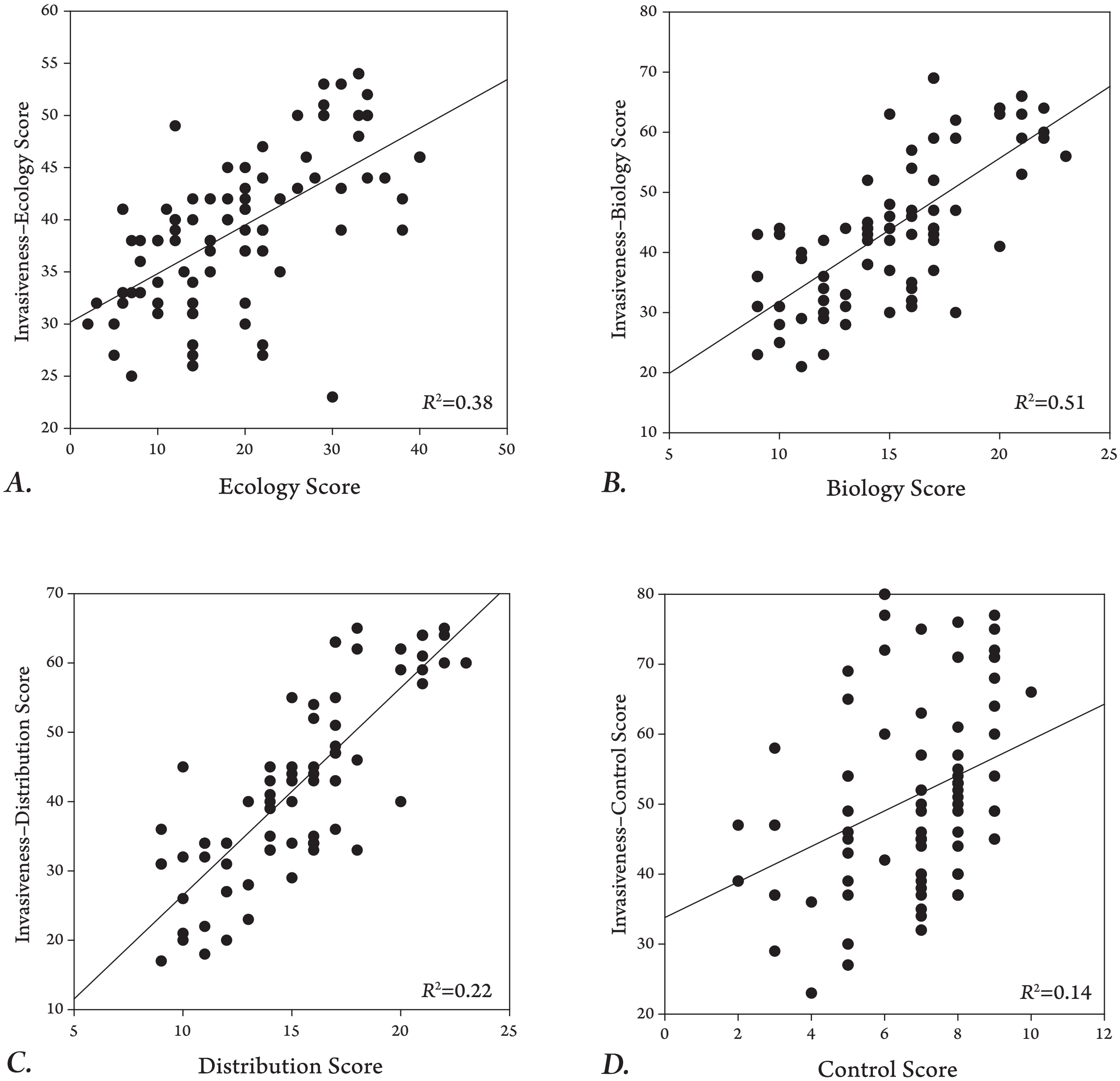
	Ecology	Biology	Distribution	Control	Invasiveness
Ecology	1.000	0.610(²)	0.472(²)	0.275(¹)	0.933(²)
N		88	97	92	103
Biology		1.000	0.490(²)	0.493(²)	0.805(²)
N			87	82	92
Distribution			1.000	0.130	0.675(²)
N				89	103
Control				1.000	.0.448(²)
N					96
Invasiveness					1.000
N					

[1] = significant correlation at the 0.05 level; [2] = significant correlation at the 0.01 level (2-tailed). Species with unknowns were removed from correlations.

A number of species, such as *Medicago lupulina*, *Rumex crispus*, and *Sonchus arvensis*, were found to have high scores in biological characteristics and dispersal ability but relatively low scores to ecological impacts. These species tend to be chronically present in agricultural and disturbed habitats and *Medicago lupulina* and *Rumex crispus* often grow at low densities, which are less likely to cause measurable impacts. It is noteworthy that the ability to establish and spread and the degree of ecological impacts are not necessarily positively correlated (Rejmanek 2001). *Zostera japonica* is a notable outlier in the ecological impacts relative to overall invasiveness, with relatively large ecological impacts, but with low scores for the remaining sections (figure 6A). This species is confined to the lower tidal zone, and the biological questions do not effectively evaluate this unusual vascular plant life history type (e.g. questions 2.5 and 2.6, competitive ability and thicket or climbing habit, respectively).

In one case we ranked a species (*Stellaria media*) for different habitat types and produced two different ranks: of (1) 42, for all habitats except grass-forb dominated seabird nesting sites and (2) 54 for grass-forb dominated seabird nesting sites. This was done because *Stellaria media* is considered weakly invasive and restricted to anthropogenic disturbance across most of Alaska; however, it is a serious problem on nutrient rich, grass-forb dominated seabird nesting habitats of the Commander Islands (Mochalova and Yakubov 2004), just west of the Aleutians and may pose a threat to seabird colonies in Alaska.

Figure 6. Scatter plots of 113 species' ranks for (A.) Ecological Impacts, (B.) Biological Characteristics and Dispersal Ability, (C.) Distribution, and (D.) Feasibility of Control section scores relative to the sum of the remaining sections. Proportion of the total variance accounted for by each section score (R^2) are also included.



Discussion

The existing weed risk assessment systems that we evaluated have useful approaches to predicting invasion and damage in particular contexts. The systems are largely driven by specific values of the authors (e.g., impacts to a specific area or to agriculture), many of which are not universal, and most require more information than is typically available (Williams and Newfield 2002), which is a severe drawback to a state such as Alaska that is only beginning to face large-scale introductions. For most non-native species, little to no research has been conducted in the state and the paucity of information curtails confidence in ranks. We emphasize the need for more research on invasive species ecology, distribution, and trends in Alaska.

The system presented here differs from the existing systems by including a climate filtering stage, handling species with a range of known information, and focusing on impacts to natural systems in Alaska. Despite those differences, the Alaska system produced ranks that were very similar to the Southwest system. We borrowed many components of the "innate ability to become a pest (i.e., biology)" and "ease of control sections" from the Southwest system, but did not include a similar "level of impact" section and the systems differed in the relative weight of the remaining sections.

Scores for the four sections of the Alaska system are generally strongly positively related to one another (i.e., species with large ecosystem impacts also have a more invasive biology, broad distributions, and are more difficult to control). However, the feasibility of control section was not as strongly correlated with the other sections and this is likely due to this section having only three questions, leading to greater variation in scores than the other sections. A number of species scored high values in the biological characteristics and distribution sections, but relatively low scores in the ecology section. These species represent a group of ruderal specialists (e.g., *Persicaria lapathifolium*, *Poa annua*, and *Plantago major*) that are good dispersers, highly dependent on soil disturbance, but poor competitors (see Baker 1974). While invasions and their impacts are very difficult to predict, our system stresses the importance of whether the species is invasive in other areas. This trait is most strongly correlated with the probability of invasion into new areas (Forcella and Wood 1984, Rejmanek and Richardson 1996, Rejmanek 2001).

Species that are regarded as particularly threatening to Alaskan ecosystems such as *Melilotus alba*, *Polygonum cuspidatum*, and *Vicia cracca* consistently ranked high in the Alaska system among reviewers, while more ruderal species such as *Chenopodium album* and *Matricaria discoidea* were consistently ranked with low scores, as expected. The Australian system, on the other hand, ranked species that are not considered problematic in Alaska with very high scores. This system gives more weight than the others to agricultural pests and to species linked to specific ecological concerns in Australia. Systems such as the Australian, Southwest, and Alaskan that produced continuous numeric invasiveness ranks resulted in less variation among assessors.

The distribution of scores in the Alaska system currently ranges from 27 (*Lepidium densiflorum*, the least invasive species) to 90 (*Myriophyllum spicatum*, the most invasive species, which is not yet recorded for Alaska). The average is 58. While different users will have different concepts of what constitutes various levels of invasiveness (e.g., what is "highly invasive" vs. "moderately invasive" may differ among management agencies), we divided the ranks into six blocks in Appendix A. We consider species with scores ≥80 as "Extremely Invasive" and species with scores 70–79 as "Highly Invasive;" both of these groups are composed of species estimated to be very threatening to Alaska. Species with scores of 60–69 as "Moderately Invasive" and scores of 50–59 represent "Modestly Invasive" species; both of these groups still pose significant risks to ecosystems. Species with scores of 40–49 are "Weakly Invasive", and <40 are considered "Very Weakly Invasive." These last two groups generally have not been shown to significantly alter ecosystem processes and communities elsewhere and probably do not require as much attention as the other species.

We stress, however, that decisions on which species to control should be based on more information than solely invasiveness rank. The objectives of land managers will range from those attempting to eliminate all non-native plants to those attempting to control only the most invasive species. Further, the distribution, abundance, control costs, and likelihood of reintroductions of each non-native species should be evaluated prior to control actions. For example, greater gains will often be achieved by targeting new introductions than trying to control large-scale infestations, even of "highly invasive" species. A "Treatment Prioritization Tool" has been developed for Alaska (see AKEPIC 2005) to account for such site-specific factors that are beyond the scope of this system. The Alaska Region, U.S. Fish and Wildlife Service produced an "Invasive Plant Treatment Guide" (ENSR 2006) that uses a breadth of information, including invasiveness ranks, to prioritize control actions. Similarly, the National Park Service in Alaska is currently preparing an "Invasive Plant Management Plan" that uses invasiveness ranks and site-specific factors to determine appropriate control methods (J. Heys pers. comm.).

The distribution of scores is bimodal with a peak around the mean and a second peak at around 85. The 113 non-native species ranked (283 non-native vascular plants have been recorded for Alaska, Carlson and Shephard 2007) were not chosen at random. The peak around the mean rank represents species with intermediate impacts that are becoming widely established in Alaska and are being considered for management. The peak around 85 reflects the authors' desire to highlight particularly problematic species to promote efforts to control the establishment and spread of these species before they become widespread. The latter peak nearly vanishes when only non-native species currently present in Alaska are included.

The ranks produced to date should be viewed as a work in progress, as we expect that as more information becomes available the ranks and amount of documentation will change. We believe that this system can be used by others to screen potential species for the probability of establishing in Alaska (climate screening component) as well as producing additional invasiveness ranks. The number of introductions and number of populations appears to be increasing exponentially in Alaska, and many more species will require ranking (Carlson and Shephard 2007). Reliance on literature and documented observations along with clear guidelines for each question's scores should produce similar scores regardless of assessors' backgrounds. However, we stress the need for experts to review all ranks.

Acknowledgements

The U.S. Forest Service, State and Private Forestry and the Alaska Natural Heritage Program, University of Alaska Anchorage provided financial support for this effort. Keith Boggs, Susan Klein, Chris McKee, and Erin Uloth made valuable contributions and edits on this manuscript and on the species ranks. Robert Pattison and Trish Wurtz made particularly insightful contributions to the manuscript. Annette Untalasco and Melinda Lamb made final formatting, design, and layout contributions.

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Appendices

Appendix A.1.

Summary Scores Of Invasiveness Ranking Of 113 Non-native Plants Ordered By Overall Invasiveness Score.

Plant species	Common name	Ecological impact	Biological characteristics	Distribution	Control	Total	Invasiveness[1]	South Coastal	Interior Boreal	Arctic Alpine
Myriophyllum spicatum †	Eurasian watermilfoil	38	20(22)	20	9	87(97)	90	Yes	Yes	Yes
Polygonum cuspidatum *	Japanese knotweed	33	21	23	7(7)	84(97)	87	Yes	Yes	–
Polygonum sachalinensis *	Giant knotweed	33	21	23	7(7)	84(97)	87	Yes	Yes	–
Polygonum X *bohemicum* *	Bohemian knotweed	33	21	23	7(7)	84(97)	87	Yes	Yes	–
Centaurea biebersteinii	Spotted knapweed	34	22	21	9	86	86	Yes	Yes	–
Spartina alterniflora * †	Smooth cordgrass	40	17	23	6	86	86	Yes	–	–
Spartina anglica * †	Common cordgrass	40	17	23	6	86	86	Yes	–	–
Spartina densiflora * †	Denseflower cordgrass	40	17	23	6	86	86	Yes	–	–
Spartina patens * †	Saltmeadow cordgrass	40	17	23	6	86	86	Yes	–	–
Euphorbia esula †	Leafy spurge	31	21	23	9	84	84	Yes	Yes	–
Lythrum salicaria *	Purple loosestrife	34	20	21	8	83	84	–	Yes	–
Lythrum virgatum *	European wand loosestrife	34	20	21	8	83	84	–	Yes	–
Phalaris arundinacea	Reed canarygrass	33	20	24	6	83	83	Yes	Yes	Yes
Impatiens glandulifera	Ornamental jewelweed	29	22	22	7	80(98)	82	Yes	Yes	–
Heracleum mantegazzianum †	Giant hogweed	33	22	17	9	81	81	Yes	Yes	Yes
Melilotus alba	White sweetclover	29	22	21	9	81	81	Yes	Yes	Yes
Hydrilla verticillata †	Waterthyme	38	17(22)	14	9	78(97)	80	Yes	Yes	Yes
Nymphaea odorata ssp. *odorata*	American white waterlily	36	18	18	6(7)	78(97)	80	Yes	–	–
Hieracium aurantiacum *	Orange hawkweed	29	23	19	8	79	79	Yes	Yes	Yes
Hieracium caespitosum *	Meadow hawkweed	29	23	19	8	79	79	Yes	Yes	Yes
Bromus tectorum	Cheatgrass	34	15	23	6	78	78	Yes	Yes	Yes
Rubus discolor	Himalayan blackberry	38	18	12	9	77	77	Yes	–	–
Cirsium arvense	Canada thistle	26	17	21	10	76	76	Yes	Yes	Yes
Prunus padus	European bird cherry	31	21	17	5	74	74	Yes	Yes	–
Sonchus arvensis	Moist sowthistle	22	21	21	9	73	73	Yes	Yes	–
Vicia cracca	Bird vetch	27	16	21	9	73	73	Yes	Yes	Yes
Lepidium latifolium	Broadleaved pepperweed	28	17(22)	16	6(7)	67(94)	71	–	Yes	Yes
Alliaria petiolata	Garlic mustard	24(30)	16	16	7	63(90)	70	Yes	–	–
Brachypodium sylvaticum †	False slender brome	31	19(23)	14	5	69(98)	70	Yes	Yes	Yes
Cytisus scoparius	Scotch broom	26	17	18	8	69	69	Yes	–	–
Linaria vulgaris	Butter and eggs	22	17	21	9	69	69	Yes	Yes	Yes
Melilotus officinalis	Yellow sweetclover	24	18	19	8	69	69	Yes	Yes	Yes
Caragana arborescens	Siberian peashrub	24	14	21	5(7)	64(97)	66	–	Yes	Yes
Lonicera tatarica	Tatarian honeysuckle	22	19(23)	18	6	65(98)	66	Yes	Yes	–
Campanula rapunculoides	Rampion bellflower	18(40)	16(20)	20(25)	5(7)	59(92)	64	Yes	Yes	Yes
Medicago sativa ssp. *falcata*	Yellow alfalfa	15(30)	17	15(19)	7	54(84)	64	Yes	Yes	Yes
Hordeum jubatum	Foxtail barley	18	16	20	9	63	63	Yes	Yes	Yes
Senecio jacobaea	Stinking willie	20	15	20	8	63	63	Yes	Yes	Yes

† = Not known in AK (2006)

* = Congeneric species ranked together

[1] Invasiveness is equal to the Relative Maximum Score, which is equal to the sum of scores from each section divided by the total possible. See pages 10–11. Climate matches to the three ecoregions of Alaska are included (Yes = present or high probability of establishing in the ecoregion, – = absent and low probability of establishment). Scores >80 = "Extremely Invasive", 70-79 = "Highly Invasive", 60-69 = "Moderately Invasive", 50-59 = "Modestly Invasive", 40-49 = "Weakly Invasive", and < 40 = "Very Weakly Invasive".

Plant species	Common name	Ecological impact	Biological characteristics	Distribution	Control	Total	Invasiveness[1]	South Coastal	Interior Boreal	Arctic Alpine
Bromus inermis ssp. *inermis*	Smooth brome	20	16	18	8	62	62	Yes	Yes	Yes
Alnus glutinosa †	European alder	24	16	14	5	59(97)	61	Yes	Yes	Yes
Carduus acanthoides * †	Spiny plumeless thistle	22	17	14	8	61	61	Yes	Yes	Yes
Carduus nutans * †	Nodding plumeless thistle	22	17	14	8	61	61	Yes	Yes	Yes
Carduus pycnocephalus * †	Italian plumeless thistle	22	17	14	8	61	61	Yes	Yes	Yes
Carduus tenuiflorus * †	Winged plumeless thistle	22	17	14	8	61	61	Yes	Yes	Yes
Cirsium vulgare	Bull thistle	20	19(23)	18	3	60(98)	61	Yes	Yes	Yes
Leucanthemum vulgare	Oxeye daisy	20	15	18	8	61	61	Yes	Yes	Yes
Hordeum murinum ssp. *leporinum*	Leporinum barley	18	17	17	8	60	60	–	Yes	–
Elymus repens	Quackgrass	20	15	19	5	59	59	Yes	Yes	Yes
Medicago sativa ssp. *sativa*	Alfalfa	13(30)	17	16	7	53(90)	59	Yes	Yes	Yes
Sorbus aucuparia	European mountain ash	22	14	16	7	59	59	Yes	–	–
Trifolium repens	White clover	22	15	14	8	59	59	Yes	Yes	Yes
Linaria dalmatica	Dalmatian toadflax	16	14	19	9	58	58	–	Yes	–
Taraxacum officinale ssp. *officinale*	Common dandelion	18	14	18	8	58	58	Yes	Yes	Yes
Gypsophila paniculata	Baby's breath	20	14	18	3(7)	55(97)	57	Yes	Yes	Yes
Potentilla recta †	Sulfur cinquefoil	20	13	17	7	57	57	Yes	Yes	–
Tanacetum vulgare	Common tansy	20	15	13	8	56(98)	57	Yes	Yes	Yes
Trifolium hybridum	Alsike clover	22	12	18	5	57	57	Yes	Yes	Yes
Convolvulus arvensis	Field bindweed	18	14	16	8	56	56	Yes	Yes	Yes
Lupinus polyphyllus	Bigleaf lupine	14	16	17	8	55	55	Yes	Yes	Yes
Crepis tectorum	Narrowleaf hawksbeard	9(30)	17	18	3(7)	47(87)	54	Yes	Yes	Yes
Phleum pratense	Timothy	14	14	19	7	56	54	Yes	Yes	Yes
Ranunculus acris *	Tall buttercup	16	13(23)	15	9	53(98)	54	Yes	Yes	Yes
Ranunculus repens *	Creeping buttercup	16	13(23)	15	9	53(98)	54	Yes	Yes	Yes
Stellaria media/sea bird colonies	Common chickweed	14	12	20	8	54	54	Yes	Yes	Yes
Dactylis glomerata	Orchard grass	16	10	22	5	53	53	Yes	Yes	Yes
Trifolium pratense	Red clover	16	12(22)	16	7	51(97)	53	Yes	Yes	Yes
Vicia villosa	Winter vetch	22	11(22)	12(19)	3	48(91)	53	Yes	Yes	–
Zostera japonica †	Dwarf eelgrass	30	10	8	1(3)	49(93)	53	Yes	Yes	–
Hypericum perforatum	Common St. Johnswort	11	15	18	8	52	52	Yes	Yes	Yes
Poa pratensis ssp. *pratensis* *	Kentucky bluegrass	12	14	19	7	52	52	Yes	Yes	Yes
Poa pratensis ssp. *irrigata* *	Spreading bluegrass	12	14	19	7	52	52	Yes	Yes	Yes
Poa trivialis *	Rough bluegrass	12	14	19	7	52	52	Yes	Yes	Yes
Verbascum thapsus	Common mullien	20	9	16	7	52	52	Yes	Yes	–
Digitalis purpurea	Purple foxglove	16	11	19	5	51	51	Yes	Yes	–
Hieracium umbellatum	Narrowleaf hawkweed	13(30)	16(20)	9	4(7)	42(82)	51	Yes	Yes	Yes
Rumex acetosella	Common sheep sorrel	12	16	16	7	51	51	Yes	Yes	Yes
Fallopia convolvulus	Black bindweed	12	16	17	5	50	50	Yes	Yes	Yes
Tragopogon dubius	Yellow salsify	20	11	16	3	50	50	Yes	Yes	–
Glechoma hederacea	Ground ivy	14	12	14	8	48	48	Yes	Yes	Yes
Medicago lupulina	Black medick	10	18	15	5	48	48	Yes	Yes	Yes

† = Not known in AK (2006)

* = Congeneric species ranked together

[1] Invasiveness is equal to the Relative Maximum Score, which is equal to the sum of scores from each section divided by the total possible. See pages 10–11. Climate matches to the three ecoregions of Alaska are included (Yes = present or high probability of establishing in the ecoregion, – = absent and low probability of establishment). Scores >80 = "Extremely Invasive", 70-79 = "Highly Invasive", 60-69 = "Moderately Invasive", 50-59 = "Modestly Invasive", 40-49 = "Weakly Invasive", and < 40 = "Very Weakly Invasive".

Plant species	Common name	Ecological impact	Biological characteristics	Distribution	Control	Total	Invasiveness[1]	South Coastal	Interior Boreal	Arctic Alpine
Rumex crispus *	Curly dock	10	16	14	8	48	48	Yes	Yes	Yes
Rumex longifolius *	Dooryard dock	10	16	14	8	48	48	Yes	Yes	Yes
Rumex obtusifolius *	Bitter dock	10	16	14	8	48	48	Yes	Yes	Yes
Tripleurospermum perforata	Scentless false mayweed	13	13(23)	15	6	47(98)	48	Yes	Yes	Yes
Persicaria lapathifolia *	Curlytop knotweed	6	16	15(19)	7	44(94)	47	Yes	Yes	Yes
Persicaria maculosa *	Spotted ladysthumb	6	16	15(19)	7	44(94)	47	Yes	Yes	Yes
Achillea ptarmica	Sneezeweed	14	12	15	2(3)	43(93)	46	Yes	Yes	Yes
Poa annua	Annual bluegrass	8	13	18	7	46	46	Yes	Yes	Yes
Polygonum aviculare	Prostrate knotweed	7	15	16	7	45	45	Yes	Yes	Yes
Lappula squarrosa	European stickseed	10	12	17	5	44	44	Yes	Yes	Yes
Plantago major	Common plantain	8	13	16	7	44	44	Yes	Yes	Yes
Cotula coronopifolia	Common brassbuttons	14	11(23)	9	7	41(98)	42	Yes	–	–
Silene dioica *	Red catchfly	13	9	13	7	42	42	Yes	Yes	Yes
Silene latifolia *	Bladder campion	13	9	13	7	42	42	Yes	Yes	Yes
Silene noctiflora *	Nightflowering silene	13	9	13	7	42	42	Yes	Yes	Yes
Stellaria media/non-seabird sites	Common chickweed	10	12	15	5	42	42	Yes	Yes	Yes
Anthemis cotula	Stinking chamomile	8	12	14	7	41	41	Yes	Yes	–
Descurainia sophia	Herb sophia	8	13	18	2	41	41	Yes	Yes	Yes
Hesperis matronalis	Dames rocket	10	10(22)	17	2(7)	39(94)	41	Yes	Yes	–
Lolium perenne ssp. *multiflorum*	Italian ryegrass	14	10	15	2	41	41	Yes	Yes	Yes
Capsella bursa-pastoris	Shepherd's purse	7	11	18	4	40	40	Yes	Yes	Yes
Galeopsis bifida *	splitlip hempnettle	14	9	12(19)	3	38(94)	40	Yes	Yes	Yes
Galeopsis tetrahit *	brittlestem hempnettle	14	9	12(19)	3	38(94)	40	Yes	Yes	Yes
Poa compressa	Canada bluegrass	6	10	17	5(7)	38(97)	39	Yes	Yes	Yes
Chenopodium album	Lambsquarters	5	12	15	5	37	37	Yes	Yes	Yes
Cerastium fontanum ssp. *vulgare* *	Big chickweed	6	8(25)	15(19)	5	34(94)	36	Yes	Yes	Yes
Cerastium glomeratum *	Sticky chickweed	6	8(25)	15(19)	5	34(94)	36	Yes	Yes	Yes
Senecio vulgaris	Old-man-in-the-Spring	4	12	15	5	36	36	Yes	Yes	Yes
Saponaria officinalis	Bouncingbet	5(30)	8(22)	12	2(3)	27(80)	34	Yes	Yes	–
Matricaria discoidea	Disc mayweed	5	9	15	3	32	32	Yes	Yes	Yes
Spergula arvensis	Corn spurry	2	11	14	5	32	32	Yes	Yes	Yes
Mycelis muralis	Wall-lettuce	7	11(23)	8	4	30(98)	31	Yes	–	–
Lepidium densiflorum	Common pepperweed	1(30)	9(23)	8	4	22(88)	25	Yes	Yes	Yes
Centaurea solstitialis	Yellow star-thistle							–	–	–
Crupina vulgaris	Common crupina							–	–	–

† = Not known in AK (2006)

* = Congeneric species ranked together

[1] Invasiveness is equal to the Relative Maximum Score, which is equal to the sum of scores from each section divided by the total possible. See pages 10–11. Climate matches to the three ecoregions of Alaska are included (Yes = present or high probability of establishing in the ecoregion, – = absent and low probability of establishment). Scores >80 = "Extremely Invasive", 70-79 = "Highly Invasive", 60-69 = "Moderately Invasive", 50-59 = "Modestly Invasive", 40-49 = "Weakly Invasive", and < 40 = "Very Weakly Invasive".

Appendix A.2.

Summary Scores Of Invasiveness Ranking Of 113 Non-native Plants Ordered By Species Name

Plant species	Common name	Ecological Impact	Biological Characteristics	Distribution	Control	Total	Invasiveness[1]	South Coastal	Interior Boreal	Arctic Alpine
Achillea ptarmica	Sneezeweed	14	12	15	2(3)	43(93)	46	Yes	Yes	Yes
Alliaria petiolata	Garlic mustard	24(30)	16	16	7	63(90)	70	Yes	–	–
Alnus glutinosa †	European alder	24	16	14	5	59(97)	61	Yes	Yes	Yes
Anthemis cotula	Stinking chamomile	8	12	14	7	41	41	Yes	Yes	–
Brachypodium sylvaticum †	False slender brome	31	19(23)	14	5	69(98)	70	Yes	Yes	Yes
Bromus inermis ssp. *inermis*	Smooth brome	20	16	18	8	62	62	Yes	Yes	Yes
Bromus tectorum	Cheatgrass	34	15	23	6	78	78	Yes	Yes	Yes
Campanula rapunculoides	Rampion bellflower	18(40)	16(20)	20(25)	5(7)	59(92)	64	Yes	Yes	Yes
Capsella bursa-pastoris	Shepherd's purse	7	11	18	4	40	40	Yes	Yes	Yes
Caragana arborescens	Siberian peashrub	24	14	21	5(7)	64(97)	66	–	Yes	Yes
Carduus acanthoides * †	Spiny plumeless thistle	22	17	14	8	61	61	Yes	Yes	Yes
Carduus nutans * †	Nodding plumeless thistle	22	17	14	8	61	61	Yes	Yes	Yes
Carduus pycnocephalus * †	Italian plumeless thistle	22	17	14	8	61	61	Yes	Yes	Yes
Carduus tenuiflorus * †	Winged plumeless thistle	22	17	14	8	61	61	Yes	Yes	Yes
Centaurea biebersteinii	Spotted knapweed	34	22	21	9	86	86	Yes	Yes	–
Centaurea solstitialis	Yellow star-thistle							–	–	–
Cerastium fontanum ssp. *vulgare* *	Big chickweed	6	8(25)	15(19)	5	34(94)	36	Yes	Yes	Yes
Cerastium glomeratum *	Sticky chickweed	6	8(25)	15(19)	5	34(94)	36	Yes	Yes	Yes
Chenopodium album	Lambsquarters	5	12	15	5	37	37	Yes	Yes	Yes
Cirsium arvense	Canada thistle	26	17	21	10	76	76	Yes	Yes	Yes
Cirsium vulgare	Bull thistle	20	19(23)	18	3	60(98)	61	Yes	Yes	Yes
Convolvulus arvensis	Field bindweed	18	14	16	8	56	56	Yes	Yes	Yes
Cotula coronopifolia	Common brassbuttons	14	11(23)	9	7	41(98)	42	Yes	–	–
Crepis tectorum	Narrowleaf hawksbeard	9(30)	17	18	3(7)	47(87)	54	Yes	Yes	Yes
Crupina vulgaris	Common crupina							–	–	–
Cytisus scoparius	Scotch broom	26	17	18	8	69	69	Yes	–	–
Dactylis glomerata	Orchard grass	16	10	22	5	53	53	Yes	Yes	Yes
Descurainia sophia	Herb sophia	8	13	18	2	41	41	Yes	Yes	Yes
Digitalis purpurea	Purple foxglove	16	11	19	5	51	51	Yes	Yes	–
Elymus repens	Quackgrass	20	15	19	5	59	59	Yes	Yes	Yes
Euphorbia esula †	Leafy spurge	31	21	23	9	84	84	Yes	Yes	–
Fallopia convolvulus	Black bindweed	12	16	17	5	50	50	Yes	Yes	Yes
Galeopsis bifida *	splitlip hempnettle	14	9	12(19)	3	38(94)	40	Yes	Yes	Yes
Galeopsis tetrahit *	brittlestem hempnettle	14	9	12(19)	3	38(94)	40	Yes	Yes	Yes
Glechoma hederacea	Ground ivy	14	12	14	8	48	48	Yes	Yes	Yes
Gypsophila paniculata	Baby's breath	20	14	18	3(7)	55(97)	57	Yes	Yes	Yes
Heracleum mantegazzianum †	Giant hogweed	33	22	17	9	81	81	Yes	Yes	Yes
Hesperis matronalis	Dames rocket	10	10(22)	17	2(7)	39(94)	41	Yes	Yes	–

† = Not known in AK (2006)

* = Congeneric species ranked together

[1] Invasiveness is equal to the Relative Maximum Score, which is equal to the sum of scores from each section divided by the total possible. See pages 10–11.

Climate matches to the three ecoregions of Alaska are included (Yes = present or high probability of establishing in the ecoregion, – = absent and low probability of establishment). Scores >80 = "Extremely Invasive", 70-79 = "Highly Invasive", 60-69 = "Moderately Invasive", 50-59 = "Modestly Invasive", 40-49 = "Weakly Invasive", and < 40 = "Very Weakly Invasive".

Plant species	Common name	Ecological Impact	Biological Characteristics	Distribution	Control	Total	Invasiveness[1]	South Coastal	Interior Boreal	Arctic Alpine
Hieracium aurantiacum *	Orange hawkweed	29	23	19	8	79	79	Yes	Yes	Yes
Hieracium caespitosum *	Meadow hawkweed	29	23	19	8	79	79	Yes	Yes	Yes
Hieracium umbellatum	Narrowleaf hawkweed	13(30)	16(20)	9	4(7)	42(82)	51	Yes	Yes	Yes
Hordeum jubatum	Foxtail barley	18	16	20	9	63	63	Yes	Yes	Yes
Hordeum murinum ssp. *leporinum*	Leporinum barley	18	17	17	8	60	60	–	Yes	–
Hydrilla verticillata †	Waterthyme	38	17(22)	14	9	78(97)	80	Yes	Yes	Yes
Hypericum perforatum	Common St. Johnswort	11	15	18	8	52	52	Yes	Yes	Yes
Impatiens glandulifera	Ornamental jewelweed	29	22	22	7	80(98)	82	Yes	Yes	–
Lappula squarrosa	European stickseed	10	12	17	5	44	44	Yes	Yes	Yes
Lepidium densiflorum	Common pepperweed	1(30)	9(23)	8	4	22(88)	25	Yes	Yes	Yes
Lepidium latifolium	Broadleaved pepperweed	28	17(22)	16	6(7)	67(94)	71	–	Yes	Yes
Leucanthemum vulgare	Oxeye daisy	20	15	18	8	61	61	Yes	Yes	Yes
Linaria dalmatica	Dalmatian toadflax	16	14	19	9	58	58	–	Yes	–
Linaria vulgaris	Butter and eggs	22	17	21	9	69	69	Yes	Yes	Yes
Lolium perenne ssp. *multiflorum*	Italian ryegrass	14	10	15	2	41	41	Yes	Yes	Yes
Lonicera tatarica	Tatarian honeysuckle	22	19(23)	18	6	65(98)	66	Yes	Yes	–
Lupinus polyphyllus	Bigleaf lupine	14	16	17	8	55	55	Yes	Yes	Yes
Lythrum salicaria *	Purple loosestrife	34	20	21	8	83	84	–	Yes	–
Lythrum virgatum *	European wand loosestrife	34	20	21	8	83	84	–	Yes	–
Matricaria discoidea	Disc mayweed	5	9	15	3	32	32	Yes	Yes	Yes
Medicago lupulina	Black medick	10	18	15	5	48	48	Yes	Yes	Yes
Medicago sativa ssp. *falcata*	Yellow alfalfa	15(30)	17	15(19)	7	54(84)	64	Yes	Yes	Yes
Medicago sativa ssp. *sativa*	Alfalfa	13(30)	17	16	7	53(90)	59	Yes	Yes	Yes
Melilotus alba	White sweetclover	29	22	21	9	81	81	Yes	Yes	Yes
Melilotus officinalis	Yellow sweetclover	24	18	19	8	69	69	Yes	Yes	Yes
Mycelis muralis	Wall-lettuce	7	11(23)	8	4	30(98)	31	Yes	–	–
Myriophyllum spicatum †	Eurasian watermilfoil	38	20(22)	20	9	87(97)	90	Yes	Yes	Yes
Nymphaea odorata ssp. *odorata*	American white waterlily	36	18	18	6(7)	78(97)	80	Yes	–	–
Persicaria lapathifolia *	Curlytop knotweed	6	16	15(19)	7	44(94)	47	Yes	Yes	Yes
Persicaria maculosa *	Spotted ladysthumb	6	16	15(19)	7	44(94)	47	Yes	Yes	Yes
Phalaris arundinacea	Reed canarygrass	33	20	24	6	83	83	Yes	Yes	Yes
Phleum pratense	Timothy	14	14	19	7	56	54	Yes	Yes	Yes
Plantago major	Common plantain	8	13	16	7	44	44	Yes	Yes	Yes
Poa annua	Annual bluegrass	8	13	18	7	46	46	Yes	Yes	Yes
Poa compressa	Canada bluegrass	6	10	17	5(7)	38(97)	39	Yes	Yes	Yes
Poa pratensis ssp. *pratensis* *	Kentucky bluegrass	12	14	19	7	52	52	Yes	Yes	Yes
Poa pratensis ssp. *irrigata* *	Spreading bluegrass	12	14	19	7	52	52	Yes	Yes	Yes
Poa trivialis *	Rough bluegrass	12	14	19	7	52	52	Yes	Yes	Yes
Polygonum aviculare	Prostrate knotweed	7	15	16	7	45	45	Yes	Yes	Yes
Polygonum cuspidatum *	Japanese knotweed	33	21	23	7(7)	84(97)	87	Yes	Yes	–
Polygonum sachalinensis *	Giant knotweed	33	21	23	7(7)	84(97)	87	Yes	Yes	–
Polygonum X *bohemicum* *	Bohemian knotweed	33	21	23	7(7)	84(97)	87	Yes	Yes	–

† = Not known in AK (2006)

* = Congeneric species ranked together

[1] Invasiveness is equal to the Relative Maximum Score, which is equal to the sum of scores from each section divided by the total possible. See pages 10–11.

Climate matches to the three ecoregions of Alaska are included (Yes = present or high probability of establishing in the ecoregion, – = absent and low probability of establishment). Scores >80 = "Extremely Invasive", 70-79 = "Highly Invasive", 60-69 = "Moderately Invasive", 50-59 = "Modestly Invasive", 40-49 = "Weakly Invasive", and < 40 = "Very Weakly Invasive".

Plant species	Common name	Ecological Impact	Biological Characteristics	Distribution	Control	Total	Invasiveness[1]	South Coastal	Interior Boreal	Arctic Alpine
Potentilla recta †	Sulfur cinquefoil	20	13	17	7	57	57	Yes	Yes	–
Prunus padus	European bird cherry	31	21	17	5	74	74	Yes	Yes	–
Ranunculus acris *	Tall buttercup	16	13(23)	15	9	53(98)	54	Yes	Yes	Yes
Ranunculus repens *	Creeping buttercup	16	13(23)	15	9	53(98)	54	Yes	Yes	Yes
Rubus discolor	Himalayan blackberry	38	18	12	9	77	77	Yes	–	–
Rumex acetosella	Common sheep sorrel	12	16	16	7	51	51	Yes	Yes	Yes
Rumex crispus *	Curly dock	10	16	14	8	48	48	Yes	Yes	Yes
Rumex longifolius *	Dooryard dock	10	16	14	8	48	48	Yes	Yes	Yes
Rumex obtusifolius *	Bitter dock	10	16	14	8	48	48	Yes	Yes	Yes
Saponaria officinalis	Bouncingbet	5(30)	8(22)	12	2(3)	27(80)	34	Yes	Yes	–
Senecio jacobaea	Stinking willie	20	15	20	8	63	63	Yes	Yes	Yes
Senecio vulgaris	Old-man-in-the-Spring	4	12	15	5	36	36	Yes	Yes	Yes
Silene dioica *	Red catchfly	13	9	13	7	42	42	Yes	Yes	Yes
Silene latifolia *	Bladder campion	13	9	13	7	42	42	Yes	Yes	Yes
Silene noctiflora *	Nightflowering silene	13	9	13	7	42	42	Yes	Yes	Yes
Sonchus arvensis	Moist sowthistle	22	21	21	9	73	73	Yes	Yes	–
Sorbus aucuparia	European mountain ash	22	14	16	7	59	59	Yes	–	–
Spartina alterniflora * †	Smooth cordgrass	40	17	23	6	86	86	Yes	–	–
Spartina anglica * †	Common cordgrass	40	17	23	6	86	86	Yes	–	–
Spartina densiflora * †	Denseflower cordgrass	40	17	23	6	86	86	Yes	–	–
Spartina patens * †	Saltmeadow cordgrass	40	17	23	6	86	86	Yes	–	–
Spergula arvensis	Corn spurry	2	11	14	5	32	32	Yes	Yes	Yes
Stellaria media/non-seabird sites	Common chickweed	10	12	15	5	42	42	Yes	Yes	Yes
Stellaria media/sea bird colonies	Common chickweed	14	12	20	8	54	54	Yes	Yes	Yes
Tanacetum vulgare	Common tansy	20	15	13	8	56(98)	57	Yes	Yes	Yes
Taraxacum officinale ssp. *officinale*	Common dandelion	18	14	18	8	58	58	Yes	Yes	Yes
Tragopogon dubius	Yellow salsify	20	11	16	3	50	50	Yes	Yes	–
Trifolium hybridum	Alsike clover	22	12	18	5	57	57	Yes	Yes	Yes
Trifolium pratense	Red clover	16	12(22)	16	7	51(97)	53	Yes	Yes	Yes
Trifolium repens	White clover	22	15	14	8	59	59	Yes	Yes	Yes
Tripleurospermum perforata	Scentless false mayweed	13	13(23)	15	6	47(98)	48	Yes	Yes	Yes
Verbascum thapsus	Common mullien	20	9	16	7	52	52	Yes	Yes	–
Vicia cracca	Bird vetch	27	16	21	9	73	73	Yes	Yes	Yes
Vicia villosa	Winter vetch	22	11(22)	12(19)	3	48(91)	53	Yes	Yes	–
Zostera japonica †	Dwarf eelgrass	30	10	8	1(3)	49(93)	53	Yes	Yes	–

† = Not known in AK (2006)

* = Congeneric species ranked together

[1] Invasiveness is equal to the Relative Maximum Score, which is equal to the sum of scores from each section divided by the total possible. See pages 10–11.

Climate matches to the three ecoregions of Alaska are included (Yes = present or high probability of establishing in the ecoregion, – = absent and low probability of establishment). Scores >80 = "Extremely Invasive", 70-79 = "Highly Invasive", 60-69 = "Moderately Invasive", 50-59 = "Modestly Invasive", 40-49 = "Weakly Invasive", and < 40 = "Very Weakly Invasive".

Appendix B. Invasiveness Ranks of 113 non-native plants of Alaska.

Achillea ptarmica L. common name: sneezewort, Russian daisy

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	14
Biological Characteristics and Dispersal	25	12
Amplitude and Distribution	25	16
Feasibility of Control	3	2
Relative Maximum		47

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Achillea ptarmica has been collected in interior boreal and south coastal ecogeographic regions of Alaska (Hultén 1968, AKEPIC 2004, UAM 2004). This species is known to occur as far north in Europe as the northern province in Norway (Finnmark) at 70°N (Lid and Lid 1994). This region is recognized as having arctic tundra vegetation (CAFF Circumpolar Arctic Vegetation Map), therefore, it is possible for this taxon to establish in the arctic alpine ecoregion of Alaska

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 3
Ecosystem impacts are largely unknown. Sneezewort can occur in dense patches and would likely reduce nutrient, moisture, or light availability for other plant species (I. Lapina pers. obs.).

Impact on Natural Community Structure (0–10) — 3
This species appears to mildly increase the density of the herbaceous layer along roadsides in south-central Alaska (I. Lapina pers. obs.).

Impact on Natural Community Composition (0–10) — 3
It is unknown if sneezewort causes changes in native populations. This species can hybridize with native species of *Achillea* (Hurteau and Briggs 2003, Plants for a future 2002) and may pose a genetic risk. Current population sizes in Alaska are small and not particularly dense, suggesting the effects of its presence on individual native species is minor (I. Lapina pers. obs.).

Impact on Higher Trophic Levels (0–10) — 5
Sneezewort is a host for numerous aphid, nematode, virus, and fungi species (MacLachlan et al. 1996). It is pollinated by bees and flies (Andersson 1991, Plants for a future 2002), and its presence may alter local pollination ecology.

Total for Ecological Impact — 14/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3
Sneezewort reproduces by abundant seeds and branching rhizomes (Lid and Lid 1994).

Long-distance dispersal (0–3) — 0
Seeds lack pappus and are not dispersed long distances (Gubanov et al. 1995).

Spread by humans (0–3) — 2
This species is grown as an ornamental and has escaped cultivation (Welsh 1974).

Allelopathic (0–2) — 0
This species is not known to be allelopathic.

Competitive Ability (0–3) — 1
Sneezewort is a very vigorous plant. It can tolerate heat, cold, low soil fertility, and drought. It is likely to compete with native species for nutrient, soil, and water (MacLachlan et al. 1996).

Thicket-forming/Smothering growth form (0–2) — 0
This species is rhizomatous, but does not grow into impenetrable thickets (I. Lapina pers. obs.).

Germination requirements (0–3) — 0
Germination of *Achillea* species is improved by exposure to light (MacLachlan et al. 1996). This suggests that seed germination in established vegetation is less likely.

Other invasive species in the genus (0–3) — 3
Achillea filipendulina Lam. is an introduced and weedy species in Alaska (AKEPIC 2006).

Aquatic, wetland or riparian species (0–3) — 3
While rarely observed in riparian habitats in North America, this species is often associated with wet meadows, marshes, and streambanks in Europe (Gubanov et al. 1995).

Total for Biological Characteristics and Dispersal — 12/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 4
Sneezewort is grown as an ornamental and has escaped cultivation. A number of varieties have been bred (Gubanov et al. 1995, MacLachlan et al. 1996).

Known level of impact in natural areas (0–6) — 4
This species is known to have spread into meadows of northern Norway, but is only found occasionally (Lid and Lid 1994).

Role of anthropogenic and natural disturbance in establishment (0–5) — 1
Sneezewort occurs in the Matanuska–Susitna Valley along the forest edges and areas that have been disturbed decades ago (I. Lapina pers. obs.).

Current global distribution (0–5) — 5
Sneezewort is native to Central Europe; it is now widespread in North America and it is known from Tasmania (Csurhes and Edwards 1998). It is known to occur in arctic–subarctic regions of Scandinavia (Lid and Lid 1994).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) — 2
Sneezewort is known from 17 of the northern United States (USDA 2002). This species is not considered noxious in North America (Rice 2006).

Total for Ecological Amplitude and Distribution — 15/25

Feasibility of Control — Score

Seed banks (0–3) — U
No information is available on seed longevity.

Vegetative regeneration (0–3) — 2
This species is rhizomatous and is able to resprout (Lid and Lid 1994).

Level of effort required (0–4) — U
Unknown. It is difficult to assess the feasibility of eradicating this weed (Csurhes and Edwards 1998).

Total for Feasibility of Control — 2/3

Total score for 4 sections — 43/93

§

Alliaria petiolata (Bieb.) Cavara & Grande   common names: garlic mustard

Ranking Summary

Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		No
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	30	24
Biological Characteristics and Dispersal	25	16
Amplitude and Distribution	25	16
Feasibility of Control	10	7
Relative Maximum		70

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	No	No
Arctic Alpine	No	No

Garlic mustard has been collected in south coastal region, in downtown Juneau, (AKEPIC, 2004). Using the CLIMEX matching program, climatic similarity between Fairbanks and areas where the species is documented is very low. This is true for Nome as well. However, this taxon has been collected from Stockholm, Sweden (Natur Historiska Riksmuseet Database, 2004), which has a moderate climate match (57% similarity) with Anchorage, suggesting that establishment in south-central Alaska may be possible.

Ecological Impact — **Score**

Impact on Ecosystem Processes (0–10) — U

No information was found identifying impacts to ecosystem processes.

Impact on Natural Community Structure (0–10) — 10

Garlic mustard dramatically displaces native grasses, herbs, and tree seedlings (Blossey 2003, Blossey et al. 2002, Plant Conservation Alliance Alien Plant Working Group).

Impact on Natural Community Composition (0–10) — 7

Garlic mustard can completely dominate and displace native plants in the rich herbaceous understory layer (Nuzzo 2000).

Impact on Higher Trophic Levels (0–10) — 7

Garlic mustard appears to alter habitat suitability for native birds, mammals, and amphibians, and may affect populations of these species. Phytotoxic chemicals produced by *Alliaria petiolata* may interfere with growth of native species (Nuzzo 2000).

Total for Ecological Impact — 24/30

Biological Characteristics and Dispersal — **Score**

Mode of Reproduction (0–3) — 3

Plant produce an average of 136–295 seeds (Byers and Quinn 1998), and up to 2,421 seeds under lab conditions (Nuzzo 2000). Maximum production per plant is estimated at 7,900 seeds on a plant with 12 stems (Nuzzo 2000).

Long-distance dispersal (0–3) — 2

Seeds typically fall within a few meters of the plant. Wind dispersal is limited, and seeds do not float well, although seeds readily attach to moist surfaces. It may be dispersed by rodents, birds, and deer (Nuzzo 2000).

Spread by humans (0–3) — 3

Anthropogenic distribution appears to be the primary dispersal mechanism of *Alliaria petiolata*. Seeds are transported on boots, clothes, and hair, and by roadside mowing, automobiles, and trains (Nuzzo 2000). The species has medicinal properties (McGuffin 1997). This plant is an ingredient in several 'gourmet' recipes. At least one U.S. seed company (Canterbury Farms) offers *Alliaria petiolata* seeds for sale ($1.00/package) (Nuzzo 2000).

Allelopathic (0–2) — 2

Alliaria petiolata produces several phytotoxic chemicals that may interfere with native plant species. The roots contain sinigrin and glucotopaeolin (Nuzzo 2000).

Competitive Ability (0–3) — 3

Garlic mustard outcompetes native herbaceous species for light, moisture, nutrient, and space (Rowe and Swearingen 2003). Experiments demonstrated that seedlings of chestnut and oak had reduced growth when grown with *Alliaria petiolata* (Nuzzo 2000).

Thicket-forming/Smothering growth form (0–2) — 0

Grows from 1 to 4 feet tall (Nuzzo 2000, Wisconsin DNR 2004). Although aggressive, this taxon does not have a smothering growth habit

Germination requirements (0–3) — 3

Seeds can remain dormant for 20 months (Blossey 2003). Cold stratification is necessary for germination. Germinates well in intact woodland communities (Wisconsin DNR 2004). Can germinate in both light and dark after dormancy is broken (Byers 1988, Bloom et al. 1990). Exposed soil caused by deer trampling has been suggested to facilitate spread of the species (Blossey 2003), but garlic mustard is capable of germinating in the absence of exposed soil.

Other invasive species in the genus (0–3) — 0

Alliaria petiolata is the only species of the genus *Alliaria* in North America. (Blossey et al. 2002, USDA 2002).

Aquatic, wetland or riparian species (0–3) — 0

Alliaria petiolata formerly considered a plant of flood plains and moist woods has become common in drier and more open habitats (Byers and Quinn 1987). It occurs in forest edges, hedgerows, shaded roadsides, and urban areas, and occasionally in full sun (Nuzzo 2000).

Total for Biological Characteristics and Dispersal — 16/25

Ecological Amplitude and Distribution — **Score**

Highly domesticated or a weed of agriculture (0–4) — 0

Alliaria petiolata is a weed of natural areas (Blossey et al. 2002). Although used in cooking and medicines, this taxon in not domesticated or associated with agriculture.

Known level of impact in natural areas (0–6) — 4

Garlic mustard is common in low-quality forests in central Pennsylvania (Nuzzo 2000) and less frequent in isolated woodlots in central Indiana (Brothers and Springarn 1992). It is rarely found under coniferous trees in the Midwest, but has been reported from under seven species of coniferous trees in Ontario. Garlic mustard is most frequently recorded from moist, usually riverine, habitat and waste ground in Kansas and Oklahoma (Nuzzo 2000).

Role of anthropogenic and natural disturbance in establishment (0–5)	4
Alliaria petiolata is disturbance adapted and frequently in sites subjected to continued or repeated disturbance (Luken et al. 1997, Pyle 1995). Byers and Quinn (1998) found that garlic mustard resource allocation was greatest in the most disturbed site. Continued disturbance promotes greater seed production which in turn promotes larger populations. In the absence of disturbance, garlic mustard gradually declines to a low stable level (Nuzzo 2000).	
Current global distribution (0–5)	3
Native to Europe, *Alliaria petiolata* also occurs in North Africa, India, Sri Lanka, New Zealand, and North America.	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Alliaria petiolata is considered to be noxious in Alabama, Minnesota, Vermont, and Washington (Invaders Database System 2003).	
Total for Ecological Amplitude and Distribution	**16/25**

Feasibility of Control	Score
Seed banks (0–3)	2
A small percentage of seed remains viable in the seed bank for up to 4 years (Byers and Quinn 1998, Nuzzo 2000).	
Vegetative regeneration (0–3)	2
Garlic mustard can resprout after removal of aboveground biomass (Wisconsin DNR 2004).	
Level of effort required (0–4)	3
Once garlic mustard is established, the management goal is to prevent seed production until the seed bank is exhausted. This requires post removal management over several growing seasons. Many successful control regimes involve a combination of spring burning, hand pulling, and herbicide treatment. Monitoring once or twice annually for garlic mustard presence is required. After 3 years of hand pulling of an infestation in Juneau, the plants are flowering earlier and at shorter heights (Raymond E. Paddock pers. com.).	
Total for Feasibility of Control	**7/10**
Total score for 4 sections	**63/90**

§

Alnus glutinosa (L.) Gaerth. common name: European alder, black alder, European black alder

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	24
Biological Characteristics and Dispersal	40	16
Amplitude and Distribution	25	14
Feasibility of Control	7	5
Relative Maximum		**61**

Climatic Comparison		
	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	No	Yes
Interior Boreal	No	Yes
Arctic Alpine	No	Yes

Alnus glutinosa has not been collected in Alaska (Hultén 1968, Welsh 1974, AKEPIC 2004, UAM 2004). Using the CLIMEX matching program, climatic similarity between Juneau and areas where *Alnus glutinosa* is documented is high. Native range of the species includes Bergen, Kristiansand, and Kråkenes (Lid and Lid 1994), which has 73%, 60%, and 55% climatic matches with Juneau, respectively. The range of this species also includes Røros and Dombås, Norway, which have 76% and 63% climatic matches with Nome, and 55% and 52% climatic matches with Fairbanks, respectively. Thus, establishment of *Alnus glutinosa* in south coastal, interior boreal, and arctic alpine ecogeographic regions may be possible.

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	7
European alder is a pioneer species capable of colonizing exposed soil. It produces copious litter and fixes nitrogen, thereby altering soil conditions (Funk 2005, USDA 2002). European alder produces biomass abundantly. Six-year-old European alder produced more than 6 times the volume of litter per tree compared to native trees of the same age. Alder leaf litter decomposes easily, which quickly increases soil fertility (Funk 2005).	
Impact on Natural Community Structure (0–10)	5
European alder colonizes bare ground and creates an initial layer of vegetation (Funk 2005, McVean 1953).	
Impact on Natural Community Composition (0–10)	5
European alder is capable of creating a pure stands in its native range. In North America it is usually present in association with willow (McVean 1953).	
Impact on Higher Trophic Levels (0–10)	7
European alder has been found associated with nitrogen-fixing Frankia (Hall et al. 1979). A portion of this fixed nitrogen becomes available for other species. European alder provides food for deer, rabbits, hares, and several bird species. Dozens of insects and diseases have been observed in association with European alder but few cause serious damage. European alder hybridizes readily with many other alders, particularly with *Alnus incana* and *A. rubra*. Establishment of European alder leads to increases in earthworm population which, via bioturbation increase the rate of soil development (Funk 2005, McVean 1953).	
Total for Ecological Impact	**24/40**

Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	3
European alder reproduces almost entirely by seed. The average number of seeds per catkin is 60, the number of female catkins is estimated to be about 4,000 per tree; thus a single tree could produce a total of 24,000 seeds. Root suckers are rare. Fallen green branches beginning to take root in soft swamp mud have been observed in Britain (McVean 1953).	
Long-distance dispersal (0–3)	3
Fruits float, therefore, are efficiently dispersed by flowing water and wind drift over standing water. Dispersal by birds is possible although seeds are generally split open and the embryo consumed. Wind dispersal occurs but is not very effective (McVean 1953). The fruits of European alder are small and light. They possess two lateral flat corky outgrowths and an oily, water-resistant coat. They can float for over 12 months in still water (McVean 1955).	
Spread by humans (0–3)	2
European alder has been recommended for planting for coal mine remediation (Funk 2005). It has escaped from reclaimed mine soils and now grows naturally in surrounding areas. There are numerous horticultural varieties in cultivation in Britain but none have been released in the United States (USDA 2002).	
Allelopathic (0–2)	0
European alder is not listed as an allelopathic (USDA 2002).	
Competitive Ability (0–3)	1
European alder is capable of competing with willow, larch, poplar, and birch. Pure alder stands can form, although other species colonize simultaneously (Funk 2005, McVean 1956). European alder possesses an extensive root system, which enables it to survive in waterlogged soils (McVean 1955) and access deep-lying soil moisture. In Europe, alder is considered to be the deepest rooting tree species and more shade tolerant than willow, larch, poplar, and birch (Funk 2005).	
Thicket-forming/Smothering growth form (0–2)	2
European alder is a shrub or tree that reaches heights up to 60–70 feet. Pure stands are common its native range; in its introduced range it often occurs in thickets with willows (McVean 1953).	
Germination requirements (0–3)	2
European alder can germinate in light or darkness, but successful establishment of seedlings requires relatively high light intensity (McVean 1953). Germination of alder seeds may be depressed by the presence of tannins in alder litter (McVean 1955).	
Other invasive species in the genus (0–3)	0
No other weedy alder species are known (USDA 2002).	
Aquatic, wetland or riparian species (0–3)	3
The native habitat of European alder is stream and lakesides (Gubanov et al. 2003, McVean 1953).	
Total for Biological Characteristics and Dispersal	**16/25**

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	0
European alder is not domesticated and or known as an agricultural weed (Funk 2005, McVean 1953).	
Known level of impact in natural areas (0–6)	3
European alder has invaded forests and wetlands in Wisconsin (Wisconsin DNR 2004). European alder has been naturalized in Tennessee and has the potential to become a problem in the future (SE-EPPC 2001).	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
European alder is a pioneer species readily colonizing open ground. Natural and humanmade disturbances might promote infestation. In particular, grazing may favor the spread of trees by reducing the shading and smothering effect of tall vegetation on the seedlings, and breaking the turf and litter mat (McVean 1953).	
Current global distribution (0–5)	3
European alder has a broad natural range that includes most of Europe except the Arctic and extends into North Africa and Asia. The species is naturalized throughout the Northeastern United States and Maritime Canada (Funk 2005, McVean 1953).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
European alder is naturalized throughout the Northeastern United States and Maritime Canada (Funk 2005, McVean 1953). This species considered invasive in Tennessee and Wisconsin (SE-EPPC 2001, USDA 2002, Wisconsin DNR 2004).	
Total for Ecological Amplitude and Distribution	**14/25**

Feasibility of Control	**Score**
Seed banks (0–3)	U
In study by McVean (1955), seeds were viable after three winters of storage in stoppered bottles at room temperature. Longevity of seeds buried in the soil is unknown.	
Vegetative regeneration (0–3)	2
European alder commonly sprouts from the stump after cutting or burning (Funk 2005, McVean 1953). Fallen green branches have been observed to take root in soft mud (McVean 1953).	
Level of effort required (0–4)	3
Mechanical or chemical methods are acceptable for European alder control (USDA 2002).	
Total for Feasibility of Control	**5/7**
Total score for 4 sections	**59/97**

§

Anthemis cotula L. common names: stinking chamomile, dog fennel, mayweed

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	8
Biological Characteristics and Dispersal	25	12
Amplitude and Distribution	25	14
Feasibility of Control	10	7
Relative Maximum		41

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	No

Anthemis cotula has been collected in south coastal and interior boreal ecogeographic regions of Alaska (Hultén 1968, Welsh 1974, AKEPIC 2004, UAM 2004). Using the CLIMEX matching program, climatic similarity between Nome and areas where the species is documented is high. Species range includes Røros, Norway (Lid and Lid 1994), which has a 76% climatic match with Nome. However, mayweed chamomile is known mostly from areas with July mean temperatures above 60 °F (Kay 1971). These conditions are unlikely to occur in the arctic alpine ecogeographic region (WRCC 2005). Thus establishment of *Anthemis cotula* in arctic alpine Alaska is predicted to not be possible.

Ecological Impact — **Score**

Impact on Ecosystem Processes (0–10) — 1

Though mayweed chamomile has not been reported from undisturbed areas (Kay 1971, Roberts and Neilson 1981, UAM 2004, Whitson et al. 2000), it may retard succession after sites have been invaded.

Impact on Natural Community Structure (0–10) — 1

Mayweed chamomile typically grows in large numbers and can change the density of the layer on cultivated fields or ruderal sites. It is not known from undisturbed plant communities (Kay 1971).

Impact on Natural Community Composition (0–10) — 1

Mayweed chamomile has not been observed in undisturbed areas in Alaska (Hultén 1968, AKEPIC 2004) and no impact on native populations has been documented (Kay 1971, Roberts and Neilson 1981, Whitson et al. 2000).

Impact on Higher Trophic Levels (0–10) — 5

Mayweed chamomile is unpalatable to grazing animals. The flowers are visited and pollinated mainly by syrphid flies and other Diptera. Hybrids with *Tripleurospermum perforata* and *Anthemis tinctoria* have been recorded. Weevils, aphids, spittlebugs, bugs, moths, slugs, and snails have been reported to feed on mayweeds, causing serious damage to achenes and vegetative parts of plants (Erneberg 1999). This plant can be seriously infected by fungi (Kay 1971). Mayweed chamomile is potentially allelopathic to certain forage species (Smith 1990).

Total for Ecological Impact — 8/40

Biological Characteristics and Dispersal — **Score**

Mode of Reproduction (0–3) — 3

The number of seeds produced by a plant varies widely depending on the soil fertility and the intensity of competition. Plants of average size are capable of producing from 550 to 12,000 achenes. The largest plant observed at the experimental site in Britain had a reproductive capacity of 27,000 achenes (Kay 1971).

Long-distance dispersal (0–3) — 0

The achenes of mayweed chamomile lack any structural adaptations for dispersal (Kay 1971).

Spread by humans (0–3) — 3

Mayweed chamomile seed can easily contaminate grass seeds. Achenes remaining on the plant may be dispersed some distance with hay. They may also be dispersed on footwear and clothes, in mud and soil adhering to agricultural equipment, and the feet of farm animals (Kay 1958, USDA ARS 2005).

Allelopathic (0–2) — 2

Mayweed chamomile is potentially allelopathic to certain forage species (Smith 1990). Mayweed chamomile leaf-tissue extract resulted in 50% reduction in Italian ryegrass and alfalfa seed germination. Tissue extracts also influenced Italian ryegrass and alfalfa seedlings growth (Smith 1999).

Competitive Ability (0–3) — 1

Mayweed chamomile is able to compete with crop species (cf. Kay 1971, Matthews 1972, Ogg et a. 1993). It is suggested to be declining in abundance following its introduction in Denmark 500 years previously, due in part to reduced competitive ability (Erneberg 1999). It is a serious weed problem in nonirrigated fields in the Pacific Northwest (Kells 1989) and it can form monocultures to the exclusion of pasture species (Matthews 1972). Ogg et al. (1993) describe the species as having only a slight impact on pea yield when comprising less than 50% of the total plants.

Thicket-forming/Smothering growth form (0–2) — 0

Mayweed chamomile typically grows in large numbers and can change the density of the layer on cultivated fields or ruderal sites. It does not form thickets and does not have a climbing growth habit (Smith 1987, Douglas et al. 1998, Whitson 2000).

Germination requirements (0–3) — 0

Mayweed chamomile is a weed of cultivated fields and is known only germinating on disturbed soils (Gealy et al. 1985, Gealy et al. 1994, Kay 1971, Roberts and Neilson 1981).

Other invasive species in the genus (0–3) — 3

Anthemis arvensis L. considered a weed in Colorado (USDA 2002)

Aquatic, wetland or riparian species (0–3) — 0

Mayweed chamomile is commonly found in cereal crops, waste areas, farm yards, overgrazed pastures, and along roadsides (Kay 1971, Roberts and Neilson 1981, Whitson et al. 2000)

Total for Biological Characteristics and Dispersal — 12/25

Ecological Amplitude and Distribution	Score
Highly domesticated or a weed of agriculture (0–4) Mayweed chamomile is a long-established weed of arable land in Britain. Its achenes have been found in archaeological material dated to medieval times. The fact that Anglo-Saxon farmers were the first to cultivate the heavy soils favoring mayweed chamomile, suggest that it may have become an important agricultural weed in Britain during Anglo-Saxon times (Kay 1958). Mayweed chamomile has become the most important weed in agriculture (Ivens 1979).	4
Known level of impact in natural areas (0–6) Mayweed chamomile is not known to cause an impact on any natural areas.	0
Role of anthropogenic and natural disturbance in establishment (0–5) Kay (1971) suggested that stinking chamomile does not grow in undisturbed habitats. Seedling establishment is slow and readily crowded out by competing plants on vegetated sites. Mayweed chamomile grows best in open conditions (Ivens 1979). This species has been encountered only on disturbed sites in Alaska (AKEPIC 2004, Hultén 1968, Kay 1971, Welsh 1974).	0
Current global distribution (0–5) Mayweed chamomile is native to the Mediterranean region, but has been widely introduced as a weed in the temperate zone. Its European distribution extends to southern Norway, central Sweden and southern Finland. Its southern extent includes the Canary Islands, Egypt, and Western Asia. This species has been introduced to the United States, Canada, Argentina, Australia, and New Zealand (Hultén 1968, Ivens 1979, Kay 1957, USDA ARS 2005).	5
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) Mayweed chamomile occurs in nearly all states of the United States. It is declared a noxious weed in Colorado and Nevada (USDA 2002).	5
Total for Ecological Amplitude and Distribution	**14/25**

Feasibility of Control	Score
Seed banks (0–3) Up to 6.7% of seeds remained viable in the soil after 5 year of sown in study by Roberts and Neilson (1981). Chippindale and Nilton (1934) suggested 6 years seed viability for mayweed chamomile. Salzmann (1954, cited in Kay 1971) obtained 63% germination after 1 year of burial in the soil, 68% germination after 3 years and only 6% after 11 years. Viability of seeds was recorded up to 30 years after burial (Darlington and Steinbauer 1961).	3
Vegetative regeneration (0–3) Mayweed chamomile can produce vigorous new shoots from the undamaged lower parts of the plant after cutting (Kay 1971).	2
Level of effort required (0–4) Combinations of rotation grazing and herbicides treatment are the best methods of successful control of mayweed chamomile (Ivens 1979). This weed is known to be resistant to a number of herbicides.	2
Total for Feasibility of Control	**7/10**
Total score for 4 sections	**41/100**

§

Brachypodium sylvaticum (Huds.) Beauv. — common names: false brome, slender false brome

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	31
Biological Characteristics and Dispersal	23	19
Amplitude and Distribution	25	14
Feasibility of Control	10	5
Relative Maximum		70

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	No	Yes
Interior Boreal	No	Yes
Arctic Alpine	No	Yes

Brachypodium sylvaticum has not been documented in Alaska (Hultén 1968, Welsh 1974, AKEPIC 2004, UAM 2004). Using the CLIMEX matching program, climatic similarity between Juneau and areas where the species is documented is high. False brome is common along the coastal region of Norway, including the area around Bergen, which has a 73% similarity with Juneau. This suggests that there are likely no abiotic limitations to its establishment in south coastal Alaska. Range of the species includes Kirov and Kazan, Russia (Gubanov et al. 1995), which has a 66%, and 58% climatic match with Nome, and 60% and 59% climatic match with Fairbanks respectively. Thus establishment of *Brachypodium sylvaticum* in interior boreal and arctic alpine ecogeographic regions may be possible. However, this species does not range into alpine or arctic regions of Scandinavia (Lid and Lid 1994).

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 7
False brome hinders tree reestablishment, altering natural successional processes. It also has the potential to change fire regimes and to impact riparian and stream habitats (Kaye 2001, Tu 2002). False brome reduces riparian tree growth, shading, and stream structure (Kaye 2001)

Impact on Natural Community Structure (0–10) — 7
False brome can become dominant in the understory of forests, forming nearly monospecific stands (Kaye 2001, Tu 2002). This species may limit establishment of shrubs and trees (Kaye 2001, Tu 2002)

Impact on Natural Community Composition (0–10) — 9
False brome appears to outcompete and completely exclude native forbs and grasses. It also inhibits establishment of tree seedlings (Kaye 2001, Tu 2002).

Impact on Higher Trophic Levels (0–10) — 8
False brome may be unpalatable to wildlife. It reduces the quality of habitat for mammals, native insects, birds, and even fish (Kaye 2001, Tu 2002).

Total for Ecological Impact — 31/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 2
False brome reproduces rapidly from seed, but does not form creeping rhizomes (Kaye 2001, Tu 2002).

Long-distance dispersal (0–3) — 2
Seeds can be dispersed by wildlife species (Kaye 2001).

Spread by humans (0–3) — 3
Seeds of false brome disperse on vehicles, boots, clothes, and forestry equipment. It appears to initially disperse along roadsides, and then move out into undisturbed areas and clearcuts (Kaye 2001). False brome is also occasionally cultivated for ornamental purposes (Hitchcock and Cronquist 1973).

Allelopathic (0–2) — U
There is no data concerning allelopathy.

Competitive Ability (0–3) — 3
False brome appears to outcompete and completely exclude native forbs and grasses (Tu 2002). The species has ability to tolerate a wide range of habitats. It can be found growing in sun or shade, in dry or moist areas (Cal-IPC 2005, Kaye 2001). Davies and Long (1991) suggested the existence of two distinct morphological types within populations of the species that are adapted to different types of environmental conditions.

Thicket-forming/Smothering growth form (0–2) — 2
Individual bunches increase in size, eventually uniting to form a solid mat 12–18 inches high that overwhelms smaller plants (Cal-IPC 2005)

Germination requirements (0–3) — 3
False brome has been observed germinating in completely vegetated natural areas (Kaye 2001).

Other invasive species in the genus (0–3) — 3
Brachypodium distachyon (L.) Beauv. is listed as an invasive plant in California (USDA 2002).

Aquatic, wetland or riparian species (0–3) — 1
In its native range false brome is most commonly found in forests and woodlands, but may occur in open habitats (Gubanov et al. 1995). False brome is well-established in closed-canopy coniferous forest in western Oregon, often growing along riparian margins (Hitchcock and Cronquist 1973, Kaye 2001).

Total for Biological Characteristics and Dispersal — 19/23

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 0
False brome is not known as a weed of agriculture.

Known level of impact in natural areas (0–6) — 4
False brome is rapidly invading coniferous forest in western Oregon, where it excludes native forbs and grasses, and inhibits establishment of tree seedlings (Kaye 2001).

Role of anthropogenic and natural disturbance in establishment (0–5) — 3
It likely requires disturbance for initial establishment, but once a population is established it can easily penetrate undisturbed forests (Kaye 2001).

Current global distribution (0–5) — 3
False brome is native to North Africa, Northern and Mediterranean Europe, and Asia (Hitchcock and Cronquist 1973). It has been documented as a part of early successional grassland from Japan (Werger et al. 2002). In North America it is known only from Oregon (Kaye 2001, USDA 2002).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) — 4
In North America it is officially known only from Oregon, where it is considered to be a noxious weed (Kaye 2001, USDA 2002).

Total for Ecological Amplitude and Distribution — 14/25

Feasibility of Control	Score
Seed banks (0–3)	0
Seeds remain viable in the soil for less than 1 year (Tu 2002). In a study in Oregon seed viability dropped to less than 2% after 2 years in the soil (Thomas Kaye pers. com.).	
Vegetative regeneration (0–3)	2
False brome can resprout from a small stem or root fragments when cut. It is fire tolerant and is able to resprout within 2 weeks after a burn (Cal-IPC 2005, Kaye 2002).	
Level of effort required (0–4)	3
Removal of the entire plant by digging is effective for small infestations, but is extremely time and labor-intensive. Repeated mowing, grazing, or burning may eliminate seed production. Herbicides can be applied late in the season after most other species are dormant (Kaye 2001, Tu 2002).	
Total for Feasibility of Control	**5/10**
Total score for 4 sections	**69/98**

§

Bromus inermis ssp. *inermis* Leyss. common names: smooth brome

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	20
Biological Characteristics and Dispersal	25	16
Amplitude and Distribution	25	18
Feasibility of Control	10	8
Relative Maximum		**62**

Climatic Comparison	*Collected in Alaska regions?*	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Bromus inermis ssp. *inermis* has been reported from all ecoregions of Alaska (Hultén 1968, Densmore et al. 2001).

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	5
Smooth brome may inhibit natural succession processes (Densmore et al. 2001, Rutledge and McLendon 1996).	
Impact on Natural Community Structure (0–10)	5
Establishes in an existing layer, increasing the density of the layer and reducing the density of shorter herbaceous layers (I. Lapina and M.L. Carlson pers obs.).	
Impact on Natural Community Composition (0–10)	5
It forms a dense sod that may eliminate other species, thus contributing to the loss of species diversity in natural areas (Butterfield et al. 1996, Rutledge and McLendon 1996). In recent years *Bromus inermis* has largely replaced *B. pumpellianus* and certain other native species (Elliott 1949).	
Impact on Higher Trophic Levels (0–10)	5
Smooth brome has high palatability for grazing animals (USDA 2002). It is an alternate host for the viral diseases of crops (Sather 1987, Royer and Dickinson 1999). In southern Alaska hybrid swarms with *B. inermis* ssp. *pumpelliana* occur (Elliott 1949, Hultén 1968).	
Total for Ecological Impact	**20/40**

Biological Characteristics and Dispersal	Score
Mode of Reproduction (0–3)	3
Bromus inermis reproduces by rhizomes and seeds. The number of seeds produced has a very wide range. Each plant is capable of producing 156–10,080 viable seeds (Butterfield et al. 1996, Sather 1987). In studies by McKone (1985) *Bromus inermis* had significantly lower average seed set (17.2 per plant). Reproductive potential in Alaska is unknown.	
Long-distance dispersal (0–3)	1
Seeds may be transported short distances by wind and ants (Rutledge and McLendon 1996, Sather 1987).	
Spread by humans (0–3)	3
Smooth brome, often planted as a forage crop, persists after cultivation and infests surrounding vegetation. It is spread when soil containing rhizomes is moved (Densmore et al. 2001).	
Allelopathic (0–2)	0
There is no known allelopathy potential. (USDA 2002).	
Competitive Ability (0–3)	2
Smooth brome is a highly competitive weed in agricultural fields (Butterfield et al. 1996). In Alaska its competitiveness is largely restricted to sunny sites with nutrient rich mesic soils (J. Conn pers. com.).	
Thicket-forming/Smothering growth form (0–2)	2
It forms a dense sod that often excludes other species (Butterfield et al. 1996, Rutledge and McLendon 1996). Stands are very dense and often greater than 1 m tall (M.L. Carlson pers. obs.)	
Germination requirements (0–3)	2
Butterfield et al. (1996) suggests this species establishes in undisturbed or lightly disturbed areas, while Densmore et al. (2001) indicate it requires open soil and disturbance for germination.	
Other invasive species in the genus (0–3)	3
Bromus arenarius Labill., *B. briziformis* Fischer and C. Meyer, *B. diandrus* Roth, *B. japonicus* Thunb. ex Murr., *B. hordeaceus* L., *B. madritensis* L., *B. secalinus* L., *B. stamineus* Desv., *B. sterilis* L., *B. tectorum* L., and *B. trinii* Desv. (Wilken and Painter 1993, Royer and Dickinson 1999, USDA 2002).	
Aquatic, wetland or riparian species (0–3)	0
Smooth brome is a weed of roadsides, forests, prairies, fields, lawns, and lightly disturbed sites (Butterfield et al. 1996, Rutledge and McLendon 1996).	
Total for Biological Characteristics and Dispersal	**16/25**

Ecological Amplitude and Distribution	Score
Highly domesticated or a weed of agriculture (0–4)	4
It is widely planted as a forage species in Alaska—*Bromus inermis* has been widely planted as a pasture and forage crop and for revegetation along roadsides and along pipeline corridors (Densmore et al. 2001).	
Known level of impact in natural areas (0–6)	3
Bromus inermis appears to be invading native prairie from roadsides in Wisconsin and other states (Sather 1987, WDNR 2003). It is found in mid-successional sites in Iowa and Nebraska. In Minnesota smooth brome is found in late successional sites that were disturbed over 50 years ago, but it may spread vegetatively into undisturbed areas (Butterfield et al 1996).	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
Smooth brome can establish in undisturbed or lightly disturbed areas (Butterfield et al. 1996). In Alaska its distribution is largely restricted to areas of substrate disturbance (I. Lapina pers. obs., M.L. Carson pers. obs.).	
Current global distribution (0–5)	3
Distribution range of smooth brome includes Europe, temperate Asia, and North America (USDA, ARS 2004).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Found throughout United States and Canada, except in the southeastern states (Royer and Dickinson 1999, USDA 2002). Listed as a weed in Tennessee (Royer and Dickinson 1999). The species is not considered noxious in North America (Invaders Database System 2003, USDA 2002).	
Total for Ecological Amplitude and Distribution	**18/25**

Feasibility of Control	Score
Seed banks (0–3)	3
Studies report a range of seeds longevity of 2–10 years (Butterfield et al. 1996, Rutledge and McLendon 1996).	
Vegetative regeneration (0–3)	2
Plants may regrow after cutting (Densmore et al. 2001, Rutledge and McLendon 1996).	
Level of effort required (0–4)	3
Cultural, chemical, and mechanical control methods have all been used in agriculture (Butterfield et al. 1996, Rutledge and McLendon 1996). Unfortunately, most current control techniques are not effective in natural communities (J. Conn pers. com.).	
Total for Feasibility of Control	8/10
Total score for 4 sections	62/100

§

Bromus tectorum L. common names: cheatgrass, downy brome

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	34
Biological Characteristics and Dispersal	25	15
Amplitude and Distribution	25	23
Feasibility of Control	10	6
Relative Maximum		**78**

Climatic Comparison	*Collected in Alaska regions?*	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Bromus tectorum has been collected in south coastal [Juneau and Kodiak] (Hultén 1968), interior boreal [Anchorage (UAM 2003) and Dawson (Hultén 1968)], and arctic alpine [Nome] (Hultén 1968) ecoregions in Alaska.

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	10
Cheatgrass infestations close communities to the establishment of the seedlings of perennial herbaceous species. It also changes the frequency and timing of wildfires in native communities (Carpenter and Murray 2005). Infestations of cheatgrass alter soil nutrient dynamics (Blank and Young 2004).	
Impact on Natural Community Structure (0–10)	10
Cheatgrass forms a monoculture, creating a new layer in the community (Carpenter and Murray 2005).	
Impact on Natural Community Composition (0–10)	7
Cheatgrass closes communities to the establishment of native perennial herbaceous species, causing a reduction in the biodiversity of the natural community (Warner et al. 2003).	
Impact on Higher Trophic Levels (0–10)	7
The sharp spikelets and rough awns damage the mouth and eyes of livestock. The effects on native game species are unknown. Cheatgrass is an alternate host for over 20 viruses (Carpenter and Murray 2005, Royer and Dickinson 1999).	
Total for Ecological Impact	**34/40**

Biological Characteristics and Dispersal	Score
Mode of Reproduction (0–3)	1
Cheatgrass establishes by seeds only. Seed production capacity can be over 300 seeds per plant (Butterfield et al. 1996, Rutledge and McLendon 1996, Warner et al. 2003). Stevens (1957) reported seed production of 700 per plant.	
Long-distance dispersal (0–3)	3
Cheatgrass can be spread by wind and by attachment to animal fur (Warner et al. 2003). Caryopses are hairy and sharp pointed.	
Spread by humans (0–3)	3
Cheatgrass spreads through attaching to human clothing and along transportation corridors such as highways and railroads. It also contaminates grain seed, hay, straw, and soil (Warner et al. 2003).	
Allelopathic (0–2)	0
Cheatgrass has not been recorded as an allelopathic.	
Competitive Ability (0–3)	3
Cheatgrass is highly competitive with perennial grasses for soil moisture and nutrients (Carpenter and Murray 2005).	
Thicket-forming/Smothering growth form (0–2)	0
Cheatgrass tends to form dominant stands (Carpenter and Murray 2005).	

Germination requirements (0–3)	2
Seeds require fall, winter, or early spring moisture to germinate. It germinates best in the dark or in diffuse light, and readily germinates under a wide range of temperatures. Optimal germination occurs in the top 2.5 cm of soil and no emergence occurs from seeds buried 4 inches below the surface (Anderson 1996, Mack and Pyke 1983, Warner et al. 2003).	
Other invasive species in the genus (0–3)	3
Bromus commutatus Schrad., *B. hordeaceus* L., *B. inermis* Leyss., and *B. secalinus* L.	
Aquatic, wetland or riparian species (0–3)	0
Cheatgrass is common in pastures, rangeland, winter crops, sand dunes, shrub–steppe areas, roadsides, and waste places (Carpenter and Murray 2005, Royer and Dickinson 1999).	
Total for Biological Characteristics and Dispersal	**15/25**

Ecological Amplitude and Distribution	Score
Highly domesticated or a weed of agriculture (0–4)	4
Cheatgrass is a weed of croplands, especially winter wheat and alfalfa (Royer and Dickinson 1999).	
Known level of impact in natural areas (0–6)	6
Cheatgrass forms dominant stands in sagebrush rangelands, juniper, and pine woodlands, less commonly in aspen and conifer communities [Colorado and California] (Rutledge and McLendon 1996, Warner et al. 2003). It has invaded undisturbed grassland communities in eastern Washington, Idaho, eastern Oregon, Nevada, and Utah (Carpenter and Murray 2005).	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
Disturbance, typically heavy grazing, allows cheatgrass to invade and proliferate in plant communities (Carpenter and Murray 2005, Warner et al. 2003).	
Current global distribution (0–5)	5
Originally from the Mediterranean region and Eurasia, cheatgrass has spread throughout Europe, southern Russia, west Central Asia, North America, Japan, South Africa, Australia, New Zealand, Iceland, and Greenland. Populations have established in northern Norway, Iceland, and Greenland (Carpenter and Murray 2005, Warner et al. 2003).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Bromus tectorum is listed as a noxious weed in Colorado, Alberta, Manitoba, and Saskatchewan (Invaders Database System 2003, Royer and Dickinson 1999, USDA, NRCS 2002).	
Total for Ecological Amplitude and Distribution	**23/25**

Feasibility of Control	Score
Seed banks (0–3)	2
Seeds remain viable in the soil for 2–5 years (Burnside et al. 1996, Carpenter and Murray 2005, Chepil 1946).	
Vegetative regeneration (0–3)	0
Cheatgrass has no ability to resprount after removal of aboveground growth (Carpenter and Murray 2005, Warner et al. 2003).	
Level of effort required (0–4)	4
Control of cheatgrass requires a combination of chemical, mechanical methods, and proper livestock management. Native perennial grasses should be seeded after treatment. Monitoring is also recommended for a few years after treatment (Carpenter and Murray 2005).	
Total for Feasibility of Control	**6/10**
Total score for 4 sections	**78/100**

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Campanula rapunculoides L.

common names: creeping bellflower

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	18
Biological Characteristics and Dispersal	25	16
Amplitude and Distribution	25	20
Feasibility of Control	7	5
Relative Maximum		**64**

Climatic Comparison	*Collected in Alaska regions?*	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	No	Yes
Arctic Alpine	No	Yes

Campanula rapunculoides has been collected in Anchorage and Cordova (UAM 2004). The native range of creeping bellflower includes Røros and Dombås, Norway (Lid and Lid 1994), which has a 55% and 52% of climatic match with Fairbanks and 76% and 63% of climatic match with Nome (CLIMEX 1999). These suggest that establishment of creeping bellflower in interior boreal and arctic alpine ecogeographic regions of Alaska may be possible.

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	3
Creeping bellflower likely reduces soil moisture and nutrients (Royer and Dickinson 1999).	
Impact on Natural Community Structure (0–10)	5
Creeping bellflower is able to form dense thickets (Gubanov et al. 2004). This species forms ground cover in mixed birch–spruce forest in Anchorage parks. It also was observed interfering with raspberry stands (M. Rasy pers. obs.).	
Impact on Natural Community Composition (0–10)	7
Creeping bellflower is able to reduce numbers of individuals of co-occurring species, especially grasses (Lewis and Lynch 1998).	
Impact on Higher Trophic Levels (0–10)	3
The flowers of creeping bellflower are pollinated by bees, flies, beetles, moths, and butterflies. It is noted that creeping bellflower rarely if ever damaged by browsing animals (Plants For A Future 2004).	
Total for Ecological Impact	**18/40**

Biological Characteristics and Dispersal	Score
Mode of Reproduction (0–3)	3
Creeping bellflower reproduces by creeping rhizomes and by seeds. Each plant may produce 3,000–15,000 seeds annually (Gubanov et al. 2004, Whiston et al. 2000, Royer and Dickinson 1999).	

Long-distance dispersal (0–3)	3
Seeds spread by wind because of their light weight and small wings (Gubanov et al. 2004).	
Spread by humans (0–3)	3
Creeping bellflower was introduced to North America as an ornamental plant (Royer and Dickinson 1999). It frequently escapes from gardens (Whitson et al. 2000). This plant also disperses with nursery stock (Alfnes 1975).	
Allelopathic (0–2)	U
Unknown	
Competitive Ability (0–3)	3
Creeping bellflower is a serious competitor for soil moisture and nutrients. It thrives under the canopy or in sun (Whitson et al. 2000, Royer and Dickinson 1999). This species appears to be a successful competitor with lawn grasses and native raspberries (M. Rasy pers. obs.).	
Thicket-forming/Smothering growth form (0–2)	1
Creeping bellflower is able to form dense thickets and quickly colonize areas (Gubanov et al. 2004); however, it does not generally overtop surrounding vegetation.	
Germination requirements (0–3)	U
Unknown	
Other invasive species in the genus (0–3)	3
Campanula glomerata is an introduced cultivated species known to be invasive in gardens (J. Riley pers. com.); however, it does not have legal weed status (USDA 2002).	
Aquatic, wetland or riparian species (0–3)	0
Creeping bellflower is a weed of gardens, horticultural fields, and forest plantations. It is a serious weed in lawns. In its native range creeping bellflower grows in open woodlands, forest edges, and meadows (Gubanov et al. 2004, Royer and Dickinson 1999).	
Total for Biological Characteristics and Dispersal	**16/20**

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
Creeping bellflower is used as an ornamental plant in Europe and North America (USDA, ARS 2005, Whitson et al. 2000). It is a serious weed in the nursery industry (Alfnes 1975). In European countries it is cultivated in vegetable gardens (Plants For A Future 2004).	
Known level of impact in natural areas (0–6)	3
Creeping bellflower is known to invade mixed birch–spruce forest in Anchorage (M. Rasy pers. obs.).	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
It is readily establish along trails, but is capable of moving into adjacent undisturbed areas (M. Rasy pers. obs.).	
Current global distribution (0–5)	5
Creeping bellflower is native to Europe and Western Asia, including arctic and subarctic regions of Norway and Sweden (Lid and Lid 1995). It has naturalized in North America and has been occasionally recorded in Siberia (USDA, ARS 2005, Gubanov et al. 2004).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Creeping bellflower is found in most American states and Canadian provinces (USDA 2002, Royer and Dickinson 1999). This species is listed as a weed in Alberta and Manitoba (Invaders Database System 2003, Royer and Dickinson 1999).	
Total for Ecological Amplitude and Distribution	**20/25**

Feasibility of Control	**Score**
Seed banks (0–3)	U
Unknown	
Vegetative regeneration (0–3)	2
Creeping bellflower sprouts readily from roots fragments (I. Lapina pers. obs., Plants For A Future 2004).	
Level of effort required (0–4)	3
Creeping bellflower infestation is extremely difficult to eradicate (Gubanov et al. 2004). It is practically impossible to control this species mechanically, and it is problematic to control it by chemical methods. Some of the selective herbicides can be effective (Alfnes 1975).	
Total for Feasibility of Control	**5/7**
Total score for 4 sections	**59/92**

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Capsella bursa-pastoris (L.) Medik. L. common names: shepherd's purse

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	***Score***
Ecological Impact	40	7
Biological Characteristics and Dispersal	25	11
Amplitude and Distribution	25	18
Feasibility of Control	10	4
Relative Maximum		40

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Capsella bursa-pastoris has been documented in all ecogeographic regions of Alaska (AKEPIC 2005, Hultén 1968, UAM 2004).

Ecological Impact — **Score**

Impact on Ecosystem Processes (0–10) — 1

Shepherd's purse colonizes open ground and may inhibit the establishment of native species (Rutledge and McLendon 1996). Though this plant is only found in highly disturbed environments (Densmore et al. 2001, Welsh 1974) it has the potential to retard succession after sites have been disturbed.

Impact on Natural Community Structure (0–10) — 3

Shephard's purse is a pioneer of disturbed ground. It tends to have a high percentage of cover initially. However, after perennial grasses enter the area, it declines in abundance and soon disappears (Aksoy et al. 1998, I. Lapina pers. obs.).

Impact on Natural Community Composition (0–10) — 0

Shepherd's purse has not been observed in undisturbed areas in Alaska and no perceived impacts on native populations have been documented (Densmore et al. 2001).

Impact on Higher Trophic Levels (0–10) — 3

Shepherd's purse is grazed by cattle, horses, sheep, and rabbits (Crawley 1990). Its leaves are also eaten by insects and slugs (Aksoy et al. 1998, Dirzo and Harper 1980, Cook et al. 1996). Flowers are usually self-pollinated; however, small insects, particularly flies and small bees, visit the flowers (Aksoy et al. 1998). Shepherd's purse is a host for a number of nematodes and viruses (Royer and Dickinson 1999).

Total for Ecological Impact — 7/40

Biological Characteristics and Dispersal — **Score**

Mode of Reproduction (0–3) — 3

Shepherd's purse reproduces entirely by seeds. Stevens (1932) recorded 38,500 seeds per plant. Hurka and Haase (1982) conducted experiment in which they recorded a minimum of 500 seeds and a maximum of 90,000 seeds per plant. The number of seeds per plant varies mainly depending on habitat.

Long-distance dispersal (0–3) — 3

Seeds are small and light, and carried by wind or rainwash. Seeds become sticky when moistened and can be dispersed on the feet of birds and mammals (Aksoy et al. 1998, Hurka and Haase 1982).

Spread by humans (0–3) — 3

Seeds may be transported in mud sticking to human feet and to car tires (Aksoy et al. 1998, Densmore et al. 2001, Hurka and Haase 1982). Hodkinson and Thompson (1997) note that horticultural stock carried Shepherd's purse seeds as a contaminant.

Allelopathic (0–2) — 0

Shepherd's purse is not known to be allelopathic.

Competitive Ability (0–3) — 1

Shephard's purse is a serious competitor with annual crops; however, it cannot compete with perennial grasses (Aksoy et al. 1998).

Thicket-forming/Smothering growth form (0–2) — 0

Shepherd's purse is capable of creating a dense stand of up to 300 plants per m^2 (Harker et al. 2000); however, plants are small, up to 18 inches tall, and do not posses a climbing or smothering growth habit (Douglas and Meidinger 1998, Royer and Dickinson 1999, Whitson at al. 2000).

Germination requirements (0–3) — 0

Shepherd's purse requires open soil and disturbance to germinate. Plants may appear on sites that have been redisturbed several decades after the last human disturbance (Densmore et al. 2001).

Other invasive species in the genus (0–3) — 0

The genus *Capsella* is monotypic (USDA, NRCS 2006).

Aquatic, wetland or riparian species (0–3) — 1

In its native and introduced range, Shepherd's purse is a weed of cultivated crops, gardens, and waste areas (Alex and Switzer 1976, Aksoy et al. 1998, Royer and Dickinson 1999, Rutledge and McLendon 1996, Welsh 1974, Whitson at al. 2000). However, this weed has been observed invading gravel bars at Brooks Camp, Katmai National Park and Preserve (J. Heys pers. obs.).

Total for Biological Characteristics and Dispersal — 11/25

Ecological Amplitude and Distribution — **Score**

Highly domesticated or a weed of agriculture (0–4) — 4

Shepherd's purse is considered one of the dominant species in the weed flora (Aksoy et al. 1998).

Known level of impact in natural areas (0–6) — 1

Shepherd's purse is established in Rocky Mountain National Park, Colorado, where it may inhibit the establishment of native species (Rutledge and McLendon 1996). Shepherd's purse is not known to impact natural areas in Alaskan National Park Units (Densmore et al. 2001), with the exception of open gravel bars at Brooks Camp, Katmai National Park and Preserve (J. Heys pers. obs.).

Role of anthropogenic and natural disturbance in establishment (0–5) — 3

Shepherd's purse usually requires open soil and disturbance for establishment (Densmore et al. 2001). However, Jeff Heys observed infestation of Shepherd's purse on river erosion sites at Brooks Camp, Katmai National Park and Preserve.

Current global distribution (0–5)	5
Shepherd's purse is native to Europe and West Asia. It has become cosmopolitan and is widely distributed throughout Europe, Asia, North America, Australia, and Africa. It is introduced into South America, New Zealand, and Tasmania (Hultén 1968). It has also been recorded in arctic and subarctic regions in Greenland, Spitsbergen, Iceland, Northland, and Alaska (Hultén 1968, Polunin 1957, Tolmatchev 1975, UAM 2004, AKEPIC 2005).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Shepherd's purse has been recorded in nearly all American states and Canadian provinces (USDA, NRCS 2006, Whitson at al. 2000). *Capsella bursa-pastoris* is listed as a noxious weed in Colorado, Alberta, and Manitoba (Royer and Dickinson 1999, USDA, NRCS. 2006).	
Total for Ecological Amplitude and Distribution	**18/25**

Feasibility of Control	**Score**
Seed banks (0–3)	3
Viable seeds were recorded after 35 years (Kivilaan and Bandurski 1981, Darlington and Steinbauer 1961), although a decline in number of viable seeds was recorded after 3.5, 5, and 6 years in other studies (Chepil 1946, Duvel 1904, Roberts and Feast 1973). A seed viability experiment in Alaska showed a dramatic decrease in viability between 6.7 and 9.7 years after burial (Conn and Deck 1995).	
Vegetative regeneration (0–3)	0
Shepherd's purse plants do not regenerate vegetatively (Aksoy et al. 1998, Densmore et al. 2001).	
Level of effort required (0–4)	1
Shepherd's purse is a pioneer colonizer of disturbed areas and usually does not persist more than 2–5 years unless the site is repeatedly disturbed. The plants can be easily pulled up by hand (Densmore et al. 2001). It seems to persist in unshaded natural sites with disturbances in Alaska (J. Heys pers. obs.).	
Total for Feasibility of Control	**4/10**
Total score for 4 sections	**40/100**

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Caragana arborescens Lam common names: Siberian peashrub

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		No
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	24
Biological Characteristics and Dispersal	25	14
Amplitude and Distribution	25	21
Feasibility of Control	7	5
Relative Maximum		**66**

Climatic Comparison		
	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	No	No
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Caragana arborescens has been collected in Fairbanks and the Kilbuck–Kuskokwim Mountains (UAM 2004). It is widely planted as an ornamental in Anchorage (Lapina pers. obs.) and towns in temperate regions of Alaska and Yukon (Welsh 1974). Using the CLIMEX matching program, climatic similarity is low between the south coastal ecoregion and areas where this species is known (CLIMEX 1999). This plant favors continental climates with long summers and cold, fairly dry winters (Plants For A Future 2002). *Caragana arborescence* is unlikely to establish in the south coastal ecoregion. Climatic similarity between Nome (arctic alpine ecoregion) and areas where the species is documented is high. Native range of the species includes Tomsk and Irkutsk, Russia (USDA ARS 2004), which has a 64%, and 60% climatic match with Nome, respectively. The species successfully has been used as an ornamental in Anchorage, which has a 61% climatic match with Nome.

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	7
Once it has established Siberian peashrub decreases light availability and reduces tree and shrub regeneration (I. Lapina pers. obs., O. Baranova pers. com.). As a nitrogen-fixer, it likely alters soil conditions (USDA 2002).	
Impact on Natural Community Structure (0–10)	7
In a few locations in south-central Alaska, this species forms a dense shrub layer in open meadows or forest edges (M.L. Carlson pers. obs., I. Lapina pers. obs.).	
Impact on Natural Community Composition (0–10)	5
Siberian peashrub appears to significantly reduce the number of native shrubs in mixed Birch–Spruce forests in European Russia (O. Baranova pers. com.). Similar effects are likely occurring in Alaska.	
Impact on Higher Trophic Levels (0–10)	5
Siberian peashrub can be severely damaged by browsing deer (Duke 1983). Stipules of leaves often persist as spines (Welsh 1974). Thick stands can effect movement of animals.	
Total for Ecological Impact	**24/40**

Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	3
Seeds are produced in great abundance; 4–6 seeds per pod and often hundreds of pods per plant. This plant may also be propagated by bare roots, root cuttings, and layering (Duke 1983, USDA 2002).	
Long-distance dispersal (0–3)	0
The seeds are large and do not have any adaptations for long-distance dispersal (USDA, NRCS 2002).	

Spread by humans (0–3)	3
The Siberian peashrub is cultivated in the more temperate regions of Alaska and Yukon (Welsh 1974). It has escaped from cultivation. It is currently sold in nurseries (Duke 1983, I. Lapina pers. obs., WDNR 2003).	
Allelopathic (0–2)	0
There is no known allelopathic potential (USDA 2002).	
Competitive Ability (0–3)	3
Siberian peashrub is reported to tolerate alkalinity, drought, cold, poor soils, and wind (Duke 1983). It also is a nitrogen-fixer (USDA 2002).	
Thicket-forming/Smothering growth form (0–2)	2
Plants can grow up to 12 feet tall (Welsh 1974) and form dense, impenetrable thickets (I. Lapina pers. obs.).	
Germination requirements (0–3)	3
Cold stratification required for germination. In horticulture, seeds need to be presoaked for about 24 hours in warm water and can then be sown in a cold period in the spring. Germination usually takes place within 2–3 weeks (Plants for a future 2002). In south-central Alaska, plants appear to be recruiting in moderately disturbed and partially native habitats (M.L. Carlson pers. obs.)	
Other invasive species in the genus (0–3)	0
No other weedy *Caragana* species are present (USDA 2002).	
Aquatic, wetland or riparian species (0–3)	0
This is a plant of roadsides and gardens (Montana Plant Life 2004).	
Total for Biological Characteristics and Dispersal	14/25

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
Siberian peashrub is cultivated as ornamental and food plant. It is widely planted in the United States and Canada for windbreaks, hedges, and outdoor screening. Because of its nitrogen-fixing capacity, it is valued as a soil-improving plant. In the Arctic it is a supplementary fodder for reindeer herds (Duke 1983). It is currently sold at nurseries. Cultivars have been developed (MSU Extension 1999, USDA 2002).	
Known level of impact in natural areas (0–6)	4
Siberian peashrub is known as an invader of forests in Wisconsin (WDNR 2003). It also invades forests in interior boreal ecoregion of European part of Russia (I. Lapina pers. obs.).	
Role of anthropogenic and natural disturbance in establishment (0–5)	4
Siberian peashrub is generally restricted to road and trailside edges on disturbed and imported soils. Nevertheless, it has been found establishing in forested areas with no perceivable human or natural disturbances (I. Lapina pers. obs.).	
Current global distribution (0–5)	5
Siberian peashrub is native to Siberia, Kazakhstan, Mongolia, and China. It now extends over Europe and North America, including arctic regions (Duke 1983, USDA, ARS 2004).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	4
Siberian peashrub is found throughout Canada and the northern American states. This species is not considered noxious in North America (Invaders Database System 2003, USDA 2002).	
Total for Ecological Amplitude and Distribution	21/25

Feasibility of Control	**Score**
Seed banks (0–3)	U
Unknown	
Vegetative regeneration (0–3)	2
Siberian peashrub can resprout after cutting (USDA 2002).	
Level of effort required (0–4)	3
Mechanical treatments can be used for control of Siberian peashrub. However, it is not very efficient, because shrub will resprout vigorously after cutting. Combination of mechanical and chemical treatments may be more efficient (Heiligmann 2006).	
Total for Feasibility of Control	5/7
Total score for 4 sections	64/97

§

Carduus nutans L.
C. acanthoides L.
C. pycnocephalus L.
C. tenuiflorus W. Curtis

common names: musk thistle, plumeless thistle, Italian thistle, slender-flowered thistle

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	22
Biological Characteristics and Dispersal	25	17
Amplitude and Distribution	25	14
Feasibility of Control	10	8
Relative Maximum		61

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	No	Yes
Interior Boreal	No	Yes
Arctic Alpine	No	Yes

No *Carduus* species have been recorded in Alaska (Hultén 1968, AKEPIC 2004, UAM 2004). The CLIMEX matching program shows that climatic similarity between Juneau and areas where the species are documented is high. Musk thistle is naturalized along the coastal region of Norway, including the area around Bergen and Kristiansand (Lid and Lid 1994), which have a 73% and 60% similarity with Juneau. The native range of the species includes Bogolovsk and Sverdlovsk, Russia (Gubanov et al. 1995), which has a 71% and 66% climatic match with Fairbanks, and 67% and 66% climatic match with Nome, respectively. This suggests that if introduced, establishment of species from the genus *Carduus* in south coastal, interior boreal and arctic alpine ecogeographic regions may be possible.

Ecological Impact — **Score**

Impact on Ecosystem Processes (0–10) — 5

Overwintering rosettes can severely inhibit the establishment of other plants. This may retard natural processes of secondary succession (Pitcher and Russo 1988, Rutledge and McLendon 1996). Dead stands can trap snow in winter, increasing soil moisture in the spring (Desrochers et al. 1988).

Impact on Natural Community Structure (0–10) — 5

Carduus species are capable of forming a dense, tall herbaceous layer of vegetation (Royer and Dickinson 1999, Whitson et al. 2000).

Impact on Natural Community Composition (0–10) — 5

Thistle stands can outcompete and reduce the number of individuals and may displace native herbaceous plants (Pitcher and Russo 1988, Royer and Dickinson 1999, Whitson et al. 2000).

Impact on Higher Trophic Levels (0–10) — 7

Infestations in meadows and rangelands reduce foraging sites and hinder the movement of grazing animals (Hull and Evans 1973, Royer and Dickinson 1999, Whitson et al. 2000). Thistle flowers are usually very attractive to insect pollinators and can alter the behavior of native pollinators (Desrochers et al. 1988, Gubanov et al. 2004). Hybridization between musk thistle and plumeless thistle has been reported (Warwick et al. 1989).

Total for Ecological Impact — 22/40

Biological Characteristics and Dispersal — **Score**

Mode of Reproduction (0–3) — 3

Carduus species reproduce by seed only. Seed production can be as great as 11,000 seeds per plant (Desrochers et al. 1988).

Long-distance dispersal (0–3) — 3

The majority of the seeds fall near the parent plant. Experimental studies in Virginia suggest that seeds do not travel far from the maternal plant, with over 80% of seeds deposited within 40 m of the parent plant (Smith and Kok 1984). However, seeds can also be dispersed by wind, small mammals, birds, and water (Beck 2004, Butterfield et al. 1996, Rutledge and McLendon 1996).

Spread by humans (0–3) — 3

Seeds may attach to animals, farm machinery, and vehicles. They may contaminate crops and hay (Rutledge and McLendon 1996, Zouhar 2002).

Allelopathic (0–2) — 2

Aqueous extracts and dead plant material from musk thistle have an inhibitory effect on germination and growth rate of several grass species (Wardle et al 1993).

Competitive Ability (0–3) — 1

Thistles are highly competitive plants; however, establishment may be negatively affected by grasses (Butterfield et al. 1996, Rutledge and McLendon 1996, Wardle et al. 1996). *Carduus* species are usually more productive in communities where levels of competition are low (Austin et al. 1985).

Thicket-forming/Smothering growth form (0–2) — 2

Members of the genus *Carduus* are capable of forming dense stands, especially at highly disturbed sites where competition is low. Plants can be as tall as 6 feet (Desrochers et al. 1988).

Germination requirements (0–3) — 0

Sufficient light is required for germination (Rutledge and McLendon 1996), therefore, more seeds germinate and establish on bare soils in open pastures and poorly vegetated sites (Beck 2004, Hamrick and Lee 1987). In greenhouse experiments, optimum levels of germination and establishment occurred in habitats with a light covering of litter that reduced evapotranspiration. Thick litter layers reduced germination and establishment by preventing seeds from reaching the soil surface (Hamrick and Lee 1987).

Other invasive species in the genus (0–3) — 3

The *Carduus* genus is comprised of a number of noxious pasture and range weeds (Royer and Dickinson 1999, USDA 2002, Whitson et al. 2000).

Aquatic, wetland or riparian species (0–3) — 0

Carduus species can be found in waste ground, old fields, pastures, and along roads and railroads. They can invade open natural areas such as meadows, prairies, and grasslands (Beck 2004, Butterfield et al. 1996).

Total for Biological Characteristics and Dispersal — 17/25

Ecological Amplitude and Distribution — **Score**

Highly domesticated or a weed of agriculture (0–4) — 2

Carduus species are not major agricultural pests; instead they are mostly weeds of pastures and ranges (Beck 2004, Royer and Dickinson 1999, Whitson et al. 2000).

Known level of impact in natural areas (0–6)	1
Musk thistle invades natural communities in the Midwest, especially in Nebraska and Kansas. Infestations of musk thistle have been observed in areas of tallgrass prairie (Heidel 1987). This species is common in open grassy meadows and spreads into sagebrush, pinyon juniper, and mountain brush communities in Rocky Mountain National Park, Colorado (Rutledge and McLendon 1996). Musk thistle invades mid-successional sites that were disturbed in the last 11–50 years in Pipestone National Monument, Minnesota (Butterfield et al. 1996). It has been observed in fir–spruce habitats in Wyoming (Hull and Evans 1973). Musk thistle infests thousands of hectares of pastures in New Zealand (Jessep 1990). Italian thistle invades chaparral and oak savanna in California (Bossard and Lichti 2000).	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
Thistles colonize anthropogenically disturbed areas, but can colonize areas subject to natural disturbances such as landslides or frequent flooding (Remaley 2004). Fire or heavy grazing are favorable to thistle establishment and development (Zouhar 2002). In Minnesota, prairie thistle populations decreased rapidly after grazing was removed and natural succession began to take place (Heidel 1987).	
Current global distribution (0–5)	3
Members of the genus *Carduus* are native to Europe, western Siberia, Asia Minor, and North Africa (Desrochers et al. 1988). They have been introduced to North and South America, Australia, and New Zealand.	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Occurs in 45 American states and all Canadian provinces. Species of genus *Carduus* are classified as noxious, restricted, or prohibited weeds in 22 American states and 5 Canadian provinces (Royer and Dickinson 1999, USDA 2002).	
Total for Ecological Amplitude and Distribution	14/25
Feasibility of Control	**Score**
Seed banks (0–3)	3
Seeds have been reported to remain viable in the soil for 10–15 years (Butterfield et al. 1996, Burnside et al. 1981, Desrochers et al. 1988, Rutledge and McLendon 1996).	
Vegetative regeneration (0–3)	2
Plants can regrow from the root buds, then flower and set seed (Butterfield et al. 1996, Heidel 1987).	
Level of effort required (0–4)	3
Cultural, mechanical, biological, and chemical control methods have all been used on thistles with varying degrees of success. Hand-cutting or mowing can provide control if repeated over a period of years (Beck 2004, Heidel 1987, Remaley 2004).	
Total for Feasibility of Control	8/10
Total score for 4 sections	61/100

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Centaurea biebersteinii DC common names: spotted knapweed

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	34
Biological Characteristics and Dispersal	25	22
Amplitude and Distribution	25	21
Feasibility of Control	10	9
Relative Maximum		86

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	No

Spotted knapweed has been recorded in Skagway, Valdez, and Prince of Wales Island (south coastal) and along Turnagain Arm (interior boreal) (AKEPIC 2004, J. Snyder pers. com.). Using CLIMEX matching program, climatic similarity between Nome and areas where the species is documented is very low. This suggests that establishment in arctic and alpine Alaska may be not possible.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 8
Erosion of topsoil has been shown to increase after spotted knapweed invasions. Surface runoff had approximately three times more sediments in *Centaurea biebersteinii* dominated sites compared with adjacent native bunchgrass sites (Rice et al. 1997).

Impact on Natural Community Structure (0–10) — 7
Spotted knapweed is capable of forming dense stands in natural communities, reducing native plant diversity.

Impact on Natural Community Composition (0–10) — 9
Spotted knapweed reduces native plant population size, decreases plant diversity, reduces forage quality, and habitats.

Impact on Higher Trophic Levels (0–10) — 10
This species may likely affect spawning habitats by increasing surface runoff and sedimentation (UAF). Winter-ranging elk may avoid foraging in habitats dominated by *Centaurea biebersteinii* (Rice et al. 1997). Knapweeds are allelopathic, inhibiting the establishment and growth of surrounding vegetation (Whitson et al. 2000).

Total for Ecological Impact — 34/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3
Spotted knapweed reproduces only by seed. However, lateral root sprouting is possible (Carpinelli 2003, Mauer et al. 1987). Average plants produce about 1,000 seeds (Lym and Zollinger 1992, Mauer et al. 1987, Wisconsin DNR 2004), but large individuals may produce over 20,000 seeds (Royer and Dickinson 1999).

Long-distance dispersal (0–3) — 2
Seeds lack pappus; however, dispersal by wind as well as transportation by rodents and livestock has been reported (Mauer et al. 1987).

Spread by humans (0–3) — 3
Humans are the primary factor for spotted knapweed movement. Seeds are dispersed by vehicles, heavy machinery, and even light aircraft. It also is widely dispersed as a contaminant in hay, commercial seed, and floral arrangements (Lym and Zollinger 1992, Mauer et al. 1987).

Allelopathic (0–2) — 2
Knapweeds are allelopathic, inhibiting the growth of surrounding plants (Lym and Zollinger 1992, Royer and Dickinson 1999, Whitson et al. 2000).

Competitive Ability (0–3) — 3
Knapweed is able to outcompete neighboring plants for moisture and nutrients due to its early spring growth (Royer and Dickinson 1999).

Thicket-forming/Smothering growth form (0–2) — 2
Spotted knapweed often forms dense stand up to 6 feet tall (Royer and Dickinson 1999).

Germination requirements (0–3) — 3
Spotted knapweed seeds germinate over a wide range of soil conditions and temperatures regimes (Schirman 1981).

Other invasive species in the genus (0–3) — 3
Centaurea cyanus L., *C. diffusa* Lam., *C. iberica* Trev. Ex Spreng., *C. pratensis* Thuill., *C. solstitialis* L., and *C. virgata* Lam. var. squarrosa (Willd.) Boiss (Whitson et al. 2000).

Aquatic, wetland or riparian species (0–3) — 1
It typically invades along highways, waterways, railroad ways, pipelines, grasslands, and open forests (Lym and Zollinger 1992, Rice et al. 1997). Spotted knapweed establishes primarily in nonwetland or riparian sites, however, it can invade streambanks and nearby meadows (Snyder and Shephard 2004).

Total for Biological Characteristics and Dispersal — 22/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 4
Spotted knapweed generally is not a problem in cultivated fields. However, it is one of the most problematic weeds in rangelands and pastures (Royer and Dickinson 1999, Whitson et al. 2000).

Known level of impact in natural areas (0–6) — 6
Spotted knapweed invades nearly undisturbed grasslands and open forests in Montana, Idaho, Colorado, Massachusetts, North Dakota, and Wisconsin (K. Boggs pers. com., Lym and Zollinger 1992, Rice et al. 1997, Wisconsin DNR 2004). It is widespread in wildland in British Columbia (Canada) (MAFF 2004).

Role of anthropogenic and natural disturbance in establishment (0–5) — 3
Anthropogenic disturbances such as overgrazing and mechanical soil disturbance accelerate its invasion in natural areas. Both biotic and abiotic soil disturbances (e.g., frost heave, small mammal burrowing, and trampling and grazing by native ungulates) can facilitate *Centaurea biebersteinii* invasion (Tyser and Kye 1988). Once a stand is established, it may invade relatively undisturbed adjacent areas (Mauer et al. 1987).

Current global distribution (0–5) — 3
Spotted knapweed is native to Central and Southeastern Europe. Now it occurs also in Northern Europe, North America, Asia, and Australia (Weeds Australia 1998).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
It occurs in nearly all states of the United States (USDA 2002). It is listed as noxious in 15 American states and in 4 Canadian provinces (Invaders Database System 2003, USDA 2002).	
Total for Ecological Amplitude and Distribution	**21/25**

Feasibility of Control	**Score**
Seed banks (0–3)	3
Seeds remain viable in the soil up to 5 years (Lym and Zollinger 1992). After 8 years about 30% of seeds may be viable (Mauer et al. 1987).	
Vegetative regeneration (0–3)	2
Lateral root-sprouting is possible for *Centaurea biebersteinii* (Carpinelli 2003, M. Shephard pers. com.).	
Level of effort required (0–4)	4
Long-term control requires a combination of management techniques. Several years of monitoring are required to exhaust the seed bank. Most knapweed control has been conducted in agricultural settings and little information is available for the use of herbicides in native communities (Lym and Zollinger 1992, Rice et al. 1997). A number of biological control agents have been moderately successful in Montana and other western states (Story et al. 1989, Story et al. 1991).	
Total for Feasibility of Control	**9/10**
Total score for 4 sections	**86/100**

§

Cerastium fontanum ssp. *vulgare* (Hartman) Greuter & Burdet common names: common mouse-ear chickweed, big chickweed
Cerastium glomeratum Thuill., sticky chickweed

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	6
Biological Characteristics and Dispersal	25	8
Amplitude and Distribution	19	15
Feasibility of Control	10	5
Relative Maximum		36

Climatic Comparison		
	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	Yes
Arctic Alpine	No	Yes

Cerastium fontanum ssp. *vulgare* has been documented in interior boreal and south coastal ecogeographic regions of Alaska (AKEPIC 2005, Hultén 1968, UAM 2004, Welsh 1974). *Cerastium glomeratum* is known from many disjunct localities in south coastal, interior boreal and arctic alpine ecogeographic regions in Alaska and Yukon (Hultén 1968, UAM 2004, Welsh 1974). *Cerastium fontanum* ssp. *vulgare* has a cosmopolitan distribution with introduction into a variety of climatic zones including arctic and subarctic (Hultén 1968). Using the CLIMEX matching program, the climatic similarity between Nome and other areas where the species is documented is fairly high. The range of the species includes Chirka-Kem', Arkhangel'sk, and Zlatoust, Russia (Gubanov et al. 2003, Hultén 1968), which have a 77%, 76%, and 71% of climatic match with Nome respectively. This suggests that establishment of common mouse-ear chickweed in Alaska arctic and alpine ecoregions may be possible.

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	1
Common mouse-ear chickweed and sticky chickweed do not appear to occur in high densities in natural areas in Alaska. The impact of these species on ecosystem processes is nearly negligible (J. Conn pers. obs., M. Carlson pers. obs.).	
Impact on Natural Community Structure (0–10)	3
Common mouse-ear chickweed and sticky chickweed likely alter the density of the layer of vegetation (Ohio perennial and biennial weed guide 2006).	
Impact on Natural Community Composition (0–10)	1
On disturbed ground common mouse-ear chickweed and sticky chickweed can form a mat that excludes other plants (Ohio perennial and biennial weed guide 2006). However, these species have not been observed in undisturbed plant communities in Alaska (M. Carslon pers. obs.) and its impact on native community composition is not documented.	
Impact on Higher Trophic Levels (0–10)	1
Flowers of common mouse-ear chickweed are self-pollinated and rarely visited by insects (Mulligan 1972). Both species are host for some nematodes (Townshend and Davidson 1962).	
Total for Ecological Impact	**6/40**

Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	3
Common mouse-ear chickweed and sticky chickweed reproduce by seeds and stems rooting at the nodes (Ohio perennial and biennial weed guide 2006).	
Long-distance dispersal (0–3)	2
Seabirds probably have some role in transport of seeds. Viable seeds of *Cerastium* species were found in pellets of sea gulls (Gillham 1956).	
Spread by humans (0–3)	2
Common mouse-ear chickweed and sticky chickweed are weeds of gardens and lawns. Seeds can be transported with horticultural stock (Hodkinson and Thompson 1997).	
Allelopathic (0–2)	0
Common mouse-ear chickweed and sticky chickweed are not known to be allelopathic.	

Competitive Ability (0–3)	0
Common mouse-ear chickweed and sticky chickweed cannot compete with established vegetation (Bonis et al. 1997, Jesson et al. 2000). In an experiment common mouse-ear chickweed had low survival of transplants and no germination in undisturbed environments due to competition from the surrounding vegetation (Jesson et al. 2000). Growth rate of common mouse-ear chickweed plants can be decrease by competition with grasses (Bonis et al. 1997).	
Thicket-forming/Smothering growth form (0–2)	0
Common mouse-ear chickweed and sticky chickweed do not form dense patches in Alaska (M. Carslon pers. obs.). Both species do not possess climbing or smothering growth habit (Douglas and MacKinnon 1998, Hultén 1968, Welsh 1974).	
Germination requirements (0–3)	0
Common mouse-ear chickweed requires open soil for germination and establishment (Jesson et al. 2000). No germination and establishment of seedlings were recorded in undisturbed environments in an experiment in New Zealand (Jesson et al. 2000).	
Other invasive species in the genus (0–3)	0
A number of *Cerastium* species has been introduced into United States but none of them listed as a noxious weed (USDA, NRCS 2006).	
Aquatic, wetland or riparian species (0–3)	1
This species is a weed of roadsides, waste places, gardens and fields (Douglas and MacKinnon 1998, Welsh 1974). It can invade grasslands, dwarf shrub heath, fern beds, and sand dunes (Broughton and McAdam 2002). However, a survey of exotic species distributions in Arthur's Pass National Park, New Zealand found common mouse-ear chickweed to be a species primarily associated with rivers (Jesson et al. 2000). It also is frequent in grass swards beside rivers in number of islands around Antarctica (Walton 1975).	
Total for Biological Characteristics and Dispersal	**8/25**

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	2
Common mouse-ear chickweed is a weed of arable and horticultural lands (Broughton and McAdam 2002, Douglas and MacKinnon 1998).	
Known level of impact in natural areas (0–6)	U
Common mouse-ear chickweed is widespread in grasslands, dwarf shrub heath, fern beds, and sand dunes in the Falkland Islands (Broughton and McAdam 2002). This species colonizes animal-disturbed areas in Prince Edward Island and in many islands around Antarctica (Ryan et al. 2003, Walton 1975). In Arthur's Pass National Park, New Zealand, common mouse-ear chickweed was found exclusively in riverbeds (Jesson et al. 2000). However, ecological impact of this exotic species on natural community has not been recorded.	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
Common mouse-ear chickweed requires either anthropogenic or natural disturbance for establishment (Broughton and McAdam 2002, Ryan et al. 2002). This species has been recorded on sites characterized by intense disturbance by seals and seabirds. It also occurs on dry slopes or erosion scars (Ryan et al. 2003). The survey of exotic species distribution in Arthur's Pass National Park, New Zealand found common mouse-ear chickweed to be a species primarily associated with sites frequently disturbed by flooding rivers (Jesson et al. 2000).	
Current global distribution (0–5)	5
Cerastium fontanum ssp. *vulgare* is native to Europe, Asia, and Northern Africa. It is now found across the world, including arctic and subarctic regions. It has been introduced into North and South America, Central and South Africa, India, Australia, and New Zealand (Hultén 1968, Walton 1975).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Common mouse-ear chickweed is found throughout the United States and Canada (USDA, NRCS 2006). *Cerastium fontanum* ssp. *vulgarum* is listed as a noxious weed in Alberta and Manitoba (Rice 2006).	
Total for Ecological Amplitude and Distribution	**15/19**

Feasibility of Control	**Score**
Seed banks (0–3)	3
Seeds of common mouse-ear chickweed germinated after 8 months of dry storage (Williams 1983). In another study most seeds germinated within 2 years (Brenchley and Warington 1930). Seeds may be viable in arable fields for 16 years (Chancellor 1985).	
Vegetative regeneration (0–3)	1
Fragments of stems are likely able to reroot (Ohio perennial and biennial weed guide 2006).	
Level of effort required (0–4)	1
Small population of common mouse-ear chickweed can be controlled by hand pulling. Herbicides can be effective when applied during active growth (AKEPIC 2005).	
Total for Feasibility of Control	**5/10**
Total score for 4 sections	**34/94**

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Centaurea solstitialis L. common names: yellow starthistle

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		No
Interior Boreal		No
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact		
Biological Characteristics and Dispersal		
Amplitude and Distribution		
Feasibility of Control		
Relative Maximum		
Rejected from consideration		

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	No	
Interior Boreal	No	
Arctic Alpine	No	

Centaurea solstitialis has not been documented in Alaska (Hultén 1968, AKEPIC 2004,UAM 2004). Yellow starthistle is believed to be native of the Mediterranean region. Today, it can be found in most temperate areas of Europe, North and South America, but not in the Arctic (Lid and Lid 1994, Maddox et al. 1985, Elven Reidar pers. com., USDA 2002). This weed occurs in nearly every American state, with the most severe infestations in California, Idaho, Oregon, and Washington. It has also expanded into Canada from British Columbia to Ontario. The CLIMEX climate matching program indicates the climatic similarity between Juneau, Fairbanks, and Nome and areas where the species is documented is low. Thus establishment of *Centaurea solstitialis* in Alaska is unlikely. The species is rejected from consideration for ranking.

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	
Impact on Natural Community Structure (0–10)	
Impact on Natural Community Composition (0–10)	
Impact on Higher Trophic Levels (0–10)	
Total for Ecological Impact	/
Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	
Long-distance dispersal (0–3)	
Spread by humans (0–3)	
Allelopathic (0–2)	
Competitive Ability (0–3)	
Thicket-forming/Smothering growth form (0–2)	
Germination requirements (0–3)	
Other invasive species in the genus (0–3)	
Aquatic, wetland or riparian species (0–3)	
Total for Biological Characteristics and Dispersal	/
Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	
Known level of impact in natural areas (0–6)	
Role of anthropogenic and natural disturbance in establishment (0–5)	
Current global distribution (0–5)	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	
Total for Ecological Amplitude and Distribution	/
Feasibility of Control	**Score**
Seed banks (0–3)	
Vegetative regeneration (0–3)	
Level of effort required (0–4)	
Total for Feasibility of Control	/
Total score for 4 sections	/

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Chenopodium album L. common names: lambsquarters, white goosefoot

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	5
Biological Characteristics and Dispersal	25	12
Amplitude and Distribution	25	15
Feasibility of Control	10	5
Relative Maximum		37

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Chenopodium album has been collected from all Alaskan ecoregions: south coastal (Afognak, Kodiak, Middleton Island, and Skagway), interior boreal (Anchorage, Bettles, Big Delta, Circle, Fairbanks, Gulkana, and Ophir), and arctic alpine (Nulato) (Hultén 1968, Welsh 1974, Densmore et al. 2001, UAM 2003).

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 1
Chenopodium album has not been observed in undisturbed areas in Alaska (Densmore et al. 2001, Hultén 1968, Welsh 1974). It is unlikely that measurable impacts to ecosystem processes occur due to its presence.

Impact on Natural Community Structure (0–10) — 1
Lambsquarters establishes in a sparsely vegetated herbaceous layer, increasing the density of the layer in south-central Alaska (I. Lapina and M.L. Carlson pers obs.).

Impact on Natural Community Composition (0–10) — 0
Lambsquarters has not been observed in undisturbed areas in Alaska, no perceived impact on native populations has been documented (Densmore et al. 2001).

Impact on Higher Trophic Levels (0–10) — 3
Plants are reported to be poisonous to sheep and pigs, but no data is present regarding its toxicity to native herbivores (CU-PPID 2004). It is an alternate host for a number of viral diseases of barley, beet, potato, turnip, and tobacco—some of these crops are grown commercially in Alaska (Royer and Dickinson 1999). All parts of the plants contain nitrate.

Total for Ecological Impact — 5/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3
Lambsquarters reproduces entirely by seed. Each plant can produce over 500,000 seeds (Royer and Dickinson 1999).

Long-distance dispersal (0–3) — 2
Chenopodium album lacks any seed dispersal adaptations and most seeds are deposited near the parental plant. Seeds may be washed into ditches and can be moved long distances despite lacking buoyancy. Also, seeds remain viable after passing through the digestive tract of animals (Rutledge and McLendon 1996).

Spread by humans (0–3) — 2
The seeds can be a contaminant in grass and cereal seed. It has been reported to spread as a contaminant of the topsoil and horticultural stock. It appears to spread along off-road vehicle trails and road edges in Alaska (M.L. Carlson pers. obs.)

Allelopathic (0–2) — 2
Leachates from *Chenopodium album* significantly reduce tomato shoot biomass and accumulation of N, P, K, Ca, and Mg (Qasem et al. 1989). The allelopathic effects were separated from competitive effects

Competitive Ability (0–3) — 0
Lambsquarters is moderately competitive for moisture and nutrient in cultivated fields. However, it competes poorly with native species (Densmore et al. 2001, Royer and Dickinson 1999, Rutledge and McLendon 1996).

Thicket-forming/Smothering growth form (0–2) — 0
Lambsquarters can grow up to 3.5 feet tall (Royer and Dickinson 1999), but usually does not form dense stands in Alaska (I. Lapina pers. obs.).

Germination requirements (0–3) — 0
Seeds must be in the top 3 cm of soil to germinate. Light has been reported as necessary for germination. Germination is inhibited in areas shaded by other plants (Densmore et al. 2001, Royer and Dickinson 1999, Rutledge and McLendon 1996).

Other invasive species in the genus (0–3) — 3
Chenopodium murale L. is considered invasive (USDA, NRCS 2002).

Aquatic, wetland or riparian species (0–3) — 0
Lambsquarters is found in cultivated fields, roadsides, and waste areas (Densmore et al. 2001, Gubanov et al. 2003).

Total for Biological Characteristics and Dispersal — 12/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 4
Lambsquarters is a cosmopolitan weed of cultivated areas (Royer and Dickinson 1999).

Known level of impact in natural areas (0–6) — 1
Chenopodium album is found in river bottoms and eroded areas associated with overgrazing, burns, or logging in the desert or desert grassland, pinyon juniper, and yellow pine forests in Arizona (Parker 1990).

Role of anthropogenic and natural disturbance in establishment (0–5) — 0
Lambsquarters is a short-lived colonizer of disturbed areas and will be present for only 1–3 years unless the site is repeatedly disturbed (Densmore et al. 2001, Royer and Dickinson 1999).

Current global distribution (0–5) — 5
Introduced from Europe, its current distribution is worldwide, including Africa, North and South America, Australia, Hawaii, Greenland, and New Zealand (Hultén 1968).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) — 5
Chenopodium album is listed as "noxious" in Minnesota and as a "weed" in Kentucky, Nebraska, Florida, Manitoba, and Quebec (Invaders Database System 2003, Royer and Dickinson 1999, USDA, NRCS 2002).

Total for Ecological Amplitude and Distribution — 15/25

Feasibility of Control	Score
Seed banks (0–3)	3

Viability of seeds was 35% after 4.7 years, and 4% after 9.7 years in a seed viability experiment conducted in Fairbanks (Conn and Deck 1995). Seeds have been reported to remain viable for at least 6 years in cultivated soil (Chepil 1946). Other authors suggested survival of seeds for 17, 20, and 24 years (Burnside et al. 1996, Lewis 1973, Chippindale and Milton 1934). One hundred and forty-three-years old viable seeds of lambsquarters were extracted from adobe bricks of historic buildings in California and northern Mexico (Spira and Wagner 1983).

Vegetative regeneration (0–3) 0

Lambsquarters does not resprout after removal of aboveground growth (Densmore et al. 2001).

Level of effort required (0–4) 2

The plants are easily pulled up by hand. However, because of a long-lived seed bank several weedings may be necessary to eliminate plants germinating from buried seeds (Densmore et al. 2001).

Total for Feasibility of Control	5/10
Total score for 4 sections	37/100

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Cirsium arvense (L.) Scop. common names: Canada thistle

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	26
Biological Characteristics and Dispersal	25	19
Amplitude and Distribution	25	21
Feasibility of Control	10	10
Relative Maximum		76

Climatic Comparison	*Collected in Alaska regions?*	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Cirsium arvense has been collected in south coastal [Afognak, Sitka, and Juneau (UAM 2004) and Cold Bay (pers. obs.)] and interior boreal [Yukon–Tanana Uplands (UAM 2004) and Wasilla (AKEPIC 2005)] ecoregions in Alaska. It has not been documented in the arctic alpine ecoregion. A few specimens have been collected from the northern Swedish Province of Norrbotten (Natur Historiska Riksmuseet Database, 2004). This region has roughly 135 frost-free days, compared with Nome's average of 80 frost-free days. This suggests that establishment in arctic and alpine regions of Alaska is unlikely. However, using CLIMEX matching program, climatic similarity between Nome and other areas where the species is documented is high. Range of the species includes Kirov, Russia (Hultén 1968), which has a 66% climatic match with Nome.

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	5

Canada thistle can increase fire frequency and severity due to its abundant and readily ignited litter (Zouhar 2001).

Impact on Natural Community Structure (0–10) 7

The spread of Canada thistle can change the structure of natural areas by the reduction or elimination of other plant and animals species (Zouhar 2001).

Impact on Natural Community Composition (0–10) 7

Canada thistle has the potential to form dense infestations quite quickly by vegetative reproduction, which crowds out and displaces native grasses and forbs through shading, competition, and allelopathy (Bossard et al. 2000, Hitchison 1992, Zouhar 2001). It produces allelopathic chemicals that assist in displacing competing plant species as well as producing a phalanx-like growth habit.

Impact on Higher Trophic Levels (0–10) 7

Cirsium arvense has been reported to accumulate nitrates that cause poisoning in animals. The spiny leaves scratch animal skin, causing infection, at a minimum. It produces allelopathic chemicals and it is a host for bean aphid and stalk borer, and for sod-web worm (Bossard et al. 2000). Last, pollinating insects appear to be drawn away from native plants to visit *C. arvense* (Zouhar 2001).

Total for Ecological Impact 26/40

Biological Characteristics and Dispersal	Score
Mode of Reproduction (0–3)	3

It reproduces by seeds, but mostly spreads by stem and root fragments (Bostock and Benton 1979, Hayden 1934, Nuzzo 1997). An individual plant may produce up to 5,300 seeds in a year (Evans 1984). A count of 600 to 1,500 seeds per plant for various localities in northern Iowa was made (Hayden 1934).

Long-distance dispersal (0–3) 3

The pappus breaks off easily from the seed and most seeds land near the parent plant. However, a small proportion of seeds (0.2%) can disperse 1 km or more from the parent plant (Bostock and Benton 1979, Nuzzo 1997). Platt (1975) observed achenes of *C. arvense* windborne on the prairie several hundred meters from the nearest source population. The seeds float and can also be distributed by water. It can also be dispersed in dung (Nuzzo 1997). There is a belief that ducks and other waterfowls are the agents of distribution of Canada thistle seeds (Hayden 1934).

Spread by humans (0–3) 3

It spreads as a contaminant in crop seed, hay, and packing material (Hayden 1934). The seeds float and are easily distributed by water (Bossard et al. 2000). Additionally, it can be spread in mud attached to vehicle and farm equipment (Nuzzo 1997).

Allelopathic (0–2) 2

It produces allelopathic chemicals that inhibit adjacent plants (Evans 1984, Hayden 1934).

Competitive Ability (0–3) 1

Canada thistle is shade intolerant and grows best when no competing vegetation is present. Its growth may be inhibited in disturbed natural areas if suitable native species are dense enough to provide sufficient competition. Seedlings are significantly less competitive than mature plants (Zouhar 2001). It is quite competitive for water and nutrients in cultivated fields (Bossard et al. 2000, Nuzzo 1997).

Thicket-forming/Smothering growth form (0–2) 2

Canada thistle can form dense colonies 1–4 feet tall, but on occasion may grow more than 6 feet tall and branch freely (Bossard et al. 2000, Royer and Dickinson 1999). The vegetative growth can produce very dense stands (I. Lapina pers. obs.).

Germination requirements (0–3) 2

Seeds germinate best in the top 0.2 to 0.6 inch of soil in bright light (they do not appear to germinate or establish without access to mineral soil) (Nuzzo 1997, Zouhar 2001). Canada thistle has been observed germinating along the road in vegetated areas (M. Shephard pers. com., P. Spencer pers.com.).

Other invasive species in the genus (0–3) 3

Cirsium vulgare (Savi) Ten. is declared a noxious weed in a number of American states and Canadian provinces (Invaders Database System 2003, USDA, NRCS 2002).

Aquatic, wetland or riparian species (0–3) 0

Canada thistle is common on roadsides, railway embankments, lawns, gardens, abandoned fields, agricultural fields, and pastures. It has been observed on exposed substrates following drawdown in wetlands, but is not common in saturated soils (Bossard et al. 2000, Nuzzo 1997, Zouhar 2001).

Total for Biological Characteristics and Dispersal 19/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) 4

Canada thistle is one of the worst weeds in agriculture (Bossard et al. 2000, Royer and Dickinson 1999).

Known level of impact in natural areas (0–6) 4

Natural areas invaded include prairies and wet grasslands (Canada and Dakota), sedge meadows (Wisconsin and Illinois). In eastern North America, it occurs in sand dunes, streambanks, lakeshores, swamps, and ditches (Nuzzo 1997). Woodland areas and creek banks are documented habitats in Iowa (Hayden 1934). It is a major pest in grasslands and moist prairies from the Pacific Northwest eastward to the plains (Bossard et al. 2000). Canada thistle has contributed to the elimination of endangered and endemic plant species such as the Colorado butterfly plant in Wyoming (Zouhar 2001).

Role of anthropogenic and natural disturbance in establishment (0–5) 3

Canada thistle has been observed on natural areas around ponds and wetlands where water levels fluctuate, areas of soil erosion, and gopher mounds. It apparently cannot become established or spread in undisturbed or good/excellent condition pastures (Bossard et al. 2000, Evans 1984, Zouhar 2001). Cultivation stimulates the growth of horizontal roots, thereby increasing the number of new upright shoots borne by the horizontal runners (Hayden 1934).

Current global distribution (0–5) 5

Native to Southeastern Europe, Western Asia, and Northern Africa, it now has a near global distribution, exclusive of Antarctica. Canada thistle occurs throughout Europe, Western and Central Asia, Northern and South Africa, India, Japan, China, North and South America, New Zealand, Tasmania, and Australia (Hayden 1934, Hultén 1968, Nuzzo 1997).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) 5

Canada thistle has been declared noxious in 35 states and 6 Canadian provinces (Invaders Database System 2003). It is a prohibited noxious weed in Alaska (Alaska Administrative Code 1987).

Total for Ecological Amplitude and Distribution 21/25

Feasibility of Control — Score

Seed banks (0–3) 3

Approximately 90% of seeds germinate within one year. Some seeds remain dormant in the soil for up to 20 years (Hutchison 1992, Roberts and Chancellor 1979).

Vegetative regeneration (0–3) 3

It readily propagates from stem and root fragments (Hayden 1934, Nuzzo 1997).

Level of effort required (0–4) 4

Management of Canada thistle may be achieved through hand-cutting, mowing, controlled burning, chemical poisoning, or some combination of these treatments. It takes at least two growing season to determine whether a particular control method is effective. Degree of control is influenced by clonal structure, growth stage, season of treatment, weather conditions, ecotype, soil type, and control methods used (Zouhar 2001).

Total for Feasibility of Control 10/10

Total score for 4 sections 76/100

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Cirsium vulgare (Savi) Ten — common names: bull thistle

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	20
Biological Characteristics and Dispersal	23	19
Amplitude and Distribution	25	18
Feasibility of Control	10	3
Relative Maximum		61

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Bull thistle has been collected in the south coastal region, at the Haines airport (University of Alaska Museum 2003), Prince of Wales Island (AKEPIC 2003), and in Ketchikan (Hultén 1968); and in interior boreal region, in Anchorage and Fairbanks (AKEPIC 2003, University of Alaska Museum 2003). Using the CLIMEX matching program, climatic similarity between Nome and areas where the species is documented is high. Native range of the species includes Røros, Norway and Vytegra and Vologda, Russia (Hultén 1968), which has a 76%, 67%, and 63% climatic match with Nome, respectively. Thus establishment of bull thistle in arctic alpine ecogeographic region in Alaska is likely possible.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 3
Bull thistle is known to retard the establishment and growth of conifers following timber harvest, thus impeding succession (Randall and Rejmáneck 1993), but it is generally associated only with highly degraded habitats.

Impact on Natural Community Structure (0–10) — 3
Bull thistle can maintain high population densities in clearcuts and areas of high grazing disturbance (Zouhar 2002).

Impact on Natural Community Composition (0–10) — 7
Bull thistle competes with and displaces native species (Bossard et al. 2000).

Impact on Higher Trophic Levels (0–10) — 7
Bull thistle displaces native species, including forage species favored by native ungulates such as deer and elk (Bossard et al. 2000). Phenolic acids found in *C. vulgare* may serve as defensive or allelopathic agents. Flavonoids and polyacetylenes may be toxic to insects and mammals. It is a host for numerous pathogenic fungi and viruses (Klinkhamer and De Jong 1993).

Total for Ecological Impact — 20/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3
Average seed production is nearly 4,000 per plant (Rutledge and McLendon 1996). Successful individual may produce up to 8,000 seeds (Klinlhamer et al. 1988). Though, losses in the seed stage are severe as a result of herbivory on the flowering stem and seed predation and number of seedlings produced per flowering individual is usually low (Klinkhamer and De Jong 1993). Reproduction is entirely by seed.

Long-distance dispersal (0–3) — 3
Seeds possess a hairy pappus and are well suited for wind dispersal (Rutledge and McLendon 1996).

Spread by humans (0–3) — 3
Extensive and rapid migration of bull thistle are likely results from the movement of livestock, vehicles, farm machines, and plant products such as seed and hay (Bossard et al. 2000, Rutledge and McLendon 1996, Zouhar 2002).

Allelopathic (0–2) — U
Not known to be allelopathic.

Competitive Ability (0–3) — 3
Bull thistle outcompetes native plant species for water, nutrients, and space (Bossard et al. 2000) and has been termed a "highly competitive weed" (Rutledge and McLendon 1996).

Thicket-forming/Smothering growth form (0–2) — 2
The plant stem is 2–5 feet tall, bearing many spreading branches. In areas of introduction, with some grazing, densities can be as high as 570 seedlings/m^2 (Forcella and Wood 1986, Whitson et al. 2000).

Germination requirements (0–3) — 2
Bull thistle germination is not inhibited by dense cover; however, subsequent seedling survival is reduced. It cannot tolerate dense shade (Klinkhamer and de Jong 1993, Rutledge and McLendon 1996).

Other invasive species in the genus (0–3) — 3
Cirsium arvense (L.) Scop. is declared noxious in nearly all American states and Canadian provinces (Invaders Database System 2003).

Aquatic, wetland or riparian species (0–3) — 0
Bull thistle is most common in recently or repeatedly disturbed areas such as pastures, rangelands, and along roads and ditches (Bossard et al. 2000).

Total for Biological Characteristics and Dispersal — 19/23

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 2
It is a serious weed of pastures and rangelands as well as clearcuts. It is known as a seed contaminant (Bossard et al. 2000, Rutledge and McLendon 1996).

Known level of impact in natural areas (0–6) — 3
In the Pacific Northwest, bull thistle invades foothills and dry meadows (Hitchcock and Cronquist 1973). It occurs in riparian areas, clearcuts, and alder flats in the western hemlock–Sitka spruce zones in Washington, in riparian areas and ponderosa pine communities in Oregon (Zouhar 2002). Bull thistle often dominates clearcuts in redwood and mixed evergreen forests in California (Bossard et al. 2000, Zouhar 2002). It is found in open meadows and ponderosa pine savanna in Colorado (Rutledge and McLendon 1996).

Role of anthropogenic and natural disturbance in establishment (0–5) — 3
Disturbance of soil and vegetation greatly increases seedling emergence and establishment of bull thistle. Even small-scale disturbances such as gopher mounds promote bull thistle establishment and survival (Klinkhamer and De Jong 1988). Spread of bull thistle is favored by trampling and soil disturbance (Rutledge and McLendon 1996). It can also colonize areas in relatively undisturbed grasslands, meadows, and forest openings (Bossard et al. 2000).

Current global distribution (0–5)	5

Bull thistle is native to Europe, from Britain and Iberia northward to Scandinavia, eastward to Western Asia, and southward to Northern Africa. It is found on every continent except Antarctica (Zouhar 2002).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5

Bull thistle has been reported in all 50 states and most Canadian provinces (Zouhar 2002). It is considered noxious in 10 states and 2 Canadian provinces (Invaders Database System 2003).

Total for Ecological Amplitude and Distribution	**18/25**
Feasibility of Control	**Score**
Seed banks (0–3)	0

Cirsium vulgare does not accumulate a persistent seed bank (De Jong and Klinkhamer 1988, Klinkhamer and De Jong 1988). Seed dry-stored, at room temperature, for more than 3 years did not germinate (Klinkhamer and De Jong 1993).

Vegetative regeneration (0–3)	0

Bull thistle propagates only by seed (Bossard et al. 2000).

Level of effort required (0–4)	3

Bull thistle will not withstand cultivation. Mechanically cutting the thistles at the soil surface is an effective method of control. A program that involves cutting should be maintained for at least 4 years. Chemicals can be used to control bull thistle as well (Rutledge and McLendon 1996).

Total for Feasibility of Control	**3/10**
Total score for 4 sections	**60/98**

§

Convolvulus arvensis L. common names: field bindweed, morning glory

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	18
Biological Characteristics and Dispersal	25	14
Amplitude and Distribution	25	16
Feasibility of Control	10	8
Relative Maximum		**56**

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	No	Yes
Arctic Alpine	No	Yes

Convolvulus arvensis has been reported from Haines and Ketchikan (AKEPIC 2004). The CLIMEX matching program indicates that climatic similarity between Nome and areas where the species is documented is high. The native range of the species includes Røros, Norway (Lid and Lid 1994) and Zlatoust and Bogolovsk, Russia (Gubanov et al. 2004), which have 76%, 71%, and 67% climatic similarity with Nome, respectively. There is also climatic similarity between Fairbanks and areas within the native range of field bindweed. Chita, Irkutsk, and Kirensk, Russia have 79%, 78%, and 77% climatic similarity with Fairbanks, respectively. We conclude *Convovlulus arvensis* could potentially establish in the interior boreal and arctic alpine ecoregions of Alaska.

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	3

Field bindweed tends to occupy bare ground under open conditions. It is unclear how long this species may persist in native plant communities, but it can affect successional processes (Rutledge and McLendon 1996). The extensive root system of field bindweed reduces the soil moisture and nutrients available to other plants (Zouhar 2004).

Impact on Natural Community Structure (0–10)	5

Field bindweed can twine and may climb over forbs and shrubs, or form dense tangled mats on the ground, but it does not create a new layer (Gubanov et al. 2004, Zouhar 2004).

Impact on Natural Community Composition (0–10)	5

Field bindweed reportedly reduces cover of native grasses and forbs thereby decreasing biodiversity (Lyons 1982).

Impact on Higher Trophic Levels (0–10)	5

This plant attracts various pollinators including bees, honeybees, bumblebees, butterflies, and moths (Zouhar 2004). Field bindweed may be mildly toxic to some grazing animals (Lyons 1998, Todd et al. 1995) although livestock has been observed consuming field bindweed (Gubanov et al. 2004). This plant hosts several viruses (Weaver and Riley 1982).

Total for Ecological Impact	**18/40**
Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	2

Field bindweed reproduces by seed and rhizome. The number of seeds per plant varies between 12 and 500 (Royer and Dickinson 1999, Weaver and Riley 1982).

Long-distance dispersal (0–3)	2

Seeds fall near the parent plant, but can be dispersed farther by water or passage through animals or birds (Harmon and Keim 1934, Proctor 1968, Weaver and Riley 1982, Zouhar 2004).

Spread by humans (0–3)	3

Seeds can be dispersed by vehicles and machinery, and in contaminated farm and garden seed, as well as root balls. Field bindweed is planted as an ornamental ground cover and in hanging baskets (Zouhar 2004).

Allelopathic (0–2)	2

Field bindweed is highly allelopathic to other species (Reynders and Ducke 1979 cited in Weaver and Riley 1982).

Competitive Ability (0–3)	3
Due to its extensive root system, field bindweed is extremely competitive (Elmore and Cudney 2003, Rutledge and McLendon 1996) and is able to outcompete native grasses for moisture and nutrients (Lyons 1982). Field bindweed is tolerant of a variety of environmental conditions allowing it to effectively compete for resources (Rutledge and McLendon 1996, Whitson et al. 2000).	
Thicket-forming/Smothering growth form (0–2)	2
Field bindweed can twine, climb ,and form dense, tangled mats over other forbs and shrubs (Gubanov et al. 2004, Zouhar 2004, Weaver and Riley 1982).	
Germination requirements (0–3)	0
Field bindweed establishes and germinates better on bare ground than on sites with vegetation or litter (Zouhar 2004).	
Other invasive species in the genus (0–3)	0
No other weedy *Convolvulus* species are known (USDA 2002).	
Aquatic, wetland or riparian species (0–3)	0
Field bindweed is especially common in cereal crops, orchards, and vineyards. It can also be found on ditch banks, along roadsides, streambanks, and lakeshores (Lyons 1998, SAFRR 2005). It is found on dry or moderately moist soils and it is not normally a weed of wetlands (Weaver and Riley 1982).	
Total for Biological Characteristics and Dispersal	**14/25**

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
Field bindweed has had a reputation as a weed in European gardens since the 17th century. In the late 19th century this pest became a problem in North America (Austin 2000) and now it is considered to be the worst agricultural weed in many areas (Hitchcock et al. 1959). It is particularly troublesome in white bean, cereal, and corn crops and is abundant in vineyards and orchards and in sugar beet and vegetable crops. Field bindweed can reduce crop yields by 50% (Royer and Dickinson 1999). This species has not been recorded in agricultural field of Alaska however, (J. Conn pers. com).	
Known level of impact in natural areas (0–6)	2
Field bindweed occurs in open annual grassland and oak savanna sites in California where it threatens endangered native grasses and forbs. In Idaho field bindweed outcompetes native grasses and threatens bunchgrass and forb-dominated habitats. Field bindweed dominates the understory in tree and shrub communities in Wyoming and has invaded remote, undisturbed aspen stands, riparian areas, and mountain shrublands and grasslands in Colorado (Lyons 1982, Zouhar 2004). It occurs in the understory in cottonwood stands along the Missouri River in southeastern South Dakota (Wilson 1970). Field bindweed is a dominant species in some disturbed riverbank areas in Quebec (Morin et al. 1989).	
Role of anthropogenic and natural disturbance in establishment (0–5)	0
Field bindweed is an early successional species that establishes well on bare ground or in disturbed natural communities. Germination is better on bare ground than on sites with litter or vegetation (Zouhar 2004).	
Current global distribution (0–5)	5
Field bindweed is native to Europe and Asia, but is now cosmopolitan between 60°N and 45°S latitudes, growing in temperate, tropical, and Mediterranean climates (Gubanov et al. 2004, Weaver and Riley 1982).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Field bindweed is common in the United States, except in the extreme Southeast, New Mexico, and Arizona. It is found in agricultural regions of all Canadian provinces, except Newfoundland and Prince Edward Island (Weaver and Riley 1982). Field bindweed is a noxious weed in 35 American states and 5 Canadian provinces (Invaders Database System 2003, USDA 2002) and is a prohibited noxious weed in Alaska (Alaska Administrative Code 1987).	
Total for Ecological Amplitude and Distribution	**16/25**

Feasibility of Control	**Score**
Seed banks (0–3)	3
The seed bank of field bindweed is extremely persistent. Seeds may lie dormant in the soil more than 50 years (Elmore and Cudney 2003, Lyons 1998, Timmons 1949, Whitson et al. 2000).	
Vegetative regeneration (0–3)	2
Field bindweed resprouts repeatedly following removal of aboveground growth. Root fragments 2.5 inches or more in length are able to produce new shoots under conditions of sufficient moisture (Lyons 1998, Sherwood 1945, Swan and Chancellor 1976). Roots and rhizomes of field bindweed store carbohydrates and proteins that provide the resources necessary for resprouting (Lyons 1998).	
Level of effort required (0–4)	3
Herbicides are generally the most effective control of field bindweed. Mechanical control is not a likely option because plants are able to reproduce from roots. Currently, no biological control agents are available (Elmore and Cudney 2003, Whitson et al. 2000, Rutledge and McLendon 1996).	
Total for Feasibility of Control	**8/10**
Total score for 4 sections	**56/100**

§

Cotula coronopofolia L. — common names: common brassbuttons

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		No
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	14
Biological Characteristics and Dispersal	23	11
Amplitude and Distribution	25	9
Feasibility of Control	10	7
Relative Maximum		42

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	No	
Arctic Alpine	No	

Cotula coronopifolia has been documented in the south coastal ecoregion of Alaska (Hultén 1968, Welsh 1974). It is known from Petersburg and Gambier Bay (M. Shephard pers. com.). Using the CLIMEX matching program, climatic similarity between Fairbanks and Nome and areas where the species is documented is relatively low. It is unlikely to establish in the arctic alpine or interior boreal ecogeographic regions of Alaska. Climatic similarity between Anchorage and areas where the species is documented is relatively high. *Cotula coronopifolia* has been reported from Lærdal, Norway (Lid and Lid 1994), which has 61% climatic similarity with Anchorage (CLIMEX 1999). However, *Cotula coronopifolia* germinates in late autumn and winter, causing high seedlings mortality due to winter frost (van der Toorn and ten Hove 1982). Thus establishment in the interior boreal region is unlikely.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 3

In northwestern Europe common brassbuttons is a pioneer colonist of bare, wet soils (van der Toorn 1980, van der Toorn and ten Hove 1982); therefore, it can likely hinder natural colonization by native species in areas where it is introduced.

Impact on Natural Community Structure (0–10) — 5

It can form large monospecific stands along upper coastal habitats and mudflats and it can integrate into densely vegetated wetland sites in California (Bixby 2004).

Impact on Natural Community Composition (0–10) — 3

This species appears to often establish in areas with few other plant species, but likely reduces the density and number of species present in upper coastal habitats (M. Shephard pers. com.).

Impact on Higher Trophic Levels (0–10) — 3

Brassbuttons is pollinated by insects; therefore, may alter pollinator's behavior (Plants for a future 2002, van der Toorn 1980).

Total for Ecological Impact — 14/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3

Common brassbuttons propagates by seed and pieces of stem that root at the nodes (Plants for a future 2002). The number of seeds produced per plant can range from 13,300 to 50,200 (van der Toorn 1980).

Long-distance dispersal (0–3) — 2

Seeds are dispersed by water. Dispersal distance was about 350–450 m per year in the study of van der Toorn (1980). Seeds dispersal by birds is possible, but it rarely occurs (van der Toorn 1980). The viability of seeds passing through intestine of geese was high in study of van der Toorn and ten Hove (1982).

Spread by humans (0–3) — 1

Movement by humans is not likely, because it generally grows in inaccessible areas (van der Toorn 1980). However, common brassbuttons is occasionally grown in gardens (Plants for a future 2002).

Allelopathic (0–2) — U

Unknown

Competitive Ability (0–3) — 0

Common brassbutton is not a completely successful colonist. It can maintain itself only in particular habitats (van der Toorn 1980, van der Toorn and ten Hove 1982). Survival of seedlings is very low (van der Toorn and ten Hove 1982). Common brassbutton has been in decline or has become locally extinct on some estuaries in Europe (Lid and Lid 1984, van der Toorn and Hove 1982).

Thicket-forming/Smothering growth form (0–2) — 0

Common brassbuttons does not form dense thickets.

Germination requirements (0–3) — 2

Common brassbuttons has been observed germinating and establishing in vegetated grassy area in California (Bixby 2004).

Other invasive species in the genus (0–3) — 0

Cotula australis (Sieber) Hook. is a common weed in urban coastal areas in California, but is not listed as an invasive species (McClintock 1993, USDA 2002).

Aquatic, wetland or riparian species (0–3) — 3

The species is widely distributed along the beaches, tidal flats, and estuaries of the world (Bixby 2004, Hultén 1968, McClintock 1993, Welsh 1974).

Total for Biological Characteristics and Dispersal — 11/23

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 0

Common brassbuttons is not an agricultural weed.

Known level of impact in natural areas (0–6) — 1

Common brassbuttons colonizes salt and freshwater marshes along the coast in California (Bixby 2004, McClintock 1993). It has been reported from river estuaries in Britain (van der Toorn 1980), New Zealand, and Australia (Calder 1961, Congdon and McComb 1981, Evans 1953).

Role of anthropogenic and natural disturbance in establishment (0–5) — 3

Common brassbuttons inhabit bare, wet mud or areas grazed by geese in estuaries or along rivers. It also occurs on inland sites, mostly in anthropogenically disturbed areas (van der Toorn 1980).

Current global distribution (0–5) — 3

Cotula coronopifolia probably originated from South Africa. It now occurs in all west coast states of the United States, in Europe, South America, New Zealand, Australia, and Tasmania (Hultén 1968, USDA 2002).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) — 2

Common brassbuttons has been reported from Alaska, Arizona, California, Massachusetts, Nevada, Oregon, and Washington (USDA 2002).

Total for Ecological Amplitude and Distribution — 9/25

Feasibility of Control	Score
Seed banks (0–3)	2
Seeds buried in soil and permanently submerged in water lost viability after 23 months (van der Toorn and ten Hove 1982).	
Vegetative regeneration (0–3)	2
The species is documented as regenerating from pieces of stem (Plants for a future 2002).	
Level of effort required (0–4)	3
Common brassbuttons can grow on very soft, deep mud, making infestations nearly inaccessible by foot or boat. No herbicides are selective enough to be used in wetlands without the potential for injuring native species.	
Total for Feasibility of Control	**7/10**
Total score for 4 sections	**41/98**

§

Crepis tectorum L. common names: narrowleaf hawksbeard

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	30	9
Biological Characteristics and Dispersal	25	17
Amplitude and Distribution	25	18
Feasibility of Control	7	3
Relative Maximum		

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Crepis tectorum has been collected in south coastal [Seward, Skagway, Lake Clark, and Unalaska (UAM 2004)], interior boreal [Anchorage and Fairbanks (Hultén 1968, UAM 2004), Wasilla (AKNHP 2003), and Denali National Park and Preserve (Densmore et al. 2001)], and arctic alpine [Dillingham (UAM 2004)] ecoregions in Alaska. The range of the species includes Dillingham, of the arctic alpine ecoregion (UAM 2004) where it withstands winter temperatures to -53 °F and a mean of 140 frost-free days (WRCC 2004). It is unclear if *Crepis tectorum* can establish in arctic sites with shorter growing seasons (e.g., Nome has similar extreme winter temperatures, but averages 30 fewer frost-free days (WRCC 2004).

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	3
Narrowleaf hawksbeard likely reduces water availability. It may delay the establishment of native species on naturally disturbed soil (J. Conn pers. com.) including following forest fires in interior Alaska (K. Villano 2007).	
Impact on Natural Community Structure (0–10)	3
Narrowleaf hawksbeard has established along the Knik River where it changes the density of other species (M. Shephard pers. com.).	
Impact on Natural Community Composition (0–10)	3
Dense stands of narrowleaf hawksbeard in Denali National Park and Healy have displaced native colonizers (R. Densmore pers. com.).	
Impact on Higher Trophic Levels (0–10)	U
No information was found identifying impacts on higher trophic levels.	
Total for Ecological Impact	**9/30**

Biological Characteristics and Dispersal	Score
Mode of Reproduction (0–3)	3
Narrowleaf hawksbeard reproduces by seeds. Each plant is capable of producing over 49,000 seeds (Royer and Dickinson 1999).	
Long-distance dispersal (0–3)	3
The small seeds have long pappus hairs that aid in wind dispersal (SAFRR 1984, Royer and Dickinson 1999).	
Spread by humans (0–3)	3
Narrowleaf hawksbeard is often a contaminant in agricultural seed (MAFRI 2004). It spreads along roadsides in Alaska (Densmore et al. 2001).	
Allelopathic (0–2)	0
None	
Competitive Ability (0–3)	3
Narrowleaf hawksbeard competes with native species for soil moisture (J. Snyder pers. com.). It competes successfully with hay crops (J. Conn pers. com.).	
Thicket-forming/Smothering growth form (0–2)	0
Narrowleaf hawksbeard does not form dense thickets (Lapina pers. obs.).	
Germination requirements (0–3)	1
Narrowleaf hawksbeard has been observed germinating in areas with anthropogenic and natural disturbances (M. Shephard pers. obs.). It can germinate in established hayfields (Royer and Dickinson 1999, J. Conn pers. obs.).	
Other invasive species in the genus (0–3)	3
Crepis capillaris (L.) Wallr. is declared noxious in Minnesota (Invaders Database System 2003).	
Aquatic, wetland or riparian species (0–3)	1
Narrowleaf hawksbeard can be found on cultivated fields, pastures, forage stands, fallow land, roadsides, and railroads (Royer and Dickinson 1999, SAFRR 1984). It is established along the Knik River (M. Shephard pers. com.).	
Total for Biological Characteristics and Dispersal	**17/25**

Ecological Amplitude and Distribution	Score
Highly domesticated or a weed of agriculture (0–4)	4
Narrowleaf hawksbeard is a weed of agricultural fields (MAFRI 2004, Royer and Dickinson 1999).	
Known level of impact in natural areas (0–6)	1
Narrowleaf hawksbeard is not considered as an invader of natural areas (Densmore et al. 2001). However, this taxon degrades a number of habitat types in the Pacific Northwest; it persists in disperse populations in disturbed headlands, grasslands, and clearcuts (M.L. Carlson pers. obs.), additionally it is known to invade and persist following forest fires in interior Alaska (Villano 2007).	

Role of anthropogenic and natural disturbance in establishment (0–5)	3
Narrowleaf hawksbeard readily colonizes disturbed sites and open areas (Densmore et al. 2001, I. Lapina pers obs). However, it has established on river bars in southeast Alaska (M. Shephard pers. obs.) and following forest fires (Villano 2007).	
Current global distribution (0–5)	5
The present world distribution of narrowleaf hawksbeard includes most of Europe, Asia, and North America to the subarctic–arctic zone (Hultén. 1968).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Narrowleaf hawksbeard is widespread in the northeastern United States and Canada (Royer and Dickinson 1999, USDA 2002). It is listed as noxious in Minnesota, Alberta, and Manitoba (Invaders Database System 2003).	
Total for Ecological Amplitude and Distribution	18/25

Feasibility of Control	**Score**
Seed banks (0–3)	U
Longevity of seed bank is not documented. Densmore (2001) suggested seed viability of 1 year or less.	
Vegetative regeneration (0–3)	0
Narrowleaf hawksbeard does not resprout after aboveground growth is removed (Densmore et al. 2001).	
Level of effort required (0–4)	3
Narrowleaf hawksbeard does not persist without repeated anthropogenic disturbance in Alaska. It is likely that control can be accomplished with repeated mechanical or chemical treatments. Future monitoring after site eradication is important as this plant is likely to be reintroduced after it is eradicated (Densmore et al. 2001).	
Total for Feasibility of Control	3/7
Total score for 4 sections	47/87

§

Crupina vulgaris Cass. common names: common crupina, bearded creeper

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		No
Interior Boreal		No
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact		
Biological Characteristics and Dispersal		
Amplitude and Distribution		
Feasibility of Control		
Relative Maximum		
Rejected from consideration		

Climatic Comparison		
	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal		
Interior Boreal		
Arctic Alpine		

Crupina vulgaris has not been collected in Alaska (Hultén 1968, Welsh 1974, AKEPIC 2004, UAM 2004). The native population of *Crupina vulgaris* is distributed around the Mediterranean region. Western limits are the Iberian Peninsula and Morocco. Northern limits include southern Europe, northern Greece, and Turkey. The range extends south to northern Iran and Iraq and east to the Caucasus region, Uzbekistan, Turkmenistan, and northeastern Afghanistan. This species has been introduced in Idaho, California, Washington, and Oregon (Garnatje et al. 2002, USDA 2002, USDA, ARS 2005). The CLIMEX climate matching program indicates the climatic similarity between Juneau, Fairbanks, and Nome and areas where the species is documented is low. Similarity between Juneau, Fairbanks, and Nome and Soria and Cuenca, Spain and Braganca, Portugal is 25% to 30%. Similarity between Alaska climate with areas of *Crupina* introduced range in Oregon and Idaho is 21% to 40%. Thus establishment of *Crupina vulgaris* in Alaska is unlikely. This species is rejected from consideration for ranking.

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	
Impact on Natural Community Structure (0–10)	
Impact on Natural Community Composition (0–10)	
Impact on Higher Trophic Levels (0–10)	
Total for Ecological Impact	/
Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	
Long-distance dispersal (0–3)	
Spread by humans (0–3)	
Allelopathic (0–2)	
Competitive Ability (0–3)	
Thicket-forming/Smothering growth form (0–2)	
Germination requirements (0–3)	
Other invasive species in the genus (0–3)	
Aquatic, wetland or riparian species (0–3)	
Total for Biological Characteristics and Dispersal	/
Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	
Known level of impact in natural areas (0–6)	
Role of anthropogenic and natural disturbance in establishment (0–5)	
Current global distribution (0–5)	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	
Total for Ecological Amplitude and Distribution	/
Feasibility of Control	**Score**
Seed banks (0–3)	
Vegetative regeneration (0–3)	
Level of effort required (0–4)	
Total for Feasibility of Control	/
Total score for 4 sections	/

§

Cytisus scoparius (L.) Link common names: English broom, Scotch broom

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		No
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	26
Biological Characteristics and Dispersal	25	17
Amplitude and Distribution	25	18
Feasibility of Control	10	8
Relative Maximum		69

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	No	No
Arctic Alpine	No	No

Cytisus scoparius has been collected from Sitka (UAM 2003) and it is reported from Ketchikan and Prince of Wales Island (M. Shephard pers. com.). The range of the species includes the British Isles, central and southern Europe (Hoshovsky 1986). Its northern limits are probably controlled by low winter temperatures. It withstands winter temperatures to -13 °F and requires 150 frost-free days (USDA 2002). Fairbanks typically has 140 frost-free days, but winter temperatures reach -60 °F. Nome has approximately 80 frost-free days and likely minimum temperatures -54 °F (WRCC 2001). *Cytisus scoparius* is unlikely to establish in the interior boreal and arctic alpine ecoregions.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 7
Scotch broom stands prevent reforestation and create a high fire hazard. Additionally, this species produces a sparse, readily decomposable litter. There is concern that its vigorous growth inhibits establishment of other species (Bossard et al. 2000, Hoshovsky 1986). This species also fixes nitrogen.

Impact on Natural Community Structure (0–10) — 7
Scotch broom can grow so dense that it is often impenetrable and prevents the establishment of the native plants (Hoshovsky 1986, Prasad 2002). There is generally a much reduced low-herbaceous layer under scotch broom canopy (M.L. Carlson pers. obs.)

Impact on Natural Community Composition (0–10) — 7
Scotch broom can form pure stands and reduce number of native species in the community (Hoshovsky 1986).

Impact on Higher Trophic Levels (0–10) — 5
When scotch broom's growth becomes too dense it eliminates forage sites for deer. It is slightly toxic and unpalatable for browsing animals (Hoshovsky 1986). Bumblebee and solitary bee pollinators find *Cytisus scoparius* highly desirable, therefore, may draw pollination services away from native plants (M.L. Carlson pers. obs.)

Total for Ecological Impact — 26/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3
Scotch broom may reproduce vegetatively or by seed. Plants can produce anywhere from 700 to 60,000 seeds per plant (Bossard et al. 2000, Waloff and Richards 1977).

Long-distance dispersal (0–3) — 3
Scotch broom fruits open explosively, seeds may be scattered many meters (Hoshovsky 1986, Prasad 2002) and secondarily dispersed by ants (Parker 2000). The seed is also distributed by water, birds, and other animals (Bossard et al. 2000, Hoshovsky 1986).

Spread by humans (0–3) — 3
Scotch broom is frequently planted in gardens and as a soil binder along highway cuts and fills. It spreads rapidly along the roads due to passing vehicles and in gravel hauled from river bottoms (Bossard et al. 2000, Hoshovsky 1986).

Allelopathic (0–2) — 0
Scotch broom is not listed as allelopathic (USDA 2002).

Competitive Ability (0–3) — 3
Cytisus scoparius is strong competitor and can dominate a plant community, forming a dense monospecific stand (Bossar et al. 2000, Parker 2000). This plant can fix nitrogen throughout the year in regions with mild winters (Wheeler et al. 1979).

Thicket-forming/Smothering growth form (0–2) — 2
Within the first year broom plants can grow over 3 feet tall. It grows very densely and is often impenetrable, preventing the establishment of the native plants (Hoshovsky 1986, Prasad 2002).

Germination requirements (0–3) — 0
Germination requires scarification and soaking. Germination is greatest when seeds are buried less than 1 inch deep in a fine textured substrate; no germination occurs when seeds are buried 4 inches deep (Hoshovsky 1986).

Other invasive species in the genus (0–3) — 3
Cytisus multiflorus (L'Heritier) Sweet and *C. striatus* (Hill) Rothm. are weedy species that are found on the Pacific coast (McClintock 1993, USDA 2002).

Aquatic, wetland or riparian species (0–3) — 0
Scotch broom invades pastures, cultivated fields, roadsides, dry scrubland, native grasslands, glacial outwash prairies, dry riverbeds, and occasionally along other waterways (Hoshovsky 1986, Parker 2000, Whitson et al. 2000).

Total for Biological Characteristics and Dispersal — 17/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 4
Scotch broom is frequently planted in gardens and as a soil binder along highway cuts and fills (Coombs and Turner 1995, Hoshovsky 1986). It appears for sale as a nursery product (USDA 2002).

Known level of impact in natural areas (0–6) — 3
Scotch broom invades native grasslands, glacial outwash prairies, dry riverbeds, other waterways, and clearcuts in states of the Pacific Northwest. In California, scotch broom has become extensively naturalized in grassland areas (Hoshovsky 1986). It may be threatening Garry oak woodlands in British Columbia (Prasad 2002).

Role of anthropogenic and natural disturbance in establishment (0–5) — 3
Bare soil caused by disturbance is very conducive for seedling establishment (Hoshovsky 1986, Prasad 2002). Scotch broom can regenerate only where the canopy is disturbed by fire, substrate instability, logging ,or grazing (Hoshovsky 1986).

Current global distribution (0–5)	3
Scotch broom is native to the British Isles as well as Central and Southern Europe to the Canary Islands (USDA, ARS 2004). It has become widely naturalized in North America (Hoshovsky 1986) as well as India, Iran, New Zealand, Australia, and South Africa (Prasad 2002).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
In western North America, scotch broom has now become established along the inland valleys of the Pacific Northwest, from British Columbia to central California (Hitchcock and Cronquist 1990). It is found in 25 states (USDA 2002) and is listed as noxious in California, Hawaii, Idaho, Oregon, and Washington (Invaders Database System 2003).	
Total for Ecological Amplitude and Distribution	18/25

Feasibility of Control	**Score**
Seed banks (0–3)	3
Seeds remain viable for over 80 years (Bossard et al. 2000, Coombs and Turner 1995, Hoshovsky 1986, Prasad 2002).	
Vegetative regeneration (0–3)	2
Plants can resprout after burning or cutting, particularly during the rainy season (Bossard et al. 2000, Hoshovsky 1986).	
Level of effort required (0–4)	3
Hand pulling, cutting, or mowing can be effective. However, broom easily resprouts and seeds are long-lived. Therefore, long-term monitoring is needed (Hoshovsky 1986).	
Total for Feasibility of Control	8/10
Total score for 4 sections	69/100

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Dactylis glomerata L. — common names: orchardgrass

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	16
Biological Characteristics and Dispersal	25	10
Amplitude and Distribution	25	22
Feasibility of Control	10	5
Relative Maximum		53

Climatic Comparison	*Collected in Alaska regions?*	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	No	Yes
Arctic Alpine	No	Yes

Dactylis glomerata has been collected in the south coastal ecogeographic region of Alaska (Hultén 1968, Welsh 1974, AKEPIC 2005,UAM 2004). *Dactylis glomerata* is known to occur throughout Europe and has been documented as far north as the northern province in Norway (Finnmark) at 70°N (Lid and Lid 1994). The range of this species also includes Røros and Dombås, Norway, which have 76% and 63% climatic matches with Nome, and 55% and 52% climatic matches with Fairbanks, respectively. Thus, it may be possible for *Dactylis glomerata* to become established in the interior boreal and arctic alpine ecogeographic regions.

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	5
Dense stands of orchardgrass may suppress the growth of native shrubs (Anderson and Brooks 1975) and trees (Powell et al. 1994). Lodgepole pine seedling survival and growth rate decreased as the density of orchardgrass increased in a field study conducted in British Columbia (Powell et al. 1994).	
Impact on Natural Community Structure (0–10)	3
Orchardgrass alone usually does not form a dense layer, but when it grows with another perennial European grass such as *Festuca arundinacea*, *Holcus lanatus*, or *Phalaris aquatica*, it is capable of developing a dense stand that excludes native perennial grasses (Cobrin et al. 2004, Cal-IPC 2005).	
Impact on Natural Community Composition (0–10)	3
As a codominant with other exotic perennial grasses, orchardgrass is capable of causing reduction and extirpation of native perennial grasses (Cobrin et al. 2004, Cal-IPC 2005).	
Impact on Higher Trophic Levels (0–10)	5
Orchardgrass is moderately nutritious and highly palatable to grazing animals. Orchardgrass also provides food and cover for a number of small mammals, birds, and insects (Sullivan 1992). However, suppressed development of native shrubs might be detrimental to native wildlife habitat (Anderson and Brooks 1975).	
Total for Ecological Impact	16/40

Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	1
Orchardgrass reproduces by seeds (Beddows 1957). Because orchardgrass breeders have traditionally focused on forage traits, most cultivars are not necessarily good seed producers (Casler et al. 2003).	
Long-distance dispersal (0–3)	2
Most seeds fall directly to the soil below the parent plant. Some seeds attach to animals and travel long distances (Beddows 1957).	
Spread by humans (0–3)	3
Orchardgrass is widely used as a forage crop and is recommended as part of a mix for erosion control and pasture rehabilitation (Anderson and Brooks 1975, McLean and Clark 1980). It is a common commercial seed contaminant (Bush et al. 2005).	
Allelopathic (0–2)	0
Orchardgrass is not listed as an allelopathic (USDA, NRCS 2006). In experimental studies orchardgrass did not show significant inhibition of germination, root, and shoot growth (Grant and Sallens 1964, Larson et al. 1995).	
Competitive Ability (0–3)	1
Orchardgrass is able to compete with native perennials and annual species (Corbin et al. 2004).	
Thicket-forming/Smothering growth form (0–2)	0
Orchardgrass rarely forms dense layers, but it is capable of creating a dense stand when grown with other perennial European grasses (Corbin et al. 2004, Cal-IPC 2005).	

Germination requirements (0–3)	3
Orchardgrass is widely used for pasture improvements and is commonly broadcast seeded (Sullivan 1992). Thus, orchardgrass presumably can germinate on vegetated sites.	
Other invasive species in the genus (0–3)	0
None (USDA, NRCS 2006).	
Aquatic, wetland or riparian species (0–3)	0
Orchardgrass prefers dry soils in waste places, fields, yards, and roadsides (Hultén 1968, Welsh 1974).	
Total for Biological Characteristics and Dispersal	10/25
Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
Orchardgrass is widely used as a forage crop. A number of cultivars have been developed (Anderson and Brooks 1975, McLean and Clark 1980).	
Known level of impact in natural areas (0–6)	3
Orchardgrass has invaded oak woodlands and perennial grasslands in California (Williamson and Harrison 2002, Corbin et al. 2004). However, its impact on natural communities is considered to be low (Cal-IPC 2005). Orchardgrass appears to have potential for invading and modifying existing plant communities in Rocky Mountain National Park (Rutledge and McLendon 1996). Orchardgrass invades open woodlands and prairies in western Oregon (M. Carlson pers. obs.)	
Role of anthropogenic and natural disturbance in establishment (0–5)	5
Orchardgrass is usually associated with human disturbances (Hultén 1968, Welsh 1974, Williamson and Harrison 2002), but it is known to invade undisturbed coastal prairie grasslands (Corbin et al. 2004).	
Current global distribution (0–5)	5
Orchardgrass was introduced from Europe and it is now present throughout temperate Asia and North America. It was also introduced into South America, Australia, and New Zealand, and can be found in the Arctic (Hultén 1968, Tolmachev et al. 1995).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Orchardgrass is present throughout the United States and Canada (USDA, NRCS 2006). It is declared noxious in New Jersey and Virginia (Rice 2006).	
Total for Ecological Amplitude and Distribution	22/25
Feasibility of Control	**Score**
Seed banks (0–3)	0
Orchardgrass does not have long-lived seeds. Most seeds germinate in the fall or following spring (Dorph-Petersen 1925, Beddows 1959).	
Vegetative regeneration (0–3)	2
Vegetative regeneration of orchardgrass occurs through tilling. When plants are cut or plowed, rooting stems may develop new plants (Beddows 1957).	
Level of effort required (0–4)	3
Generally, mechanical methods are not effective in control of orchardgrass. Numerous herbicides are available for this species (Rutledge and McLendon 1996).	
Total for Feasibility of Control	5/10
Total score for 4 sections	54/100

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Descurainia sophia (L.) Webb ex Prantl. common names: flixweed, herb sophia

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	8
Biological Characteristics and Dispersal	25	13
Amplitude and Distribution	25	18
Feasibility of Control	10	2
Relative Maximum		41

Climatic Comparison		
	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Descurainia sophia has been collected from the south coastal, interior boreal, and arctic alpine ecoregions of Alaska (Hultén 1968, UAM 2004).

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	0
Flixweed is a pioneer species of disturbed soils, facilitating the establishment of other weedy species. It can form dense stands that become dried, creating a fire hazard. If flixweed stands do not burn, dried plants facilitate cheatgrass establishment (Howard 2003). Nevertheless in Alaska, this species does not tend to invade natural plant communities (M. Carlson pers. obs., I. Lapina pers. obs.).	
Impact on Natural Community Structure (0–10)	0
Flixweed establishes in an existing layer and changes the density of the layer on disturbed sites (I. Lapina pers. obs., WSSA 2003). No impact on the natural community structure has been documented. Increases total percent cover in open, disturbed sites.	
Impact on Natural Community Composition (0–10)	1
Flixweed has not been observed in undisturbed areas in Alaska; no perceived impact on native populations has been documented (Densmore et al. 2001).	

Impact on Higher Trophic Levels (0–10)	7
All parts of the plant are poisonous, causing blindness, staggering, and loss of ability to swallow. Flixweed is a larval food for pierid butterflies. It is an alternate host for several viruses (Howard 2003, MAFRI 2004).	
Total for Ecological Impact	8/40

Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	3
Flixweed reproduces entirely by seed. It generally produces 75–650 seeds per plant. Some plants can produce over 700,000 seeds (Howard 2003, Rutledge and McLendon 1996).	
Long-distance dispersal (0–3)	3
Seeds of flixweed can be dispersed by multiple vectors: wind, water, and animals. It has a mucilaginous seedcoat that sticks to feathers or fur (Howard 2003, WSSA 2003). However, most seed falls near the parent plant (Howard 2003).	
Spread by humans (0–3)	2
Flixweed is spread by vehicles and machinery (Howard 2003). It also is known as a contaminant in cereal and forage seed (MAFRI 2004, Rutledge and McLendon 1996).	
Allelopathic (0–2)	0
No known documentation of allelopathy.	
Competitive Ability (0–3)	1
Flixweed can be quite competitive with crops for moisture and nutrients, severely reducing crop yields (MAFRI 2004). However, in natural late-seral communities of perennial grasses and forbs, flixweed is a poor competitor (Baker et al. 2003, SAFRR 1984).	
Thicket-forming/Smothering growth form (0–2)	1
Flixweed tends to form dense and crowded stands up to 3 feet tall (Howard 2003, WSSA 2003). Populations in Alaska are generally dispersed (I. Lapina pers. obs.).	
Germination requirements (0–3)	0
Flixweed requires open soil and disturbance for germination (Densmore et al. 2001).	
Other invasive species in the genus (0–3)	3
Descurainia pinnata (Walt.) Britt. is considered an invasive weed (USDA 2002).	
Aquatic, wetland or riparian species (0–3)	0
Flixweed has not been observed in undisturbed areas in Alaska; no perceived impact on native populations has been documented (Densmore et al. 2001). It is common in dry, well-drained anthropogenically disturbed areas (e.g., roadsides, railroads, pastures, cultivated areas, old fields) where the native vegetation has been damaged or destroyed (Baker et al. 2003, Howard 2003, MAFRI 2004).	
Total for Biological Characteristics and Dispersal	13/25

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
Flixweed is a serious weed of crops. It has been reported to reduce crop yields drastically (Howard 2003, MAFRI 2004, Royer and Dickinson 1999).	
Known level of impact in natural areas (0–6)	3
Flixweed occurs in sagebrush, pinyon, and juniper communities of Washington, Oregon, Nevada, Utah, and California (Howard 2003). This weed, therefore, may invade Alaska's sagebrush–steppe communities of the interior ecogeographic region. Flixweed appears to have little impact on native plant communities and succession processes in Rocky Mountain National Park, Colorado (Rutledge and McLendon 1996).	
Role of anthropogenic and natural disturbance in establishment (0–5)	1
Flixweed appears to establish only in areas with non-natural soil disturbance and an open canopy. Intensive grazing makes rangelands vulnerable to flixweed invasion (Howard 2003).	
Current global distribution (0–5)	5
Flixweed is native to Southern Europe and Northern Africa. Its current distribution includes all Nordic countries to 70°N, Siberia, East Asia, South Africa, North and South America, and New Zealand (Howard 2003, Hultén 1968).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Flixweed now occurs in 48 states and throughout Canada. It is classified as a noxious weed in Colorado and Minnesota (USDA 2002).	
Total for Ecological Amplitude and Distribution	18/25

Feasibility of Control	**Score**
Seed banks (0–3)	2
The seed bank of flixweed can be large. Buried seeds remained viable 4 years or more in interior Alaska (Conn 1990, Densmore et al. 2001).	
Vegetative regeneration (0–3)	0
Flixweed does not resprout after removal of aboveground growth (Densmore et al. 2001).	
Level of effort required (0–4)	0
Flixweed is not maintained in late-seral communities. It may not require directed control measures (Densmore et al. 2001, Howard 2003). Control can be achieved with mechanical treatment. Seedlings are very sensitive to most herbicides, even at low dosages.	
Total for Feasibility of Control	2/10
Total score for 4 sections	41/100

§

Digitalis purpurea L. common names: purple foxglove

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	16
Biological Characteristics and Dispersal	25	11
Amplitude and Distribution	25	19
Feasibility of Control	10	5
Relative Maximum		51

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	No

Digitalis purpurea has been reported from Ketchikan, Petersburg, and Sitka (Hultén 1968, UAM 2004, AKEPIC 2004). It is commonly grown in Juneau and Anchorage (J. Riley pers. obs.). Using the CLIMEX matching program, there is a high climatic match between Nome and areas where the species is documented such as Røros, Norway (76%). In Norway, *Digitalis purpurea* occurs along the coast as far north as 69°N (Lid and Lid 1994). However, it appears to reach its physiological limit around Anchorage as it not able to overwinter (J. Riley pers. obs., R. Densmore pers. obs.). Therefore, it is unlikely to establish in the arctic alpine ecoregion.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 3
As a pioneer of disturbed sites, purple foxglove likely hinders natural successional processes (M.L. Carlson pers. obs.).

Impact on Natural Community Structure (0–10) — 3
Purple foxglove often forms dense patches, increasing the density of the herbaceous and herbaceous–shrub layers (Harris 2000).

Impact on Natural Community Composition (0–10) — 3
Purple foxglove is capable of forming dense patches, displacing natural vegetation (Harris 2000).

Impact on Higher Trophic Levels (0–10) — 7
Purple foxglove is toxic to human and animals (CUPPID 2004, Harris 2000, USDA 2002, Whitson et al. 2000). Rabbits and deer avoid the leaves of foxglove (Floridata 2002).

Total for Ecological Impact — 16/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 1
Purple foxglove reproduces entirely by seed, but produces many hundreds of seeds/plant (Floridata 2002, Harris 2000).

Long-distance dispersal (0–3) — 3
Seeds are dispersed by wind and water (Harris 2000). However, the seeds lack apparent adaptations for long-distance dispersal.

Spread by humans (0–3) — 3
Purple foxglove is cultivated as an ornamental plant and grown commercially as a heart stimulant source(Floridata 2002). It has escaped cultivation (Hultén 1968, Welsh 1974).

Allelopathic (0–2) — 0
Purple foxglove is not known to be allelopathic (USDA 2002).

Competitive Ability (0–3) — 0
Purple foxglove species does not compete with established native vegetation, especially under the canopy (Harris 2000).

Thicket-forming/Smothering growth form (0–2) — 1
Foxglove can form dense and tall patches (Harris 2000).

Germination requirements (0–3) — 0
Roots of young plants are not able to penetrate turf or litter. Successful establishment requires disturbance of soil, vegetation, and litter (Harris 2000, Vazquez-Yanes et al. 1990).

Other invasive species in the genus (0–3) — 3
Digitalis lanata Ehrh. is known as an invader of grasslands and woodlands in Wisconsin (WDNR 2004).

Aquatic, wetland or riparian species (0–3) — 0
Purple foxglove can be found on roadsides, fields, forest edges, wet ditches, moist meadows, open woodland, and pastures (Harris 2000, Pojar and MacKinnon 1994).

Total for Biological Characteristics and Dispersal — 11/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 4
Foxglove is cultivated as an ornamental plant and is grown commercially for medical reasons. Many cultivars have been developed (Floridata 2002).

Known level of impact in natural areas (0–6) — 3
It readily colonizes disturbed areas, forming dense patches that displace natural vegetation in California (Harris 2000).

Role of anthropogenic and natural disturbance in establishment (0–5) — 3
Young plants are not able to penetrate turf or litter. Soil disturbance greatly increases establishment of seedlings (Harris 2000, Vazquez-Yanes et al. 1990). In Oregon and Washington foxglove commonly establishes on natural slides and windfalls (M.L. Carlson pers. obs.)

Current global distribution (0–5) — 5
Foxglove is native to Western Europe, the Mediterranean, and Northwest Africa. It has become naturalized in other parts of Europe (including arctic and subarctic Scandinavia), Asia, Africa, South America, New Zealand, Canada, and much of the United States (Hultén 1968, USDA 2002, Wilson 1992).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) — 4
Foxglove is widely naturalized in northwestern and northeastern states (USDA 2002). *Digitalis purpurea* is on the Colorado Invasive Weed Species List (BLM Colorado 2004).

Total for Ecological Amplitude and Distribution — 19/25

Feasibility of Control — Score

Seed banks (0–3) — 2
Seeds remain viable in the soil for at least 5 years (Harris 2000).

Vegetative regeneration (0–3) — 0
Purple foxglove has no ability to resprout (USDA 2002).

Level of effort required (0–4) — 3
Hand pulling is an effective control of foxglove. Herbicides are effective in large infestations. Control efforts generally require at least 5 years. Sites must be monitored for 5–10 years after treatment due to the long-lived seed bank. Biological control has not been pursued because of plant's value in horticulture (Harris 2000).

Total for Feasibility of Control — 5/10

Total score for 4 sections — 51/100

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Elymus repens (L.) Gould. common names: quackgrass

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	20
Biological Characteristics and Dispersal	25	15
Amplitude and Distribution	25	19
Feasibility of Control	10	5
Relative Maximum		59

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Elymus repens has been reported from all ecoregions of Alaska (Hultén 1968, Densmore et al. 2001, AKEPIC 2004).

Ecological Impact **Score**

Impact on Ecosystem Processes (0–10) 7

Quackgrass consumes soil moisture and limiting nutrients (Batcher 2002). It may alter secondary succession following fires, where its cover can dramatically increase (Snyder 1992).

Impact on Natural Community Structure (0–10) 5

Quackgrass establishes in an existing layer, changes the density of the layer, and often forms a new layer on disturbed substrates (Irina Lapina pers. obs.).

Impact on Natural Community Composition (0–10) 5

The species is able to exclude native vegetation, resulting in an overall loss of biodiversity in other climates (Batcher 2002). This plant is not observed in undisturbed plant communities in Alaska and does not appear to pose an imminent threat to natural community composition (J. Conn and M. Shephard pers. com., Densmore et al. 2000). *Elymus repens* is a cool-season grass that can photosynthesize and grow during early spring. It can suppress species that grow in warmer season (Batcher 2002).

Impact on Higher Trophic Levels (0–10) 3

Elymus repens provides cover for numerous small rodents, birds, and waterfowl in grassland systems. It is allelopathic (Batcher 2002). This grass is highly palatable to grazing animals (USDA 2002).

Total for Ecological Impact 20/40

Biological Characteristics and Dispersal **Score**

Mode of Reproduction (0–3) 2

Quackgrass is an aggressive perennial reproducing by seed and spreading by a shallow mass of rhizomes. Each stem can produce up to 400 seeds, although 20–40 is more common.

Long-distance dispersal (0–3) 2

Seed dispersal mechanisms are unknown, although seeds remain viable after passing through the digestive systems of many domestic animals (Batcher 2002).

Spread by humans (0–3) 3

Quackgrass is planted for livestock. It has been used to revegetate mine tailings (Snyder 1992) and is often a contaminant in hay and straw (Royer and Dickinson 1999).

Allelopathic (0–2) 2

This grass is allelopathic. It produces ethylacetate, cyclic hydroxamic acids, and several other phytotoxins from its shoots and roots. These compounds can suppress the growth or reproductive vigor of competing plants (Batcher 2002).

Competitive Ability (0–3) 2

Quackgrass competes strongly with cultivated crops. Its production of allelopathic toxins contributes to its high level of competitiveness (Batcher 2002). Without soil disturbance, this plant does not appear to compete strongly with native grasses and forbs in Alaska (J. Conn pers. com.).

Thicket-forming/Smothering growth form (0–2) 1

Elymus repens can form dense stands (Batcher 2002), but is generally not significantly taller than other grasses and forbs.

Germination requirements (0–3) 0

The species requires open soil and disturbance to germinate (Densmore et al. 2001). Seeds germinate either in the fall or spring. Alternating temperatures are required for germination (15–25 °C diurnal fluctuations) (Batcher 2002).

Other invasive species in the genus (0–3) 3

Elymus sibiricus L.

Aquatic, wetland or riparian species (0–3) 0

This grass can invade gardens, yards, crop fields, roadsides, ditches, and other disturbed, moist areas. It can also colonize mixed-grass prairies and open woodlands (Batcher 2002). It is often a serious pest in alkaline wetlands in arid regions of Oregon and California (M.L. Carlson pers. obs.)

Total for Biological Characteristics and Dispersal 15/25

Ecological Amplitude and Distribution **Score**

Highly domesticated or a weed of agriculture (0–4) 4

It is a serious threat in crops and gardens (Batcher 2002, Densmore et al. 2001). Many palatable hybrid crosses of quackgrass and other species have been developed and planted for livestock (Snyder 1992).

Known level of impact in natural areas (0–6) 2

Elymus repens is invading the land between riparian and upland habitats in Selver Creek Preserve, Idaho (Batcher 2002). This grass has invaded natural areas in Oregon and Ohio (Batcher 2002). It invades Wisconsin oak–hickory forest openings (Snyder 1992).

Role of anthropogenic and natural disturbance in establishment (0–5) 3

This plant in not observed in undisturbed plant communities in Alaska (Densmore et al. 2001). Once established on disturbed sites it can easily colonize adjacent undisturbed areas (Batcher 2002, Snyder 1992).

Current global distribution (0–5) 5

It is native to Eurasia (temperate Europe and Central Asia: Afghanistan, India, Pakistan). It is now found in South America (Argentina and Chile), North Africa, Australia, New Zealand, Indonesia, and occurs even in Greenland (Batcher 2002, Hultén 1968).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
It has now been reported from every state in the United States and throughout Canada. Quackgrass is listed as noxious in 27 states and 5 Canadian provinces (Invaders Database System 2003, USDA 2002). It is classified as a noxious weed in Alaska (Alaska Administrative Code 1987). It is economically detrimental in agricultural fields and rarely invades undisturbed soils in Alaska (J. Conn pers. com.).	
Total for Ecological Amplitude and Distribution	19/25

Feasibility of Control	**Score**
Seed banks (0–3)	0
Studies in Alaska showed that seed viability is reduced significantly after burial for 21 months (Conn and Farris 1987, Batcher 2002).	
Vegetative regeneration (0–3)	2
It has vigorous vegetative regeneration from rhizomes (Batcher 2002).	
Level of effort required (0–4)	3
Successful control measures currently include applying herbicides, burning, tilling, and combinations of these three methods. Monitoring for 2 years after treatment is recommended (Batcher 2002). Unfortunately, most current control techniques are not effective in natural communities (J. Conn pers. com.).	
Total for Feasibility of Control	5/10
Total score for 4 sections	59/100

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Euphorbia esula L. common names: leafy spurge

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		No
	Potential Max.	***Score***
Ecological Impact	40	31
Biological Characteristics and Dispersal	25	21
Amplitude and Distribution	25	23
Feasibility of Control	10	9
Relative Maximum		84

Climatic Comparison		
	Collected in Alaska regions?	***CLIMEX similarity?***
South Coastal	Yes	Yes
Interior Boreal	No	Yes
Arctic Alpine	No	No

Euphorbium esula has not been documented in Alaska (Weeds of Alaska Database 2004, Hultén 1968, UAM 2004, Welsh 1974). The CLIMEX matching program indicates the climatic similarity between Anchorage and areas where this species is documented is high. Leafy spurge is well established in Lillehammer, Dalen, and Oslo, Norway (Lid and Lid 1994), which have 61%, 54%, and 53% climatic matches with Anchorage. The climatic similarity between Fairbanks and Nome with the native or introduced range of leafy spurge is low. Temperature and the number of frost-free days may be a limiting factor for seed germination and seedling establishment in interior or arctic alpine ecogeographic regions (Selleck et al. 1962). However, a well established population has recently been documented near Dawson City, Yukon Territory (Bennett 2007), which has a climate very similar to Fairbanks. It should also be noted that once established, a population is capable of maintaining itself vegetatively over a broad range of environmental conditions (Butterfield et al. 1996, Kreps 2000, Selleck et al. 1962). The establishment of *Euphorbia esula* in the south coastal and interior boreal ecoregions may be possible.

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	5
Leafy spurge infestations may promote the establishment of other weeds, particularly smooth brome and Kentucky bluegrass (Belcher and Wilson 1989). It likely has soil impact due to allelopathy (Butterfield et al. 1996, Royer and Dickinson 1999, Steenhagen and Zimdahl 1979).	
Impact on Natural Community Structure (0–10)	7
Leafy spurge is capable of forming dense stands in natural communities and reducing native plant diversity. Almost complete exclusion of native forbs and grasses may result from the allelopathic chemicals (Kreps 2000, Butterfield and Stubbendieck 1999, Selleck et al. 1962).	
Impact on Natural Community Composition (0–10)	9
Leafy spurge can reduce species richness and even exclude native forbs and grasses. Displacement of native species in undisturbed areas can occur in a few years if the infestation is unchecked (Biesboer 1996, Kreps 2000). Leafy spurge reduced native plant species by 51% in woodland, 36% in grassland, 28% in flood plain, and 21% in shrubland (Butler and Cogan 2004). In experiments in Saskatchewan, all annual species disappeared at all study sites (Selleck et al. 1962). In Manitoba the frequency of five common native species decreased significantly with introduction of leafy spurge. The only species that were positively correlated with leafy spurge establishment were smooth brome and Kentucky bluegrass (Belcher and Wilson 1989).	

Impact on Higher Trophic Levels (0–10) 10

Leafy spurge is unpalatable and often toxic to herbivores such as deer, elk, and antelope. Infestations of leafy spurge reduce the availably of forage for these species (Kreps 2000, Masters and Kappler 2002). Most North American insects avoid leafy spurge. Alteration of grassland vegetation structure by leafy spurge may degrade nesting habitat of breeding birds. In a North Dakota study, densities, breeding, nest-site selection, and nest success of Savanna sparrow was lower on sites infested by leafy spurge (Scheiman et al. 2003).The milky sap contained in leafy spurge tissue may cause severe skin rashes in humans (Royer and Dickinson 1999). Bees, flies, ants, and mosquitoes feed on the nectar of leafy spurge flowers (Messersmith et al. 1985, Fowler 1983, Selleck et al. 1962). Over 60 species of insects have been recorded visiting leafy spurge flowers (Butterfield et al. 1999). Decomposing plant tissues release allelopathic chemicals that suppress the growth of other plant species (Steenhagen and Zimdahl 1979, Royer and Dickinson 1999).

Total for Ecological Impact 31/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) 3

Leafy spurge can spread by seed, rhizome, or root fragment. Root buds can regenerate new shoots if the stems are destroyed. Each stem of leafy spurge can produce up to 250 seeds and dense infestations can produce over 8,000 seeds per square meter (Royer and Dickinson 1999, Selleck et al. 1962).

Long-distance dispersal (0–3) 3

Fruits open explosively and can scatter seeds up to 15 feet from the parent plant. Long-distance dispersal by animals is also suspected (Best et al. 1980, Butterfield et al. 1996) and the seeds can float and geminate in water (Masters and Kappler 2002). Leafy spurge seeds contain fat and protein which make them a desirable food source for ants who act as dispersal agents (Remberton 1988).

Spread by humans (0–3) 3

It is likely that the first introduction of leafy spurge to North America was in contaminated oats from Russia. Leafy spurge is known to contaminate commercial seed, grain, and hay. Fragments of roots and rhizomes can be carried on road maintenance or farm equipment (Kreps 2000, Butterfield et al.1996, Dunn 1985, Selleck et al. 1962).

Allelopathic (0–2) 2

Decomposing plant tissues release allelopathic chemicals that inhibit the growth or development of other plant species (Butterfield et al. 1996, Royer and Dickinson 1999, Steenhagen and Zimdahl 1979). In greenhouse experiments the growth of tomato seedlings was inhibited 60% when leafy spurge litter was present in soil (Steenhagen and Zimdahl 1979). A reduction in frequency and density of quackgrass and common ragweed was also reported.

Competitive Ability (0–3) 3

Leafy spurge outcompetes native forbs and grasses (Masters and Kappler 2002), and is alleopathic toward associated species (Steenhagen and Zindahl 1979). Leafy spurge has extensive vegetative reproduction, effective seed dispersal, high seed viability, and very rapid development of seedlings (Masters and Kappler 2002). In a detailed study of *Euphorbia esula* growing with smooth brome and crested wheatgrass neither species was successful in competition with leafy spurge (Selleck at al. 1962).

Thicket-forming/Smothering growth form (0–2) 1

Leafy spurge is capable of creating dense monocultures. A density of 200 shoots per square meter was recorded in Saskatchewan (Selleck et al. 1962). Stem densities of 1,000 per square yard are not uncommon (Kreps 2000).

Germination requirements (0–3) 2

Leafy spurge requires anthropogenic or natural disturbances for germination (Belcher and Wilson 1989, Selleck et al. 1962).

Other invasive species in the genus (0–3) 3

Euphorbia cyparissias, *E. myrsinites*, *E. oblongata*, *E. serrata*, and *E. terracina* have state noxious status in various American states (USDA 2002).

Aquatic, wetland or riparian species (0–3) 1

Although leafy spurge prefers dry sandy soils, it is able to establish in irrigated meadows and along riparian areas (Masters and Kappler 2002). Leafy spurge is known from riverbanks in Central Europe, Sweden, and Western Asia. In Saskatchewan infestations often follow drain channel contours (Selleck et al. 1962).

Total for Biological Characteristics and Dispersal 21/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) 4

Leafy spurge is a successful weed in untilled fields (Kreps 2000).

Known level of impact in natural areas (0–6) 6

Leafy spurge has invaded prairies, pine savannas, and riparian areas in Minnesota, North and South Dakota, Idaho, Oregon, Colorado, and California (Kreps 2000, Dunn 1979). It is known to invade native grassland in Ontario, Quebec, and Saskatchewan (Selleck et al. 1962). Leafy spurge is spreading rapidly into native rangeland in Western Canada (Frankton and Mulligan 1970).

Role of anthropogenic and natural disturbance in establishment (0–5) 3

Leafy spurge requires anthropogenic or natural disturbances for initial establishment. It has been found to spread in native grassland, presumably after establishment from seed in a gopher mound (Selleck et al. 1962). Almost all (95%) of leafy spurge infestations are associated with anthropogenic disturbances such as vehicle tracks, road construction, and fire lines (Belcher and Wilson 1989).

Current global distribution (0–5) 5

Leafy spurge is native to Eurasia. It is presently found worldwide (including the boreal zone), except for Australia (Biesboer 1996, Butterfield et al. 1996).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) 5

Leafy spurge has spread into 30 states and every Canadian province, except Newfoundland (Best et al. 1980, Butterfield et al. 1996, USDA 2002). All indications are that it will continue to expand its range in Canada (White et al. 1993). Leafy spurge is a noxious weed in 22 American states and 6 Canadian provinces (Invaders Database System 2003, Royer and Dickinson 1999). Leafy spurge is a prohibited noxious weed in Alaska (Alaska Administrative Code 1987).

Total for Ecological Amplitude and Distribution 23/25

Feasibility of Control	Score
Seed banks (0–3)	3
Ninety-nine percent of viable seeds will germinate in the first 2-years. The rest of the seeds may be viable in the soil for up to 8 years. However, viability deceases by about 13% each year (Butterfield et al. 1996, Whitson et al. 2000). Selleck et al. (1962) reported seeds remain viable no longer than 5 years.	
Vegetative regeneration (0–3)	2
Root buds give rise to new shoots after removal of aboveground parts. Root fragments buried 9 feet deep can produce new plants (Royer and Dickinson 1999). An experiment showed that tilling increased the density of leafy spurge from 134 shoots/m² in untilled area to 316 shoots/m² (Selleck et al. 1962).	
Level of effort required (0–4)	4
Leafy spurge is extremely difficult to control, and the best approach is the early detection and elimination of new infestation. Mechanical, chemical, cultural, and biological control methods have all been used on leafy spurge with varying levels of success. Most control methods have a detrimental effect on other plant species, and they all constitute a disturbance that will promote the establishment of leafy spurge or other exotic species (Masters and Kappler 2002, Biesboer 1996, Lym 1998, Selleck et al. 1962). Treated sites require monitoring for 10 years after treatment.	
Total for Feasibility of Control	9/10
Total score for 4 sections	84/100

§

Fallopia convolvulus (Linnaeus) Á. Löve (*Polygonum convolvulus* L.) common names: black bindweed

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	12
Biological Characteristics and Dispersal	25	16
Amplitude and Distribution	25	17
Feasibility of Control	10	5
Relative Maximum		50

Climatic Comparison	*Collected in Alaska regions?*	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Polygonum convolvulus has been documented in all ecogeographic regions of Alaska (Hultén 1968, Welsh 1974, UAM 2004, AKEPIC 2005).

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	3
Black bindweed quickly covers bare soil (Hume et al. 1983, Rutledge and McLendon 1996). It may prevent native species from establishing.	
Impact on Natural Community Structure (0–10)	3
Black bindweed is able to create a dense canopy, covering herbaceous plants (Friesen and Shebeski 1960, Royer and Dickinson 1999). However, dense stands of black bindweed have not been observed in native communities in Alaska (J. Conn pers. obs.).	
Impact on Natural Community Composition (0–10)	3
Black bindweed is a strong competitor (Fabricius and Nalewaja 1968, Friesen and Shebeski 1960, Pavlychenko and Harrington 1934, Welbank 1963) and it likely reduces the number of individuals in the native species community.	
Impact on Higher Trophic Levels (0–10)	3
The seeds and leaves of black bindweed are an important foods for granivorous birds (Wilson et al. 1999). It also is an alternate host for a number of fungi, viruses, and nematode species (Cooper and Harrison 1973, Royer and Dickinson 1999, Townshend and Davidson 1962)	
Total for Ecological Impact	12/40

Biological Characteristics and Dispersal	Score
Mode of Reproduction (0–3)	3
Black bindweed reproduces by seed only. A single plant is capable of producing up to 11,900 to even 30,000 seeds (Stevens 1932, Forsberg and Best 1964).	
Long-distance dispersal (0–3)	1
The seeds have no adaptation for long-distance dispersal, but apparently they can be transported by water (Hume et al. 1983, Rutledge and McLendon 1996).	
Spread by humans (0–3)	2
The seeds of black bindweed are commonly dispersed by farm machinery. This plant is also a frequent cereal crop contaminant (Gooch 1963, Rutledge and McLendon 1996, J. Conn pers. obs.). Black bindweed seeds remain viable after digestion by ruminants, therefore, it may be transported by animals (Blackshaw and Rode 1991).	
Allelopathic (0–2)	0
Black bindweed is not known to be allelopathic.	
Competitive Ability (0–3)	2
Black bindweed is able to compete with cultivated crops and other weeds for moisture, nutrients, and light (Friesen and Shebeski 1960, Welbank 1963, Fabricius and Nalewaja 1968, Royer and Dickinson 1999). In experimental studies black bindweed appears to be a stronger competitor than *Chenopodium album*, *Polygonum aviculare*, *P. persicaria*, *Stellaria media*, and *Capsella bursa-pastoris* (Pavlychenko and Harrington 1934, Welbank 1963).	
Thicket-forming/Smothering growth form (0–2)	2
Black bindweed climbs and smothers other plants and can form dense thickets (Rutledge and McLendon 1996). A density of 56 to 215 plants per m² has been observed in number of studies (Friesen and Shebeski 1960)	

Germination requirements (0–3)	2
The germination of black bindweed seeds is greater on disturbed sites. The disturbance of soils apparently reactivates dormant seeds (Milton et al. 1997). However, germination in undisturbed soil was also recorded (Roberts and Feast 1973).	
Other invasive species in the genus (0–3)	3
Polygonum cuspidatum Sieb. & Zucc., *P. perfoliatum* L., *P. polystachyum* Wallich ex Meisn., and *P. sachalinense* F. Schmidt ex Maxim. are declared noxious weeds in number of American states (USDA, NRSC 2006). Also *Polygonum arenastrum* Jord. ex Boreau, *P. caespitosum* Blume, *P. aviculare* L., *P. orientale* L., *P. persicaria* L., and *P. lapathifolium* L. are listed as a weeds in PLANTS Database (USDA, NRSC 2006). A number of *Polygonum* species native to North America have a weedy habit and are listed as noxious weeds in some of the American states. Although some of the recent taxonomic treatments considers these as a species of three different genera: *Polygonum*, *Fallopia*, and *Persicaria* (FNA 1993+), they are closely related taxa and can be considered as congeneric weeds.	
Aquatic, wetland or riparian species (0–3)	1
Black bindweed is a common weed in cultivated fields, gardens, roadsides, and waste areas. It may be occasionally found on river gravel bars (Hume et al. 1983).	
Total for Biological Characteristics and Dispersal	**16/24**

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
Black bindweed is a serious weed in crops (Friesen and Shabeski 1960, Forsberg and Best 1964).	
Known level of impact in natural areas (0–6)	1
Black bindweed has invaded natural communities in Rocky Mountain National Park (J. Conn pers. obs.).	
Role of anthropogenic and natural disturbance in establishment (0–5)	2
Black bindweed readily established on cultivated fields and disturbed grounds (Royer and Dickinson 1999, Welsh 1974). However, it is recorded to establish in grasslands with small-scale animal disturbances in Germany (Milton et al. 1997).	
Current global distribution (0–5)	5
Black bindweed originated from Eurasia. It has now been introduced into Africa, South America, Australia, New Zealand, and Oceania (Hultén 1968, USDA, ARS 2003). It has been collected from arctic regions in Alaska (Hultén 1068, UAM 2006).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Black bindweed is found throughout Canada and the United States. It is declared noxious in Alaska, Alberta, Manitoba, Minnesota, Oklahoma, Quebec, and Saskatchewan (Alaska Administrative Code 1987, Rice 2006, Royer and Dickinson 1999).	
Total for Ecological Amplitude and Distribution	**17/25**

Feasibility of Control	**Score**
Seed banks (0–3)	3
Most seeds of black bindweed germinate in their first year (Chepil 1946). However, seeds remain viable in the soil for up to 40 years (Chippendale and Milton 1934). Viability of seeds was 5% after 4.7 years, and <1% after 9.7 years in seed viability experiment conducted in Fairbanks (Conn and Deck 1995).	
Vegetative regeneration (0–3)	0
Black bindweed does not regenerate vegetatively (Hume et al. 1983).	
Level of effort required (0–4)	2
Mechanical methods have only limited success in controlling black bindweed. A number of chemicals are recommended for control of this weed. Several pathogenic fungi have been studied as a potential biocontrol agent for this weed (Dal-Bello and Carranza 1995, Mortensen and Molloy 1993).	
Total for Feasibility of Control	**5/10**
Total score for 4 sections	**50/100**

§

Galeopsis bifida Boenn. and *G. tetrahit* L. common name: splitlip hempnettle and brittlestem hempnettle

Ranking Summary

Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	14
Biological Characteristics and Dispersal	25	9
Amplitude and Distribution	19	12
Feasibility of Control	10	3
Relative Maximum		40

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Hempnettle has been collected in the south coastal (Kodiak, Afognak, Ketchikan, Yakutat, Skagway, Sitka, Seldovia, Kenai, Seward, Admiralty Island); interior boreal (Anchorage, Fairbanks, Ophir, Matanuska–Susitna Valley); and arctic alpine (Unalakleet) ecoregions in Alaska (Hultén 1968, AKEPIC 2004, UAM 2004).

Ecological Impact — **Score**

Impact on Ecosystem Processes (0–10) — 1

Hempnettle consumes soil moisture and limiting nutrients. It is likely to delay establishment of native species in disturbed sites (I. Lapina pers. obs.).

Impact on Natural Community Structure (0–10) — 5

In Alaska, hempnettle has been observed established in disturbed areas, creating a dense mid-forb layer and reducing the cover of graminoids and low forbs (I. Lapina pers obs.). Plant densities can reach up to 400 plants per square yard (MAFRI 2004).

Impact on Natural Community Composition (0–10) — 5

After soil disturbance and the establishment of hempnettle, dense populations likely inhibit numerous species of native grasses and forbs from establishing (M.L. Carlson pers. obs.). In Juneau, hempnettle is very competitive in open woodlands (M. Shephard pers. com.).

Impact on Higher Trophic Levels (0–10) — 3

The bristly hairs along the stems and spiny flower clusters are strong enough to penetrate the skin (Pojar and MacKinnon 1999).

Total for Ecological Impact — 14/40

Biological Characteristics and Dispersal — **Score**

Mode of Reproduction (0–3) — 3

Hempnettle reproduces entirely by seeds. Each plant is capable of producing up to 2,800 seeds (Royer and Dickinson 1999).

Long-distance dispersal (0–3) — 0

The seeds are large and do not have any apparent adaptations for long-distance dispersal (I. Lapina pers. obs.).

Spread by humans (0–3) — 2

Hempnettle is a common grain contaminant (MAFRI 2004, USDA, ARS 2004).

Allelopathic (0–2) — 0

There is no recorded allelopathy in this species.

Competitive Ability (0–3) — 1

Hempnettle is a serious competitor with crops for moisture and soil nutrients (Royer and Dickinson 1999). Without soil disturbance, this plant does not appear to compete strongly with native grasses and forbs in Alaska (I. Lapina pers. com.).

Thicket-forming/Smothering growth form (0–2) — 0

Plants grow to 3 feet tall, but to not overtop most vegetation, nor form extremely dense thickets (Royer and Dickinson 1999, Welsh 1974).

Germination requirements (0–3) — 0

Established vegetation can suppress hempnettle germination. Germination is better at high temperatures (SAFRR 1984), and occurs at soil depths of 0.5 to 1.5 inches (Royer and Dickinson 1999).

Other invasive species in the genus (0–3) — 3

Galeopsis speciosa Mill. (Royer and Dickinson 1999).

Aquatic, wetland or riparian species (0–3) — 0

Hempnettle is a plant of waste places, roadsides, gardens, and agricultural land (Hultén 1968, Welsh 1974). It also is can be found in open woods (SAFRR 1984).

Total for Biological Characteristics and Dispersal — 9/25

Ecological Amplitude and Distribution — **Score**

Highly domesticated or a weed of agriculture (0–4) — 4

Hempnettle is a serious weed in crops (Royer and Dickinson 1999).

Known level of impact in natural areas (0–6) — U

Unknown

Role of anthropogenic and natural disturbance in establishment (0–5) — 0

This species is tied to areas with anthropogenic disturbances (I. Lapina pers. obs., Royer and Dickinson 1999, Welsh 1974). Tillage may encourage germination (SAFRR 1984).

Current global distribution (0–5) — 3

Galeopsis tetrahit and *G. bifida* are native to Europe and Asia. Now they are found throughout Canada and northeastern quarter of the United States. These plants were introduced into New Zealand and Canary Islands (Hultén 1968, Royer and Dickinson 1999, USDA 2002).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) — 5

The two species, *Galeopsis bifida* and *Galeopsis tetrahit*, are declared noxious in Alberta, Manitoba, and Quebec. They are prohibited noxious weeds in Alaska (Alaska Administrative Code 1987, Invaders Database System 2003, Royer and Dickinson 1999).

Total for Ecological Amplitude and Distribution — 12/19

Feasibility of Control — **Score**

Seed banks (0–3) — 1

The seeds can remain dormant in soil for several years (MAFRI 2004, Royer and Dickinson 1999). However, seed bank study showed very little germination after 2 years (J. Conn unpublished).

Vegetative regeneration (0–3) — 0

Hempnettle is annual plant, reproducing by seed only and has no ability to resprout (Royer and Dickinson 1999).

Level of effort required (0–4) — 2

The seeds remain dormant for long periods of time, making it hard to manage this weed once it becomes established. Cultivation and crop rotation can control the two species on agricultural lands. Herbicides are also available for hempnettle's control (MAFRI 2004, SAFRR 1984).

Total for Feasibility of Control — 3/10

Total score for 4 sections — 38/94

§

Glechoma hederacea L. common names: ground ivy

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	14
Biological Characteristics and Dispersal	25	12
Amplitude and Distribution	25	14
Feasibility of Control	10	8
Relative Maximum		48

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Glechoma hederacea has been collected from Petersburg and Juneau (Hultén 1968, UAM 2004). It has been observed established in Earthquake Park in Anchorage (J. Riley pers. obs.). Using the CLIMEX matching program, climatic similarity between Fairbanks and areas where the species is documented is high. Native range of the species includes Sverdlovsk and Zlatoust in Russia and Regina, Saskatchewan in Canada (Gubanov et al. 1995, Hultén 1968), which has a 66%, 64%, and 53% climatic match with Fairbanks. The range of the species includes Røros, Norway and Vytegra and Kirov, Russia (Hultén 1968, Lid and Lid 1994), which has a 76%, 67%, and 66% climatic match with Nome, respectively. Thus establishment of *Glechoma hederacea* in interior boreal and arctic alpine ecogeographic regions may be possible.

Ecological Impact — **Score**

Impact on Ecosystem Processes (0–10) 3

The impact of ground ivy to ecosystem processes is largely unknown. However, this species likely competes with native species for soil nutrients, water, and light in partially disturbed communities (I. Lapina pers. obs.).

Impact on Natural Community Structure (0–10) 3

Ground ivy can reach ground cover values as high as 33% in forb communities (Hutchings and Price 1999).

Impact on Natural Community Composition (0–10) 3

Ground ivy likely reduces the number of grass individuals due to its allelopathic effects (Price and Hutchings 1996).

Impact on Higher Trophic Levels (0–10) 5

Ground ivy is toxic to many vertebrates, although many insects are known to feed on it. Studies suggest strong allelopathic effects of ground ivy on other species. Ground ivy is insect-pollinated (Hutchings and Price 1999, Southwick et al. 1981).

Total for Ecological Impact 14/40

Biological Characteristics and Dispersal — **Score**

Mode of Reproduction (0–3) 3

Ground ivy spreads primarily vegetatively; establishment from seed is rare in many habitats. Each flower produces up to four seeds (Hutchings and Price 1999).

Long-distance dispersal (0–3) 2

Seeds are primarily dispersed passively. They may be further dispersed by ants. Nutlets produce the mucilage on contact with water and can be fixed to various substrates (Hutchings and Price 1999).

Spread by humans (0–3) 2

Ground ivy has been sold as a horticultural plant for use in hanging baskets. Garden varieties occasionally naturalize (Hessayon 1987 cited in Hutchings and Price 1999).

Allelopathic (0–2) 2

Studies suggest strong allelopathic effects on co-occurring *Raphanus sativus* and *Bromus tectorum* (Hutchings and Price 1999). Exudates from leaves and roots of ground ivy decrease seed germination, but stimulate root and shoot growth (Hutchings and Price 1999).

Competitive Ability (0–3) 1

Ground ivy does not compete well with grasses and has a limited capacity to persist under tall herbs or tree canopy (Price and Hutchings 1996). Total biomass of plants was significantly reduced by the presence of competing *Lolium perenne* in experimental treatments. Also the number and length of secondary stolons were reduced in grass stands (Price and Hutchings 1996).

Thicket-forming/Smothering growth form (0–2) 1

Ground ivy forms extensive monospecific stands (Hutchings and Price 1999, Mitich 1994), but does not grow taller than the surrounding vegetation.

Germination requirements (0–3) 0

Ground ivy is unlikely to establish outside of open, disturbed soil (Grime et al. 1981). This species requires light for germination (Grime et al. 1981).

Other invasive species in the genus (0–3) 0

The genus *Glechoma* is monotypic (USDA 2002).

Aquatic, wetland or riparian species (0–3) 1

Ground ivy is frequent on shaded roadsides, waste areas, edges of pastures and arable fields, grasslands, cleared woodlands, and scrubs. Although it is generally absent from aquatic habitats, it is occasionally observed on riverbanks and flood plains (Hitchings and Price 1999).

Total for Biological Characteristics and Dispersal 12/25

Ecological Amplitude and Distribution — **Score**

Highly domesticated or a weed of agriculture (0–4) 0

Ground ivy occurs on edges of pastures and arable fields, and it is not an agricultural pest (Hutchings and Price 1999).

Known level of impact in natural areas (0–6) 1

Ground ivy generally grows in woodlands, grasslands, and pastures edges (Hutchings and Price 1999).

Role of anthropogenic and natural disturbance in establishment (0–5) 3

The open conditions, created by the death of plants or disturbance caused by grazing animals, probably opportunities for colonization by ground ivy (Hutchings and Price 1999).

Current global distribution (0–5) 5

Ground ivy is native to Europe and temperate Asia. It is documented from subarctic and alpine regions in Norway. It has been introduced in North America and New Zealand. (Hutchings and Price 1999, Lid and Lid 1994, USDA, ARS 2005).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5

The range of ground ivy extends throughout the United States; it is naturalized in Canada and ranges from Newfoundland to British Columbia. This species is listed as a weed in Kentucky, Nebraska, and Wisconsin, though the species is not declared noxious (Invaders Database System 2003, USDA 2002). Ground ivy is on the Invasive Garden Perennials Not to Plant Statewide List of Alaska (Integrated Pest Management Program 2004).

Total for Ecological Amplitude and Distribution **14/25**

Feasibility of Control	**Score**
Seed banks (0–3)	3

Seeds of ground ivy remain viable in the soil more than 4 years (Chancellor 1985). Small numbers of viable seeds were found in soil samples of nearly 20 to over 40 years old (Hutchings and Price 1999).

Vegetative regeneration (0–3) — 2

Pieces of stem can root at the nodes (Hutchings and Price 1999).

Level of effort required (0–4) — 3

Once it is establishes ground ivy is difficult to control. Ground ivy is nearly impossible to dig up and remove all roots and stolon fragments (Mitich 1994).

Total for Feasibility of Control **8/10**

Total score for 4 sections **48/100**

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Gypsophila paniculata L. — common names: baby's-breath

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	25
Biological Characteristics and Dispersal	25	14
Amplitude and Distribution	25	18
Feasibility of Control	7	3
Relative Maximum		57

Climatic Comparison	*Collected in Alaska regions?*	*CLIMEX similarity?*
South Coastal	No	Yes
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Gypsophila paniculata has been collected in Anchorage and Matanuska–Susitna Valley in Alaska (I. Lapina pers. obs., J. Snyder pers. com.). Using CLIMEX matching program, climatic similarity between Nome and areas where the species is documented is high. Range of the species includes Banff, Alberta, Canada and Regina, Saskatchewan, Canada (Darwemt 1975), which has a 61% and 54% climatic match with Nome respectively. *Gypsophila paniculata* can withstand considerable variation in temperature and moisture. It is one of the few perennial ornamentals recommended for gardens located on permafrost (Darwent 1975). This suggests that establishment of *Gypsophyla paniculata* in lower part of arctic alpine Alaska may be possible. Establishment is also likely in drier portions of the south coastal region, such as upper Lynn Canal.

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	3

Baby's-breath appears to reduce available nutrients for co-occurring grass species (Robson 2004, Wisconsin DNR 2004). Protein content of desirable grasses declines with the presence of *Gypsophila paniculata* (Wisconsin DNR 2005).

Impact on Natural Community Structure (0–10) — 7

Baby's-breath can form dense stands and outcompete native perennial species (Darwent 1975, Rutledge and McLendon 1996, Wisconsin DNR 2005).

Impact on Natural Community Composition (0–10) — 5

Baby's-breath likely displaces native species (Robson 2004, Rutledge and McLendon 1996, Wisconsin DNR 2005).

Impact on Higher Trophic Levels (0–10) — 5

Though baby's-breath is not used by native mammals or birds, it has the ability to degrade wildlife habitat (Robson 2004). Baby's-breath contains high levels of saponins that could result in animal toxicity (Plants for a future 2002). Flowers of this plant are attractive to numerous species of pollinating bees and flies (Darwent 1975, Darwent and Coupland 1966), potentially impacting pollination ecology of co-occurring plant species. Baby's-breath is also reported to be an alternate host for number of viruses (Royer and Dickinson 1999).

Total for Ecological Impact **20/40**

Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	3

Baby's-breath reproduces entirely by seed. Plants are capable of producing up to 14,000 seeds (Royer and Dickinson 1999, Rutledge and McLendon 1996).

Long-distance dispersal (0–3) — 3

Most capsules drop off near the parent plant. However, wind is capable of carrying seeds distances of 1 km (Rutledge and McLendon 1996). At maturity, the plant often breaks off at base and tumbles in the wind, spreading seeds widely (Royer and Dickinson 1999).

Spread by humans (0–3) — 3

Baby's-breath is cultivated in gardens and flower beds; it is readily available for sale at nurseries. It has escaped cultivation into pastures and rangelands (Robson 2004, Rutledge and McLendon 1996, Whitson et al. 2000). Its fairly wide distribution in the northwestern U.S. may be a result of it invading transportation corridors (Robson 2004).It also is a potential seed contaminant (USDA, ARS 2004).

Allelopathic (0–2) — 0

No considerable allelopathic effects were found in experiments (Robson 2004).

Competitive Ability (0–3) 3

Baby's-breath has been observed to outcompete native perennial plants (Darwent 1975, MAFF 2005, Robson 2004, Rutledge and McLendon 1996, Wisconsin DNR 2005). It has the ability to thrive in a variety of climatic conditions and soil types; water and nutrient allocation is facilitated by its deep tap root. Grasses exhibited reduced growth rates in the micro-environment closes to the largest plants (Robson 2004).

Thicket-forming/Smothering growth form (0–2) 0

Baby's-breath forms dense stands, but it does not have climbing or smothering growth habit (Douglas et al. 1998, Royer and Dickinson 1999, Whitson et al. 2000).

Germination requirements (0–3) 2

Maximum germination occurs at temperatures ranging from 50–82 °F from a depth no more then 0.25 cm in the soil (Rutledge and McLendon 1996, Wisconsin DNR 2005). Germination is not light sensitive (Darwent and Coupland 1966), therefore, it is likely to occur in vegetated areas.

Other invasive species in the genus (0–3) 0

Other introduced species of the genus are known in U.S. but they are not listed as weeds (Royer and Dickinson 1999, USDA 2002).

Aquatic, wetland or riparian species (0–3) 0

Baby's-breath occurs in pastures, roadsides, hayfields, and waste places (Royer and Dickinson 1999, Rutledge and McLendon 1996, Wisconsin DNR 2005).

Total for Biological Characteristics and Dispersal 14/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) 4

Baby's-breath is cultivated in gardens and flower beds. It has escaped cultivation into pastures and rangelands (Darwent 1975, Rutledge and McLendon 1996, Whitson et al. 2000).

Known level of impact in natural areas (0–6) 3

Baby's-breath has invaded grasslands in Canada (MAFF 2005). Large infestations occurred in lightly-grazed pastures located on sand dunes (Darwent 1975). It is known to invade sand dunes in Wisconsin (Wisconsin DNR 2005). Baby's-breath is becoming a threat to semi-disturbed areas of native grasslands in Idaho (Robson 2004).

Role of anthropogenic and natural disturbance in establishment (0–5) 3

Baby's-breath occurs in lightly grazed pastures and grasslands (Robson 2004, Wisconsin DNR 2005), and on stabilized sand dunes in Saskatchewan (Darwent and Coupland 1966).

Current global distribution (0–5) 3

Baby's-breath is native to Europe and temperate Asia. It is now widespread throughout North America (MAFF 2005, Royer and Dickinson 1999, USDA, ARS 2004).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) 5

Baby's-breath is widespread across Canada and the Northern United States (MAFF 2005, Royer and Dickinson 1999, USDA, ARS 2004). This species is listed as a noxious weed in California and Washington (USDA 2002).

Total for Ecological Amplitude and Distribution 18/25

Feasibility of Control — Score

Seed banks (0–3) U

There is no data concerning seed viability.

Vegetative regeneration (0–3) 0

The plant does not sprout from root or stumps (MAFF 2005, Rutledge and McLendon 1996, Wisconsin DNR 2005).

Level of effort required (0–4) 3

Annual tilling is very effective in control of baby's-breath. This species is also sensitive to herbicides. In Canada, heavy grazing has suppressed growth of plants and prevented the establishment of seedlings. Mowing or clipping does not appear effective (Robson 2004, Rutledge and McLendon 1996, Wisconsin DNR 2005).

Total for Feasibility of Control 3/7

Total score for 4 sections 55/97

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Heracleum mantegazzianum Sommier & Levier

common names: giant hogweed

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	33
Biological Characteristics and Dispersal	25	22
Amplitude and Distribution	25	17
Feasibility of Control	10	9
Relative Maximum		81

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	No	Yes
Interior Boreal	No	Yes
Arctic Alpine	No	Yes

Heracleum mantegazzianum has not been documented in Alaska (Hultén 1968, Welsh 1974, AKEPIC 2004, UAM 2004). Using the CLIMEX matching program, climatic similarity between Juneau and areas where the species is documented is high. Introduced range of the species includes Eskdalemuir, United Kingdom (Tiley et al. 1996) and Kristiansund, Norway (Lid and Lid 1994), which has a 63% and 53% climatic match with Juneau. Range of the species includes Røros and Dombås, Norway (Lid and Lid 1994), which has a 76% and 63% climatic match with Nome, and 55% and 53% climatic match with Fairbanks respectively. Thus establishment of *Heracleum mantegazzianum* in south coastal, interior boreal, and arctic alpine ecogeographic regions may be possible.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 8

Giant hogweed results in a reduction of native species and an increase in soil erosion along streambanks in winter (Noxious Weed Control Program 2003, Tiley and Philp 1992, Wright 1984). The availability of nutrients increases in areas infested by giant hogweed due to the large amount of easily decomposed biomass (Pysek and Pysek 1995).

Impact on Natural Community Structure (0–10) — 7

Giant hogweed has the ability to dominate native communities with 50–100% cover (Pysek and Pysek 1995).

Impact on Natural Community Composition (0–10) — 8

Giant hogweed replaces native vegetation (Noxious Weed Control Program 2003, Tiley and Philp 1992, Tiley et al. 1996, Wright 1984). In studies by Pysek and Pysek (1995), invaded vegetation was 40.5% less species-rich than surrounding vegetation. Eleven species, which were not present in noninvaded vegetation, were recruited in areas invaded by giant hogweed. These species are mainly other invasive plants (*Alopecurus pratensis*, *Dactylis glomerata*, *Elymus repens*, *Cirsium arvense*, *Lupinus polyphyllus*, and *Tanacetum vulgare*).

Impact on Higher Trophic Levels (0–10) — 10

The plant is a public health hazard, causing severe dermatitis. Similar injury has been reported in birds and animals. The flowers of giant hogweed are insect-pollinated and it may alter local pollination ecology. This plant produces coumarins that have antifungal and antimicrobial properties. Numerous phytophagous animals and parasites are recorded for giant hogweed (Noxious Weed Control Program 2003, Tiley et al. 1996, Wright 1984). Hybrids between *H. mantegazzianum* and *H. sphondylium* occur where the two grow in the same location (Stewart and Grase 1984, Tiley and Philp 1992).

Total for Ecological Impact — 33/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3

Giant hogweed reproduces by numerous seeds, from 27,000 to over 50,000 seeds on a vigorous plant, (Pysek 1991, Tiley et al. 1996, Noxious Weed Control Program 2003).

Long-distance dispersal (0–3) — 2

The majority of seeds fall near the maternal plant. Wind disperses seeds a short distance (Pysek and Prach 1993, Tiley et al. 1996, Wright 1984). Long-distance dispersal occurs naturally along watercourses. The fruits float in water for up to 3 days. Most seeds and seedlings were found within 10 m of the colony and few more than 50 m away (Clegg and Grace 1974).

Spread by humans (0–3) — 3

Giant hogweed has escaped from ornamental gardens and naturalizes easily. Despite prohibition of giant hogweed, it is sometimes misidentified and sold in nurseries. Dispersal also includes the use of seed heads in flower arrangements and it is spread along right-of-ways (Noxious Weed Control Program 2003, Tiley et al. 1996, Wright 1984).

Allelopathic (0–2) — 0

There is no recorded allelopathy in this species. The large volume of literature on invasiveness of this species and lack of its mention suggests it is not allelopathic.

Competitive Ability (0–3) — 3

Giant hogweed is very competitive due to its quick early-season growth, tolerance of shade, and very large leaf area (Noxious Weed Control Program 2003, Pysek and Pysek 1995).

Thicket-forming/Smothering growth form (0–2) — 2

Giant hogweed has the ability to shade out the surrounding vegetation due to its height and large leaves (Noxious Weed Control Program 2003, Pysek and Pysek 1995, Wright 1984).

Germination requirements (0–3) — 3

Under field conditions germination and establishment is best in open vegetation with adequate light and moisture. However, germination also occurs under vegetation (Tiley et al. 1996).

Other invasive species in the genus (0–3) — 3

Heracleum sphondylium is another introduced species, but it is not listed as an invasive (USDA 2002).

Aquatic, wetland or riparian species (0–3)	3
In its native habitat giant hogweed occurs in forest edges and glades, often at streamsides in montane (Pysek 1991 or Tiley et al. 1996, Pysek and Prach 1993, Wright 1984). In Europe its primary colonization has been along watercourses (Clegg and Grace 1974, Pysek 1991). Pysek (1991) reported habitat type where the species has been recorded: 42% occurred in a ponds, valleys, riverbanks, road verges, and railway tracks, 41.5% occurred in human-made, disturbed habitats including garbage dumps, parks, and gardens, and 15.7% occurred in seminatural habitats such as shrublands, meadows, and forests.	
Total for Biological Characteristics and Dispersal	22/25

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	0
Giant hogweed is not considered an agricultural weed.	
Known level of impact in natural areas (0–6)	4
Giant hogweed's infestations are located along streams and rivers in Washington State (Noxious Weed Control Program 2003). In Scotland giant hogweed invades grasslands and woodlands (Tiley et al. 1996). Giant hogweed was observed in mixed riparian communities, where it became entirely dominant (Clegg and Grace 1974). In the Czech Republic giant hogweed replaces native vegetation in meadows, shrubs, forest, and forest margins (Pysek 1991, Pysek and Pysek 1995).	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
Disturbed habitats such as open disturbed communities are more easily invaded by giant hogweed. However, it can also invade closed communities such as grasslands and woodlands (Pysek and Pysek 1995, Tiley et al. 1996).	
Current global distribution (0–5)	5
Giant hogweed is native to the Caucasus Mountains and Southwestern Asia. It has naturalized throughout central Russia and Europe. It was introduced to Australia, New Zealand, Canada, and the United States (Tiley et al. 1996, USDA, ARS 2005). It has been recorded from arctic and subarctic regions in Norway (Lid and Lid 1995).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Giant hogweed has been documented from Connecticut, Maine, Massachusetts, New Jersey, New York, Oregon, Vermont, and Washington. Giant hogweed is currently on the United States federal noxious weed list. This plant is considered noxious in 12 U.S. states, including Oregon and Washington (USDA 2002).	
Total for Ecological Amplitude and Distribution	17/25

Feasibility of Control	**Score**
Seed banks (0–3)	3
Seed longevity can be greater than 7 years (Noxious Weed Control Program 2003).	
Vegetative regeneration (0–3)	2
Resprouting occurs from the base of the plant when flowering stems are cut above ground level. After the stem is cut, a tall canopy is reestablished within 2 weeks (Tiley et al. 1996, Wright 1984).	
Level of effort required (0–4)	4
Control of giant hogweed can include mechanical, chemical, and biological methods. Plants must be dug out entirely or the roots cut at least 3–4 inches below ground level. Cutting plant stems is ineffective. Herbicides have been used on this plant with variable effectiveness. Grazing by domestic herbivores in springtime may be effective. A coordinated control program is required over the whole infestation and surrounding areas, since fresh seed supplies continue to spread from uncontrolled plants. A minimum of 5 years of an intensive control is required to control giant hogweed (Wright 1984, Tiley and Philp 1992).	
Total for Feasibility of Control	9/10
Total score for 4 sections	81/100

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Hesperis matronalis L. — common names: sweet rocket, dames rocket, dame's violet, mother-of-the-evening

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	10
Biological Characteristics and Dispersal	22	10
Amplitude and Distribution	25	17
Feasibility of Control	7	2
Relative Maximum		41

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	No

Hesperis matronalis is cultivated and has naturalized in Juneau, Sitka, and Ketchikan (M. Shephard pers. com., Welsh 1974). It is growing in gardens in Anchorage and Homer (J. Riley pers. com.). It has also been recorded in Fort Wainwright Army Post (UAM 2004).

Ecological Impact — **Score**

Impact on Ecosystem Processes (0–10) — 1
Dames rocket may delay the establishment of native species on sites where it has formed stands (M. Shephard pers. com.)

Impact on Natural Community Structure (0–10) — 3
Dames rocket causes a moderate increase in the density of the mid-herbaceous layer, and in Ontario it has been recorded as dominating localized areas (CWS 2004).

Impact on Natural Community Composition (0–10) — 3
Dames rocket likely competes with native species (Wisconsin DNR 2003).

Impact on Higher Trophic Levels (0–10) — 3
Dames rocket may alter pollinator behavior. Hawkmoths have been observed pollinating dames rocket in Alaska and may draw pollinators away from native species (M. Shephard pers. obs.). It is an alternate host for number of viruses (Royer and Dickinson 1999).

Total for Ecological Impact — 10/40

Biological Characteristics and Dispersal — **Score**

Mode of Reproduction (0–3) — 3
Dames rocket reproduces entirely by seed. A single plant is capable of producing up to 20,000 seeds (Royer and Dickinson 1999).

Long-distance dispersal (0–3) — 2
Dames rocket does not have particular adaptations to long-distance dispersal, but the large numbers of small seeds increase the probability of a long-distance dispersal event.

Spread by humans (0–3) — 3
Dames rocket is planted as an ornamental and quickly escapes cultivation. This plant is often included as a part of "wildflower" seed mixes and is widely sold at nurseries (CWMA 2004, Wisconsin DNR 2003).

Allelopathic (0–2) — 0
Dames rocket has no allelopathy potential (USDA 2002).

Competitive Ability (0–3) — 1
Dames rocket likely competes with native species (Wisconsin DNR 2003). It can outcompete grasses in open forest in Wisconsin (J. Riley pers. com.).

Thicket-forming/Smothering growth form (0–2) — 0
Dames rocket does not form dense thickets.

Germination requirements (0–3) — U
It is unknown if this species can germinate in established vegetation.

Other invasive species in the genus (0–3) — 0
Other introduced species of *Hesperis* are not known in North America (USDA 2002).

Aquatic, wetland or riparian species (0–3) — 1
Dames rocket tends to invade riparian and wetland habitats as well as moist and mesic woodlands (CWMA 2004). It also grows along roadsides, fence lines, and in open areas (Wisconsin DNR 2003).

Total for Biological Characteristics and Dispersal — 10/22

Ecological Amplitude and Distribution — **Score**

Highly domesticated or a weed of agriculture (0–4) — 4
Dame's rocket is widely planted as an ornamental. It is often included in "wildflower" seed mixes (Wisconsin DNR 2003).

Known level of impact in natural areas (0–6) — 3
Dames rocket invades forests and prairies in Wisconsin competing with native species (J. Riley pers. com., Wisconsin DNR 2003). It tends to invade riparian and wetland habitat throughout Colorado (CWMA 2004).

Role of anthropogenic and natural disturbance in establishment (0–5) — 2
Dames rocket often establishes on anthropogenic disturbances and can be maintained in previously disturbed forest remnants (M. Shephard pers. com.).

Current global distribution (0–5) — 3
Dames rocket is native to Middle and Southern Europe and temperate Asia. It is now introduced to the northern portion of North America (USDA, ARS 2004).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) — 5
Dames rocket is now found throughout Canada and the United States, except for the southern states (USDA 2002). The species is declared noxious in Colorado (Invaders Database System 2003, USDA 2002). It is considered a weed in Manitoba and Tennessee (Royer and Dickinson 1999).

Total for Ecological Amplitude and Distribution — 17/25

Feasibility of Control — **Score**

Seed banks (0–3) — U
Seeds of dames rocket can remain viable in the soil for several years (Wisconsin DNR 2003), but it is unknown if viability is retained 5 years or more.

Vegetative regeneration (0–3) — 0
This plant has no ability to resprout (USDA 2002).

Level of effort required (0–4) — 2
Pulling is required for several years to remove new plants established from the seed bank. Seeds are likely to mature if the fruits have begun developing at the time the plant is pulled, putting plants in a bag or burning them will prevent further seed dispersal. Burning and herbicides treatment has been found to be an effective control method (Wisconsin DNR 2003).

Total for Feasibility of Control — 2/7

Total score for 4 sections — 39/94

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Hieracium aurantiacum L. and H. caespitosum Dumort.

common names: orange hawkweed meadow hawkweed

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	29
Biological Characteristics and Dispersal	25	23
Amplitude and Distribution	25	19
Feasibility of Control	10	8
Relative Maximum		79

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Hieracium aurantiacum has been collected in the south coastal [Juneau (Hultén 1968) and Kodiak (Spencer pers. com.)] and interior boreal [Willow (Lapina 2003)] ecoregions in Alaska. *Hieracium caespitosum* has been collected in Juneau and Valdez (AKEPIC 2005, M. Shephard pers. com.). Using the CLIMEX matching program, climatic similarity between Nome and areas where *Hieracium aurantiacum* is documented is moderately high. Range of the species includes Anchorage (Alaska), Vaasa (Finland), and Saint Petersburg (Russia) (Hultén 1968), which has a 61%, 54%, and 53% climatic match with Nome, respectively. These suggest that establishment of orange hawkweed in arctic alpine ecogeographic region may be possible. Range of *Hieracium caespitosum* includes Kirov and Kazan, Russia (Gubanov et al. 1995), which has a 66%, and 58% climatic match with Nome, and 60% and 59% climatic match with Fairbanks respectively. Thus establishment of meadow hawkweed in interior boreal and arctic alpine ecogeographic regions may be possible.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 7
Orange and meadow hawkweed likely reduce soil moisture and nutrient availability (J. Snyder pers. com.).

Impact on Natural Community Structure (0–10) — 7
Extensive stolons form dense mats of hawkweed plants creating a new layer, and excluding other forbs and grasses (Callihan and Miller 1999, Prather et al. 2003, Rinella and Sheley 2002).

Impact on Natural Community Composition (0–10) — 8
Orange and meadow hawkweed eliminate other vegetation by forming dense, monospecific stands (Callihan and Miller 1999, Prather et al. 2003, Rinella and Sheley 2002). Effects of this taxon are likely restricted to low herbaceous species (M. Carlson). Orange hawkweed reduces the population of native species in forbs–fern meadows in Kodiak (P. Spencer pers. com.).

Impact on Higher Trophic Levels (0–10) — 7
Orange and meadow hawkweed are unpalatable and reduces the forage value of grasslands for grazing animals. It hybridizes freely with native and non-native hawkweeds (Callihan and Miller 1999, Noxious Weed Control Program 2004, Prather et al. 2003, Rinella and Sheley 2002). Orange hawkweed is also a host for nematode species (Townshend and Davidson 1962).

Total for Ecological Impact — 29/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3
Each rosette of hawkweed is capable of producing between 600 and 45,000 tiny seeds. In addition to reproducing by seeds, these hawkweeds are capable of spreading by rhizomes, stolons, and adventitious root buds (Callihan and Miller 1999, Prather et al. 2003, Rinella ans Sheley 2002).

Long-distance dispersal (0–3) — 3
The seeds are spread by wind and animals (Callihan and Miller 1999, Rinella and Sheley 2002). Seeds are tiny and plumed.

Spread by humans (0–3) — 3
The seeds are easily carried by vehicles, animals, and clothing. Orange hawkweed has escaped from flower gardens (Noxious Weed Control Program 2004, Rinella and Sheley 2002).

Allelopathic (0–2) — 2
These species are described as allelopathic (Murphy and Aarssen 1995, Noxious Weed Control Program 2003).

Competitive Ability (0–3) — 3
Orange and meadow hawkweeds outcompete many native species by forming dense, monospecific stands (Prather et al. 2003, Rinella and Sheley 2002).

Thicket-forming/Smothering growth form (0–2) — 2
Orange and meadow hawkweeds form dense, monospecific stands. However, leaves are primarily basal and do not shade grasses and most other forbs (Callihan and Miller 1999, Rinella and Sheley 2002).

Germination requirements (0–3) — 2
These hawkweed species can germinate in vegetated areas, but germination is best in full sun (Rinella and Sheley 2002).

Other invasive species in the genus (0–3) — 3
Hieracium umbellatum L., *H. pilosella* L., *H. piloselloides* Vill, and *H. floribundum* Wimmer & Grab. are listed as noxious weeds in U.S. (Invaders Database System 2002, Royer and Dickinson 1999, USDA, NRCS 2002).

Aquatic, wetland or riparian species (0–3) — 2
Orange and meadow hawkweeds generally inhabit roadsides, gravel pits, pastures, and moist grasslands (Callihan and Miller 1999, Prather et al. 2003). In Alaska, orange hawkweed has been observed invading wetlands and boreal white spruce–birch forests (M. Shephard pers. obs., M. Carlson pers. obs.).

Total for Biological Characteristics and Dispersal — 23/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 4
Orange hawkweed was first introduced into United States for use as an herbal remedy and garden ornamental. It is currently being planted as an ornamental in Girdwood and the Susitna Valley (I. Lapina pers. obs.).

Known level of impact in natural areas (0–6) — 4
Orange and meadow hawkweeds invade permanent meadows, grasslands, rangelands, and pastures in Montana and Washington. It is a major environmental weed in montane areas in Canada and New Zealand (Noxious Weed Control Board 2004, Prather 2003, Rinella and Sheley 2002). Orange hawkweed invades forb–fern meadows in Kodiak (P. Spencer pers. com.).

Role of anthropogenic and natural disturbance in establishment (0–5) Hawkweeds readily grow in cleared areas in forests. Mowing promotes flowering and spreading of stolons. However, populations often establish in remote mountain meadows and forested habitats with moderate levels of natural disturbance (Rinella and Sheley 2002). Orange and meadow hawkweeds have been established in native communities with natural disturbances in Kodiak, Juneau, and Valdez (P. Spencer pers. com., M. Shephard pers. com.).	3
Current global distribution (0–5) Orange hawkweed originates from the British Isles, southern Scandinavia, west to Russia, and south to the Mediterranean. Meadow hawkweed is indigenous to Northern, Central, and Eastern Europe. Hawkweeds now are also established in East Asia, the United States, Canada, and New Zealand (Hultén 1968, Rinella and Sheley 2002).	3
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) *Hieracium aurantiacum* listed as a noxious weed in British Colombia, Colorado, Idaho, Minnesota, Montana, Quebec, and Washington. *H. caespitosum* is considered a noxious in Idaho, Montana, Oregon, and Washington (Invaders Database System 2003, USDA 2002).	5
Total for Ecological Amplitude and Distribution	19/25
Feasibility of Control	**Score**
Seed banks (0–3) Seeds of hawkweeds are viable up to 7 years (Rinella and Sheley 2002).	3
Vegetative regeneration (0–3) The hawkweeds are capable of spreading by rhizomes and stolons and adventitious root buds (Rinella and Sheley 2002).	2
Level of effort required (0–4) Mechanical control procedures are generally not successful; digging, grazing, or tillage can stimulate the growth of new plants from fragmented roots, stolons, and rhizomes. Orange hawkweed can be controlled with herbicides. The site should be monitored for several years for plants growing from root fragments and from seed bank. Small, isolated populations are more easily controlled (Rinella and Sheley 2002).	3
Total for Feasibility of Control	8/10
Total score for 4 sections	79/100

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Hieracium umbellatum L. — common names: narrowleaf hawkweed

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	30	13
Biological Characteristics and Dispersal	20	16
Amplitude and Distribution	25	9
Feasibility of Control	7	4
Relative Maximum		51

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	Yes

This species has been collected near Coldfoot in the Brooks Range (edge of the arctic alpine ecogeographic region); Fairbanks, Anchorage, Tanana Lowlands, and Matanuska–Susitna Valley (interior boreal ecogeographic region); and Wrangell Island and Petersburg (south coastal ecogeographic region) (AKEPIC 2007, UAM 2004). *Hieracium umbellatum* has been collected from the edge of the arctic alpine ecogeographic region on the southern side of the Brooks Range (AKEPIC 2007). This specific site is a more interior boreal plant community and has relatively warm summers, but cold and long winters. Additionally, its range includes subarctic regions such as Northwest Territory and Yukon Territory, Canada and Siberia, Russia (Douglas et al. 1998, USDA, ARS 2004), with a greater than 50% climatic similarity between known sites and Nome (CLIMEX 1999). This suggests that establishment in arctic and alpine regions of Alaska may be possible.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 5
Narrowleaf hawkweed consumes soil moisture and nutrients. It can form relatively dense stands in only weakly disturbed sites and is likely to delay establishment of native species (M. Carlson pers. obs., I. Lapina pers. obs.).

Impact on Natural Community Structure (0–10) — 3
It establishes in an existing herbaceous layer, changing the density of the layer (I. Lapina pers. obs.).

Impact on Natural Community Composition (0–10) — 5
Narrowleaf hawkweed has been observed in naturally disturbed areas following forest fires in interior Alaska (Villano 2007) as well as partially disturbed roadsides areas in Alaska (I. Lapina pers. obs.). It likely reduces the diversity and density of native species in these disturbed habitats.

Impact on Higher Trophic Levels (0–10) — U
Impact on higher trophic levels is unknown.

Total for Ecological Impact — 13/30

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 2
Narrowleaf hawkweed spreads by both seed and rhizomes (Plants for a future 2002).

Long-distance dispersal (0–3) — 3
Seeds have pappus and are likely wind dispersed (Douglas et al. 1998).

Spread by humans (0–3) — 3
Narrowleaf hawkweed has been observed spreading along transportation corridors (I. Lapina pers. obs.). It has been used as an ornamental (Plants for a future 2002).

Allelopathic (0–2) — U
Unknown

Competitive Ability (0–3) — 3
It has moderate competitive abilities with other non-native species on disturbed sites (I. Lapina pers. obs.). The plant is adapted to all soil types (sandy, loamy, and clay). It can grow in nutritionally poor soil and withstand semishade (Plants for a future 2002).

Thicket-forming/Smothering growth form (0–2) — 1
Narrowleaf hawkweed is capable of forming dense nearly monocultural stands in disturbed sites in south-central Alaska. Plants can grow up to 4 feet tall and overshadow other herbaceous plants (I. Lapina pers. obs.).

Germination requirements (0–3) — U
Unknown

Other invasive species in the genus (0–3) — 3
Hieracium aurantiacum L., *H. caespitosum* Dumort, *H. pilosella* L., and *H. piloselloides* Vill. (Royer and Dickinson 1999, USDA, NRCS 2006).

Aquatic, wetland or riparian species (0–3) — 1
In Alaska narrowleaf hawkweed is generally observed in disturbed mesic areas. However, in its native range it grows along streambanks, moist meadows, grasslands, and forests (Douglass et al. 1998, Gubanov et al. 1995). It has been noted invading 40 year old abandoned fields along the Stikine River (M. Shephard pers. com.).

Total for Biological Characteristics and Dispersal — 16/20

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 2
Narrowleaf hawkweed is known as an ornamental (Plants for a future 2002).

Known level of impact in natural areas (0–6) — 0
The impact of narrowleaf hawkweed in natural areas has not been documented.

Role of anthropogenic and natural disturbance in establishment (0–5) — 0
Narrowleaf hawkweed has been observed only in sites with disturbed substrates (I. Lapina pers. obs., Villano 2007).

Current global distribution (0–5) — 5
The native range of narrowleaf hawkweed includes Europe, temperate Asia, and North America. It is known from subarctic regions in Northwest Territory and Yukon Territory, Canada and Siberia, Russia (Douglas et al. 1998, ITIS 2004, USDA, ARS 2004).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) — 2
Introduced populations in North America extend from Alaska south to Idaho and northwestern Oregon (Hitchcock & Cronquist 1990, Welsh 1974). However, it is considered native to United States as far south as Colorado and Nebraska (ITIS 2004, USDA, ARS 2004). This species is on threatened and endangered plants list in New Hampshire (USDA 2002). It is not listed as noxious in any American states or Canadian provinces (Rice 2006).

Total for Ecological Amplitude and Distribution — 9/25

Feasibility of Control	Score
Seed banks (0–3)	U
Unknown	
Vegetative regeneration (0–3)	2
Narrowleaf hawkweed can resprout from rhizomes (Plant for a future 2002).	
Level of effort required (0–4)	2
Control options have not been investigated. Populations in south-central Alaska appear to be persisting and spreading without continual disturbance (I. Lapina pers. obs.).	
Total for Feasibility of Control	4/7
Total score for 4 sections	44/82

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Hordeum jubatum L.

common names: foxtail barley

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	18
Biological Characteristics and Dispersal	25	16
Amplitude and Distribution	25	20
Feasibility of Control	10	9
Relative Maximum		63

Climatic Comparison	*Collected in Alaska regions?*	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Special Note–nativity: *Hordeum jubatum* is native to western North America and has become naturalized in eastern North America, as well as Europe (Hitcock and Cronquest 1971, ITIS 2002, USDA 2002). Judging from herbarium records (University of Alaska Museum 2004), it is most likely to have been present in small populations in eastern interior Alaska prior to the 1900s. However, it has spread dramatically in the last half century associated with accelerated human disturbances. Populations in much of Alaska are generally associated with anthropogenic disturbance and are most likely introduced or introgressed genotypes as in *Phalaris arundinacea* in the Pacific Northwest (see Merigliano and Lesica 1998). Greater study, using molecular and morphological markers and paleoecological study is necessary to tease apart the patterns of nativity of this species in Alaska.

Hordeum jubatum has been collected in all ecogeographic regions in Alaska (Hultén 1968, UAM 2004).

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	3
Foxtail barley accumulates high amounts of salt in its stems and leaves, reducing soil salinity (Badger and Ungar 1990, Keiffer and Ungar 2002).	
Impact on Natural Community Structure (0–10)	3
Foxtail barley has been observed creating a dense graminoid layer along barren river bars and eroding slopes (J. Conn pers. obs., I. Lapina pers. obs.).	
Impact on Natural Community Composition (0–10)	5
Hordeum jubatum was often the dominant species in Ohio where soil salinity averaged about 0.6%. At moderate salinity concentrations, it made up 90–100% of the vegetation cover (Badger and Ungar 1990). In Alaska it has been recorded forming large component of the herbaceous vegetation (J. Conn pers. obs.). These high densities are believed to reduce populations of other grasses and forbs.	
Impact on Higher Trophic Levels (0–10)	7
In early summer foxtail is palatable to browsing animals. Many waterfowl species eat the seeds and leaves of foxtail barley. In late summer, the sharp pointed awns may cause damage to the mouth, eyes, and skin of animals. This plant is host for number of viruses (MAFRI 2004, Royer and Dickinson 1999, Tesky 1992, Whitson et al. 2000, Woodcock 1925). *Hordeum jubatum* is interfertile with numerous species, forming hybrids (Hultén 1968, Murry and Tai 1980, Welsh 1974).	
Total for Ecological Impact	18/40

Biological Characteristics and Dispersal	Score
Mode of Reproduction (0–3)	1
This plant reproduces primarily by seed. Each plant is capable of producing more than 180 seeds (Royer and Dickinson 1999).	
Long-distance dispersal (0–3)	3
The seeds are dispersed by wind or transported in the hair of animals (Royer and Dickinson 1999, Tesky 1992).	
Spread by humans (0–3)	3
Foxtail barley has been grown as an ornamental (Tesky 1992). It also is a potential crop contaminant (USDA, ARS 2004). This grass has increased in frequency as a response to human activities that increase soil salinity (Badger and Ungar 1994).	
Allelopathic (0–2)	0
No records are found concerning allelopathy.	
Competitive Ability (0–3)	1
Foxtail barley is capable of dominating sites with high soil salinity, but it is typically a poor competitor with other species at low salinities (Badger and Ungar 1994).	
Thicket-forming/Smothering growth form (0–2)	0
This plant can grow 1 to 2 feet tall (Whitson et al. 2000)	
Germination requirements (0–3)	2
As a pioneer on disturbed sites, foxtail barley likely adapted to germinate in open soils (Tesky 1992). However, it has been observed in wet meadows without obviously open soils in Alaska (M. Carlson pers. obs.)	
Other invasive species in the genus (0–3)	3
Hordeum murinum L., *H. pusillum* Nutt., and *H. vulgare* are considered weeds in United States (USDA 2002, Whitson et al. 2000).	

Aquatic, wetland or riparian species (0–3)	3
Foxtail barley can be found on roadsides and waste areas. It is common also on tidal flats, terraces, and riverbanks (Hultén 1968, Tesky 1992, Welsh 1974).	
Total for Biological Characteristics and Dispersal	**16/23**
Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
Foxtail barley is a common weed in cultivated fields (MAFRI 2004, Robson et al. 2004). It also is considered a pasture weed because of the damage to animals (Tesky 1992).	
Known level of impact in natural areas (0–6)	3
Foxtail barley is known to grow in grasslands throughout the West. It reaches its greatest abundance on the edges of sloughs and salt marshes, grassy slopes, and flatlands of the prairies. It also is abundant in sagebrush margins and irrigated meadows (Tesky 1992).	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
This species has been observed invading areas with natural disturbances such as flooding and river erosion (J. Conn pers. obs.). Some types of disturbance, such as overgrazing, mowing, burning, increasing soil salinity, and soil contamination increases the density of foxtail barley (Badger and Ungar 1990, Robson et al. 2004, Tesky 1992).	
Current global distribution (0–5)	5
Foxtail barley is native to western North America and has become naturalized in eastern North America, Europe, and Asia, including arctic and subarctic regions. It also is recorded from Mexico and Great Britain (Hultén 1968, ITIS 2002, USDA 2002).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
The current range of *Hordeum jubatum* includes most of the United States except for the southeastern states (ITIS 2002, USDA 2002). Foxtail barley is declared a noxious weed in Manitoba and Quebec (Invaders Database System 2003, USDA 2002).	
Total for Ecological Amplitude and Distribution	**20/25**
Feasibility of Control	**Score**
Seed banks (0–3)	3
Test in Alaska indicated that up to 67% of seeds remained viable during first year in the soil. Germinability decreased with burial and time. Less than 1% of buried seeds remain viable for up to 7 years (Conn and Deck 1995, Badger and Ungar 1994).	
Vegetative regeneration (0–3)	2
Foxtail barley reproduces by seed (MAFRI 2004, Whitson et al. 2000). Reproduction vegetatively by tilling has also been reported (Tesky 1992). Foxtail barley has the ability to resprout after mowing or cutting (J. Conn pers. com.).	
Level of effort required (0–4)	4
Once established foxtail barley is hard to eradicate. Revegetating disturbed areas with desirable plants and controlling water levels is effective in reducing the amount of foxtail barley (Tesky 1992). This species can be control with herbicides (MAFRI 2004).	
Total for Feasibility of Control	**9/10**
Total score for 4 sections	**63/100**

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Hordeum murinum ssp. *leporinum* (Link) Arcang.

common names: leporinum barley, lepor barley, rabbit barley, hare barley

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		No
Interior Boreal		Yes
Arctic Alpine		No
	Potential Max.	***Score***
Ecological Impact	40	18
Biological Characteristics and Dispersal	25	17
Amplitude and Distribution	25	17
Feasibility of Control	10	8
Relative Maximum		**60**

Climatic Comparison		
	Collected in Alaska regions?	***CLIMEX similarity?***
South Coastal	No	No
Interior Boreal	Yes	–
Arctic Alpine	No	No

Hordeum murinum ssp. *leporinum* has been collected in the Matanuska and Susitna Valleys in Alaska (AKEPIC 2004). The climatic similarity between Juneau and Fairbanks and areas where this species occurs is low (CLIMEX 1999, USDA 2002). This low similarity suggests that establishment of *Hordeum murinum* ssp. *leporinum* in south coastal and arctic alpine ecogeographic regions is unlikely.

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	3
Leporinum barley likely reduces soil moisture and nutrients (I. Lapina pers. obs.). This species can form high densities in Alaska where it certainly uses substantial soil moisture and nutrients (I. Lapina pers. obs.). It is not known if these resources are limiting to other species in these sites.	
Impact on Natural Community Structure (0–10)	3
A high density of leporinum barley has been observed in an existing layer of vegetation in south-central Alaska (I. Lapina pers. obs.). It becomes the dominant component of mixed crop pastures in Australia and New Zealand (Cocks and Donald 1973, Govey et al. 2003, Popay 1981).	
Impact on Natural Community Composition (0–10)	5
Leporinum barley can reduce the number of native individuals in forb and grass communities (Cocks and Donald 1973, Govey et al. 2003).	
Impact on Higher Trophic Levels (0–10)	7
Awns of mature plants can cause serious injury to the eyes, nose, and throat of grazing animals (Klott 1981, Warr 19981, Whitson et al. 2000). This plant also hosts several diseases (Klott 1981).	
Total for Ecological Impact	**18/30**

Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	3
Leporinum barley reproduces by seeds that are produced in large numbers (Halloran and Pennell 1981).	
Long-distance dispersal (0–3)	3
The seeds can be transported by attachment to animal hair (Cocks and Donald 1973).	
Spread by humans (0–3)	3
Seed can be transported by entanglement in commercial wool or as a contaminant in seed and hay (Cocks and Donald 1973, Klott 1981, USDA, ARS 2005). It can be dispersed with sled dog bedding (J. Conn pers. com.).	
Allelopathic (0–2)	0
No records are found concerning allelopathy.	
Competitive Ability (0–3)	3
Leporinum barley can invade pastures and dominate native forb and grass communities (Cocks and Donald 1973, Groves et al. 2003). Leporinum barley has several features which give it a potential advantage over native or resident species. It has high seed production and earlier, more rapid and more complete germination than other annual grasses (Cocks and Donald 1973, Groves et al. 2003, Halloran and Pennell 1981). Milthorpe (1961) found that in mixed cultures rapidly-germinating plant species tend to dominate over more slowly-germinating species. Leporinum barley is also able to germinate at lower seed moisture content and over a broader range of temperatures. Germination is strongly stimulated by short periods of wetting. The long awns provide a competitive advantage by making seeds difficult for animals to eat and by assisting natural seed burial (Cocks and Donald 1973, Halloran and Pennell 1981, Piggin et al. 1973).	
Thicket-forming/Smothering growth form (0–2)	0
Leporinum barley is not characterized by a climbing or smothering growth habit. It can grow up to 10 inches tall (Hitchcock et al. 1969, Whitson et al. 2000).	
Germination requirements (0–3)	2
Leporinum barley typically establishes on bare soils but likely is able to establish in vegetated areas also (Cocks and Donald 1973, Piggin et al. 1973, Popay 1981).	
Other invasive species in the genus (0–3)	3
Hordeum jubatum L., *H. pusillum* Nutt., and *H. vulgare* are considered weeds in the United States (USDA 2002, Whitson et al. 2000).	
Aquatic, wetland or riparian species (0–3)	0
Leporinum barley occupies ruderal places such as roadsides and the margins of cultivated land. In Australia this grass occupies annual pastures, while in New Zealand it is a greater problem in sheep pastures and alfalfa crops (Cocks and Donald 1973, Davison 1971).	
Total for Biological Characteristics and Dispersal	**17/25**

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
Leporinum barley was introduced during the eighteenth and nineteenth centuries to North and South America, Australia, and New Zealand where it has become a weed of considerable economic importance (Cocks and Donald 1973, Davison 1971, Popey 1981).	
Known level of impact in natural areas (0–6)	1
Many annual grass pastures in Australia are invaded and become dominated by leporinum barley (Cock and Donald 1973).	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
Leporinum barley readily establishes in areas subject to regular grazing and trampling. It becomes dominant with increasing intensity of grazing (Groves et al. 2003).	
Current global distribution (0–5)	5
Leporinum barley is believed to have originated in Eurasia. Its native range extends from Middle Europe south to Northern Africa and west to Western Asia and the Caucasus (USDA, ARS 2005). It has become naturalized in North and South America, Australia, and New Zealand (Halloran and Pennell 1981, Davison 1971).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	4
The species' range in North America extends along both the west and east coasts. *Hordeum murinum* ssp. *leporinum* is not considered noxious in North America (Invaders Database System 2003, USDA 2002).	
Total for Ecological Amplitude and Distribution	**17/25**

Feasibility of Control	**Score**
Seed banks (0–3)	3
One viable seed of leporinum barley was found in 200-year old adobe bricks from Northern Mexico (Spira and Wagner 1983). Additional information on leporinum barley seed viability is lacking, but seeds of other *Hordeum* species appear to remain viable for long periods (Haferkamp et al. 1953).	
Vegetative regeneration (0–3)	2
Leporinum barley can resprout after removal of aboveground growth.	
Level of effort required (0–4)	3
Grazing, mowing, and herbicides can be used to reduce the leporinum barley content in pastures. Leporinum barley is known to be strongly resistant to a number of herbicides (Klott 1981, Stephenson 1993).	
Total for Feasibility of Control	**8/10**
Total score for 4 sections	**60/90**

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Hydrilla verticillata (L. f.) Royle common names: hydrilla

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	38
Biological Characteristics and Dispersal	22	17
Amplitude and Distribution	25	14
Feasibility of Control	10	9
Relative Maximum		78

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	No	Yes
Interior Boreal	No	Yes
Arctic Alpine	No	No

Hydrilla verticillata has not been documented in Alaska (Hultén 1968, Pfauth and Sytsma 2005, UAM 2004). The CLIMEX climate matching program indicates a climatic similarity between south coastal region of Alaska and areas of the species documented occurrence are high. The native range of hydrilla includes Akita, Japan and Thredbo, Australia (Cook and Lüönd 1982) which have 55% and 53% of climate similarity with Juneau. The distribution range of hydrilla also includes Minsk, Belarus and Semipalatinsk, Russia (Cook and Lüönd 1982) which have a 62% and 61% climate similarity with Anchorage, respectively. Climatic similarities between Fairbanks and Semipalatinsk and Blagoveshchensk, Russia and Qiqihar, China have a 64%, 61%, and 50% similarity with Fairbanks respectively. Hydrilla is not known from arctic regions. In general, aquatic species are less impacted by variation in terrestrial climates. *Hydrilla verticillata* is likely to become established in the south coastal and interior boreal regions of Alaska.

Ecological Impact **Score**

Impact on Ecosystem Processes (0–10) 8

Hydrilla infestations slow the movement of water, causing flooding. Slow waterflow can also increase the sedimentation rates, water temperature, and pH level (Estes et al. 1990, Joyce et al. 1992) and decrease dissolved oxygen (Bossard et al. 2000). It also affects water nutrient turnover (Bole and Allan 1978, Sinha et al. 2000).

Impact on Natural Community Structure (0–10) 10

Hydrilla forms a dense mat of vegetation at the water surface and limits light penetration degrading or eliminating all layers below (Bossard et al. 2000). Haller and Sutton (1975) reported that light penetration is reduced by at least 95% at 1 foot of depth. An aquatic vegetation study in Florida found that area coverage of submersed aquatic macrophytes increased from 8% in 1987 to 90% in 1989 and 1990 due to the expansion of hydrilla (Estes et al. 1990).

Impact on Natural Community Composition (0–10) 10

Hydrilla infestations can cause a reduction or the extirpation of populations of native aquatic species (Bossard et al. 2000). Hydrilla may also shift the phytoplankton composition (Canfield et al. 1984). Infestations also adversely affect fish populations. Hydrilla may reduce seed production of native species, resulting eventually in a reducing of a number of native species in the community (de Winton and Clayton 1996). A study in Florida found that the frequency of occurrence for the most abundant native submersed plants, coontail and southern naiad decreased from 11% to 4% and 56% to 4%, respectively, from 1987 to 1990 (Ester et al. 1990).

Impact on Higher Trophic Levels (0–10) 10

Hydrilla is eaten by waterfowl and fish. Some studies support the view that hydrilla is beneficial as a fishfood and cover (Estes et al. 1990); other researches suggest that fish populations are adversely affected when hydrilla coverage exceeds 30% (Colle and Shireman 1980). Hydrilla appears to be an important habitat for a number of mosquito species (Hearnden and Kay 1997).

Total for Ecological Impact 38/40

Biological Characteristics and Dispersal **Score**

Mode of Reproduction (0–3) 3

Hydrilla reproduces by seeds, but seed production has minor importance. Vegetative reproduction is very efficient and occurs by fragmentation of the stem, or by the production of axillary buds (turions) and below-ground tubers. One plant can produce an average of 6,046 tubers per season (Sutton et al. 1992). An experiment by Thullen (1990) showed that hydrilla can produced up to 46 axillary turions per 1.0 g dry weight (estimated of 2803 turions per m^3). About 50% of the fragments with a single whorl can sprout and form new plant, and more than 50% of the fragments with three whorls can sprout (Langeland and Sutton 1980).

Long-distance dispersal (0–3) 2

Tubers, turions, and stem fragments disperse with flooding. Tubers survive ingestion by waterfowl and might be transported from one water body to another (Joyce et al. 1980). The importance of tubers dispersal, therefore, is unknown.

Spread by humans (0–3) 2

Hydrilla was first introduced into North America as an aquarium plant. Turions or small pieces of hydrilla stems can travel on boat trailers or planes. Accidental introductions with planted waterlily have been reported (Washington State Department of Ecology 2004). Hydrilla twigs survive 16 hours of desiccation (Basiouny et al. 1978, Kar and Choudhuri 1982). Tubers can remain viable for several days out of water (Basiouny et al. 1978).

Allelopathic (0–2) 2

In experiments by Elakovich and Wooten (1989) extracts of hydrilla exhibit high allelopathy potential and inhibited the growth of lettuce seedling and duckweed.

Competitive Ability (0–3) 3
Hydrilla is highly adaptive to the environment and competitive with most other aquatic plants (Haller and Sutton 1975). It is able to outcompete native submerged plants for light and nutrients. The growth habit of hydrilla enables it to compete effectively for sunlight. It can elongate up to 1 inch per day, and produces the majority of the stems in the upper 2–3 feet of water (Haller and Sutton 1975). This mat of vegetation intercepts sunlight and leads to exclusion of other aquatic plants. Hydrilla is also adapted to use low light levels for photosynthesis (Barko and Smart 1981, Van et al. 1976). Hydrilla efficiently uses a limited supply of nutrients such as carbon, nitrogen, and phosphorus.

Thicket-forming/Smothering growth form (0–2) 2
Hydrilla can form a dense mat near the water surface (Bossard et al. 2000).

Germination requirements (0–3) N/A
Germination of seeds is not a significant factor in reproduction. (Bossard et al. 2000).

Other invasive species in the genus (0–3) 0
None

Aquatic, wetland or riparian species (0–3) 3
Hydrilla is a submerged aquatic perennial. Typical habitats of hydrilla include ditches, canals, ponds, reservoirs. It can be found in fresh and brackish, flowing, and still waters (Bossard et al. 2000, Thorne 1993).

Total for Biological Characteristics and Dispersal 17/22

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) 0
Hydrilla is not an agricultural weed.

Known level of impact in natural areas (0–6) 1
Hydrilla causes severe alterations of plant community composition, community structure, and ecosystem processes in water bodies in California (Bossard et al. 2000). This aquatic weed displaces native plants and adversely impacts freshwater habitats in Florida (Langeland 1996). Hydrilla is reported from one lake system in Washington. This is the only known occurrence of hydrilla in the Pacific Northwest and impact on native aquatic ecosystem has not been recorded (Washington State Department of Ecology 2004).

Role of anthropogenic and natural disturbance in establishment (0–5) 5
Hydrilla can be readily established in undisturbed aquatic ecosystem (Bossard et al. 2000).

Current global distribution (0–5) 3
Hydrilla is probably native to the warmer regions of Asia (Cook and Lüönd 1982). It is a cosmopolitan species that occurs in Europe, Asia, Australia, New Zealand the Pacific Islands, Africa, and North and South America.

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) 5
In the United States hydrilla populations occur in all Southeastern states and in Arizona, California, and Washington (USDA, NRCS 2006). *Hydrilla verticillata* is declared a federal noxious weed in U.S. It also is listed noxious in 17 American states (Rice 2006, USDA, NRCS 2006).

Total for Ecological Amplitude and Distribution 14/25

Feasibility of Control — Score

Seed banks (0–3) 2
Seed production and seed viability is probably low. However, propagules of hydrilla tubers survived in undisturbed sediment for a period of over 4 years. Axillary turions usually do not remain viable for more than 1 year (Van and Steward 1990).

Vegetative regeneration (0–3) 3
Hydrilla can regenerate from stem fragments, tubers, and turions (Basiouny et al. 1978, Spencer and Rejmanek 1989, Steward 1992, Sutton et al. 1992). About 50% of the fragments with a single whorl can sprout and form new plants. More than 50% of the fragments with three whorls can sprout (Langeland and Sutton 1980).

Level of effort required (0–4) 4
The cost of hydrilla management is extremely high. Management methods currently include mechanical removal, herbicides applications, and biological control. Hydrilla is fragmented easily and damaged plants that are not removed by mechanical control methods can act as a source of reestablishment. Several species of weevils, leaf-mining flies, and moth have been introduced to control hydrilla (Bossard et al. 2000, Langeland 1996).

Total for Feasibility of Control 9/10

Total score for 4 sections 78/97

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Hypericum perforatum L. common names: St. Johnswort

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	11
Biological Characteristics and Dispersal	25	15
Amplitude and Distribution	25	18
Feasibility of Control	10	8
Relative Maximum		52

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	
Interior Boreal	Yes	
Arctic Alpine	No	

Hypericum perforatum has been recorded from Anchorage, Sitka, Ketchikan, and Baranof Island (AKEPIC 2004). Climatic similarity is high between Nome (arctic alpine ecoregion) and areas where the species is documented. Native range of the species includes Ust'Tsil'ma, Ust'Shchugor, and Zlatoust, Russia (Gubanov et al. 2003, USDA, ARS 2004), which has a 78%, 73% and 71% climatic match with Nome and 66%, 67%, and 64% with Fairbanks, respectively. The species has been recorded from Anchorage which has a 61% climatic match with Nome. Thus establishment of *Hypericum perforatum* in arctic alpine and interior boreal ecoregions may be possible.

Ecological Impact — **Score**

Impact on Ecosystem Processes (0–10) 3

Common St. Johnswort depletes soil moisture. It is likely to delay the establishment of native species in disturbed sites. In late summer, the dry stalks of St. Johnswort may constitute a fire hazard to forests and rangelands (Sampson and Parker 1930).

Impact on Natural Community Structure (0–10) 3

Common St. Johnswort is capable of forming dense stands in grasslands and pastures (Powell et al. 1994, Tisdale et al. 1959, White et al. 1993).

Impact on Natural Community Composition (0–10) 3

Common St. Johnswort is capable of displacing native species and modifying native plant community composition (Rutledge and McLendon 1996).

Impact on Higher Trophic Levels (0–10) 2

The plant contains a toxin that causes severe dermatitis in light-haired livestock when they are exposed to strong sunlight (Powell et al. 1994, Rutledge and McLendon 1996, Whitson et al. 2000). Hybrids of *H. perforatum* and *H. maculatum* are common in Europe where both species occur (Campbell and Delfosse 1984, Lid and Lid 1994).

Total for Ecological Impact 11/40

Biological Characteristics and Dispersal — **Score**

Mode of Reproduction (0–3) 3

Common St. Johnswort reproduces by seed and short runners. The root system spreads horizontally and forms new buds (Rutledge and McLendon 1996). According to Davey (1919) plants are capable of producing up to 15,000 seeds. Seed production during a 2-year study in Idaho averaged 23,350 seeds per plant (Tisdale et al. 1959).

Long-distance dispersal (0–3) 3

Water and animals are likely the main factors of seed dispersal (Rutledge and McLendon 1996, Parsons 1957). Seeds have no adaptation to wind dispersal; however, a few tests conducted in Idaho indicate that seeds can be dispersed by wind up to 30 feet from the nearest plant (Tisdale et al. 1959). A gelatinous coat of the seed facilitates long-distance dispersal by sticking to objects or animals (Sampson and Parker 1930 cited in Crompton et al. 1988).

Spread by humans (0–3) 3

Common St. Johnswort was introduced to new areas for ornamental and medicinal purposes (Parsons 1957). It has been cultivated on farms in Eastern European countries (Gubanov et al. 2003). Seeds may contaminate commercial crop seed (USDA, ARS 2005). Seeds also can be distributed over large areas, adhering to wheels of vehicles, or contaminating hay or soil (Parsons 1957).

Allelopathic (0–2) 0

Allelopathy has never been reported for common St. Johnswort, there is likely no allelopathy potential for this plant.

Competitive Ability (0–3) 1

Seedlings of common St. Johnswort are very small, grow slowly, and are extremely susceptible to competition from other pasture plants. Once the new seedlings pass their first year and are established, they are able to outcompete and displace their neighbors (Cambell 1985). Tisdale and others (1959) found that perennial pasture grasses are more competitive plants compared to common St. Johnswort. The root system of seedlings commonly attains a depth of about 1 foot during its first growing season. Mature plants have an extensive root system which extends 4–5 feet in depth and about 3 feet laterally. The deep root system is capable of supporting the plant when soil water has been depleted (Tisdale et al. 1959).

Thicket-forming/Smothering growth form (0–2) 1

Common St. Johnswort forms a dense spreading canopy over 3 feet tall and may overtop other pasture forbs and grasses (Crompton et al. 1988).

Germination requirements (0–3) 0

Seeds require bare soil, sunlight, and/or heavy rain for germination (Tisdale et al. 1959). Germination is generally inhibited by high levels of litter (Rutledge and McLendon 1996).

Other invasive species in the genus (0–3) 3

Hypericum androsaemum is a very important weed in Australia (Parsons 1957).

Aquatic, wetland or riparian species (0–3) 1

Common St. Johnswort is commonly found along roadsides and on other disturbed areas. It also invades rangelands, pastures, and meadows (Guide to weeds in British Columbia 2002, Powell et al. 1994). It is known to invade large areas on riverbanks in northeastern Australia (Parsons 1957).

Total for Biological Characteristics and Dispersal 15/25

Ecological Amplitude and Distribution — **Score**

Highly domesticated or a weed of agriculture (0–4) 4

Although common St. Johnswort is not domesticated, it has been cultivated on farms in Eastern European countries for medicinal purposes (Gubanov et al. 2003)

Known level of impact in natural areas (0–6)	3
Common St. Johnswort invades grasslands and open forests in California, Oregon, Washington, Idaho, and Montana. In Idaho, common St. Johnswort creates medium to dense stands in grasslands, replacing native vegetation. It has been established in cut and burned-over areas in *Pinus* ponderosa forests in Idaho (Tisdale et al. 1959). This weed forms large dense stands in moist grasslands and open forest areas in British Columbia (Powell et al. 1994, White et al. 1993). Common St. Johnswort invades large areas in forests, riverbanks, and pastures in Northeastern Australia (Parsons 1957)	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
Original infestations are usually associated with logging, fire, mining, or other disturbance. It can establish in forested areas experiencing natural disturbances such as fire or animal digging and burrowing (Clark 1953, Davey 1919). Vegetative propagation is usually stimulated when St. Johnswort plants are affected by grazing, mowing, or fire (Tisdale et al. 1959).	
Current global distribution (0–5)	3
Common St. Johnswort is native to Europe, and it is naturalized in Asia, South Africa, Japan, North and South America, Australia, and New Zealand (Gubanov et al. 2003, USDA, ARS 2005).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Common St. Johnswort has been found in nearly all the continental United States and Hawaii. It is known from British Columbia, Ontario, Manitoba, and Quebec (Crompton et al. 1988, USDA 2002). *Hypericum perforatum* is declared a noxious weed in California, Colorado, Montana, Nevada, Oregon, Washington, Wyoming, Manitoba, and Quebec (Invaders Database System 2003, USDA 2002).	
Total for Ecological Amplitude and Distribution	18/25

Feasibility of Control	**Score**
Seed banks (0–3)	3
In Australia, Clark (1953) found that St. Johnswort seeds may remain viable in the soil for as long as 6 years. In Idaho, seed buried in soil retained viability after 3 years (Tisdale et al. 1959).	
Vegetative regeneration (0–3)	2
Common St. Johnswort can sprout from buds on lateral roots (Rutledge and McLendon 1996).	
Level of effort required (0–4)	3
Common St. Johnswort is difficult to control because of its extensive root system and long-lived seeds. Tillage, hand pulling, mowing, or burning appears to be ineffective because vegetative reproduction may be stimulated by mechanical treatment (Tisdale et al. 1959). Common St. Johnswort can be controlled by herbicides, however, wax on the leaves inhibit herbicide uptake. Biological control has been relatively successful using several leaf-feeding beetles. However, in Canada and at high elevations these insects do not thrive (Rutledge and McLendon 1996, White et al. 1994).	
Total for Feasibility of Control	8/10
Total score for 4 sections	52/100

§

Impatiens glandulifera Royle common names: ornamental jewelweed, policemen's helmet, Himalayan balsam, Washington orchid

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	29
Biological Characteristics and Dispersal	23	22
Amplitude and Distribution	25	22
Feasibility of Control	10	7
Relative Maximum		82

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	No

Ornamental jewelweed has been recorded in Haines (AKEPIC 2004) and Wrangell (M. Shephard pers. com.). It is widely planted as an ornamental in Anchorage (I. Lapina pers. obs.). The length of the growing season may be a limiting factor in its northern distribution, while absolute minimum temperatures appear to be not significantly limiting. Beerling (1993) calculated a minimum required value of 2,195 day-degrees from its present distribution in Europe and used this to predict the northward spread. The growing season in arctic alpine Alaska is less than 2,195 day-degrees: 1,112 day-degrees in Nome, 1,564 in Dillingham, 313 in Barrow (WRCC 2001). This suggests that *Impatiens glandulifera* cannot extend its distribution into arctic alpine Alaska.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 7

This plant can alter waterflow and increase erosion and flooding at high densities (King County 2004). Additionally, as it suppresses the growth of co-occurring species it likely reduces available resources (light, nutrients, moisture) (Prots and Klotz 2004)

Impact on Natural Community Structure (0–10) — 8

Impatiens gladulifera creates a dense canopy, eliminating most layers below. Despite being an annual, its dry stems persist as a layer the following spring (Beerling and Perrins 1993, King County 2004).

Impact on Natural Community Composition (0–10) — 7

This aggressive plant is able to reduce the growth of native species, eventually replacing them at sites where it gets established (King County 2004, Prots and Klotz 2004). In studies in Great Britain very few species were found co-occurring with ornamental jewelweed (Beerling and Perrins 1993,).

Impact on Higher Trophic Levels (0–10) — 7

This plant competes with native plants for pollinators reducing seed set in native plants. Pollinators include several species of bumblebees, honeybees, moths, and wasps (Beerling and Perrins 1993, Chittka and Schürkens 2001, King County 2004). It alters habitats for wildlife species. Because of high holocellulose content in its stems, it persists as a litter the following spring, suppressing competing seedlings of other species (Beerling and Perrins 1993). Nectar of *Impatiens glandulifera* is rich and more rewarding than that of any known native plant in Central Europe (Chittka and Schürkens 2001).

Total for Ecological Impact — 29/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3

Jewelweed reproduces entirely by seeds. Medium-sized plants growing at a density of 20 per square meter produce between 700 and 800 seeds (Beerling and Perrins 1993). Large plants can produce up to 2,500 seeds, (Chittka and Schürkens 2001, King County 2004).

Long-distance dispersal (0–3) — 3

The seeds can be transported long distance by both water and small mammals (Beerling and Perrins 1993, King County 2004). The rate of spread in the U.K. was estimated as 2–5 km per year (Beerling and Perrins 1993).

Spread by humans (0–3) — 3

Ornamental jewelweed is a garden plant that has escaped cultivation. It is frequently sold at nurseries (King County 2004), and commonly planted in southern Alaska.

Allelopathic (0–2) — U

There is no record of allelopathy.

Competitive Ability (0–3) — 3

This species is an aggressive competitor, overtopping and suppressing the growth of neighboring species (Beerling and Perrins 1993). *Impatiens glandulifera* tolerates many types of soil, it occurs on fine and coarse alluvium, maritime shingle, free-draining mineral soils, and peat. It can grow in full sun as well as partial shade. It has been found along industrial rivers, suggesting it is tolerant or resistant to aquatic and/or atmospheric pollution (Beerling and Perrins 1993, King County 2004).

Thicket-forming/Smothering growth form (0–2) — 2

Impatiens glandulifera creates dense thickets up to 10 feet tall and it is normally taller than surrounding herbaceous vegetation (Beerling and Perrins 1988).

Germination requirements (0–3) — 2

This plant requires open soil to germinate and establish (Beerling and Perrins 1993). It will also germinate in tidal wrack (M. Shephard pers. obs.).

Other invasive species in the genus (0–3) — 3

Impatiens walleriana Hook. f. is considered an invasive in Hawaii (USDA 2002). *Impatiens parviflora* DC. is an Asiatic species invasive in northern Europe (Lid and Lid 1994)

Aquatic, wetland or riparian species (0–3) — 3

Jewelweed is found in wetlands, riparian areas, streamsides, lowlands, wet meadows and forests, and roadside ditches. It is planted in gardens and parks (Beerling and Perrins 1993, King County 2004).

Total for Biological Characteristics and Dispersal — 22/23

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 4

Ornamental jewelweed is known as "one of the many desirable hardy plants" for use in flower gardens (Beerling and Perrins 1993).

Known level of impact in natural areas (0–6)	6
Ornamental jewelweed is an aggressive invader of wetlands and streams in Washington State. It has been recorded displacing native plants and altering wildlife habitats (King County 2004, Pojar and MacKinnon 1994). In Great Britain ornamental jewelweed invades river bars, grasslands, and mixed woodland in the early stages of succession. It is considered extremely invasive to moist natural areas and listed in the "top 20" aliens in Great Britain (Beerling and Perrins 1993).	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
For successful establishment this plant requires a moderate amount of disturbance and bare ground. It can establish on areas locally disturbed by uprooted trees or fallen branches e.g. (Beerling and Perrins 1993).	
Current global distribution (0–5)	5
Native to the western Himalayas, ornamental jewelweed is now naturalized in 31 countries. It is widespread in Europe, North America, and Asia between the latitudes of 30° and 64°N (Beerling and Perrins 1993, Prots and Klotz 2004).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	4
Ornamental jewelweed has been recorded in California, Maine, Massachusetts, Michigan, New York, Oregon, Vermont, Washington, and British Columbia (Hitchcock and Cronquist 1973, USDA 2002). Currently, it is rapidly expanding its range in North America (Prots and Klotz 2004). It is considered to be noxious in Washington (Invaders Database System 2003, USDA 2002).	
Total for Ecological Amplitude and Distribution	22/25

Feasibility of Control	**Score**
Seed banks (0–3)	2
Seeds were viable for at least 18 months in one field experiment and 3 years in another experiment (Beerling and Perrins 1993, King County 2004, Mumford 1988).	
Vegetative regeneration (0–3)	2
Impatiens glandulifera may resprout after mowing (Beerling and Perrins 1993).	
Level of effort required (0–4)	3
Small population can be hand pulled or dug up. Sites need to be monitored following years for new seedlings from the seed bank. Mowing is very effective and reduces the risk of erosion compared to hand pulling. However, mowed or cut plants may resprout later in the season. Only specific herbicides can be used in wetlands. No biological control agents have been identified (Beerling and Perrins 1993, King County 2004).	
Total for Feasibility of Control	7/10
Total score for 4 sections	78/98

§

Lappula squarrosa (Retz.) Dumort. common names: European stickseed, bristly sheepburr

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	10
Biological Characteristics and Dispersal	25	12
Amplitude and Distribution	25	17
Feasibility of Control	10	5
Relative Maximum		44

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Lappula squarrosa has been collected in the south coastal and interior boreal ecogeographic regions of Alaska (Hultén 1968, Welsh 1974, Densmore et al. 2001 AKEPIC 2004, UAM 2004). The CLIMEX matching program indicates the climatic similarity between Nome and areas where *Lappula squarrosa* is documented is moderately high. The range of this species includes Zlatoust, Bogolovsk, and Kirov, Russia (Gubanov et al. 2004), which have 71%, 67%, and 66% climatic match with Nome, respectively. The native range of European stickseed also includes Dombås, Norway (Lid and Lid 1994), which has a 63% climatic match with Nome, as well as occurring as far north as Svalbard (70°N). On the basis of these matches establishment of *Lappula squarrosa* in arctic alpine ecogeographic region may be possible.

Ecological Impact — **Score**

Impact on Ecosystem Processes (0–10) — 3

As an early colonizing species, European stickseed is important to successional processes on disturbed soil. Dense stands of European stickseed reduce evaporation and soil erosion. Senescent plants persist over winter and trap snow which, increases soil moisture (Frick 1984).

Impact on Natural Community Structure (0–10) — 3

European stickseed is capable of forming dense stands on bare ground (Frick 1984); however, dense stands of European stickseed have not been observed in Alaska (M. Densmore et al. 2001, M. Carlson pers. obs., I. Lapina pers. obs.).

Impact on Natural Community Composition (0–10) — 1

European stickseed has not been reported from native communities in Alaska (UAM 2003). It presumably competes for limited moisture and nutrients with adjacent plants in disturbed areas (Frick 1984).

Impact on Higher Trophic Levels (0–10) — 3

European stickseed is occasionally eaten by wildlife species. The plant hosts fungus species and attracts a large nunber of herbivorous insects (Frick 1984).

Total for Ecological Impact — 10/40

Biological Characteristics and Dispersal — **Score**

Mode of Reproduction (0–3) — 3

European stickseed reproduces exclusively by seed. Summer annuals can produce 200 to 500 seeds, while winter annuals may produce as many as 40,000 seeds (Frick 1984, Royer and Dickinson 1999). It is unlikely that European stickseed can behave as winter annual in Alaska (M. Carlson pers. com, J. Conn pers. com.).

Long-distance dispersal (0–3) — 3

The primary mechanism of long-distance dispersal is by attachment of the hooked seeds to animal hair, but seeds may also be carried by the wind, either alone or as detached portions of the plant (Frick 1984, Royer and Dickinson 1999).

Spread by humans (0–3) — 3

The seeds readily attach to clothing and animal hair (Frick 1984).

Allelopathic (0–2) — 0

Allelopathy has not been documented for this species.

Competitive Ability (0–3) — 1

European stickseed presumably competes for limited moisture and nutrients with adjacent plants (Frick 1984). European stickseed is adapted to conditions of deficient moisture and nutrients. It is able to produce seed under poor growing conditions and maximizes seed production under optimum conditions (Frick 1984).

Thicket-forming/Smothering growth form (0–2) — 0

European stickseed can grow up to 2 feet tall and is not characterized by a climbing or smothering growth habit (Douglas et al. 1998, Frick 1984, Royer and Dickinson 1999).

Germination requirements (0–3) — 0

This plant typically germinates and establishes on disturbed areas. Seeds germinate best in light and in the top 1-inch of soil. Presumably mechanical disturbance of soil that brings seeds to the surface induces germination (Frick 1984, Royer and Dickinson 1999).

Other invasive species in the genus (0–3) — 3

Flatspine stickseed (*Lappula occidentalis* (S.Wats.) Greene) is a native annual of western North America, is a serious weed in Western Europe (USDA 2002, Whitson et al. 2000).

Aquatic, wetland or riparian species (0–3) — 0

European stickseed can be found on roadsides, in disturbed and waste areas, and cultivated fields (Frick 1984, Royer and Dickinson 1999). It can also inhabit dry to mesic rocky slopes, grasslands, shrublands, and forest openings in lowland, steppe, and montane zones (Douglass et al. 1998).

Total for Biological Characteristics and Dispersal — 12/25

Ecological Amplitude and Distribution — **Score**

Highly domesticated or a weed of agriculture (0–4) — 4

European stickseed was reported as a wheat field pest in Canada as early as 1895. It is common in crops of wheat, barley, oats, rye, flax, and rape (Frick 1984).

Known level of impact in natural areas (0–6) — 3

European stickseed is known to invade rocky slopes, grasslands, shrublands, and forest openings in British Columbia (Douglass et al. 1998).

Role of anthropogenic and natural disturbance in establishment (0–5)	0
European stickseed typically establishes in disturbed areas and may become abundant in overgrazed pastures (Royer and Dickinson 1999). In Denali National Park it was found only on sites disturbed within the last 3 years or sites regularly disturbed (Densmore et al. 2001).	
Current global distribution (0–5)	5
European stickseed is native to the eastern Mediterranean region. Its modern-day distribution extends from Europe (including the North Pacific islands of Spitsbergen and Iceland) to North America, Asia and Japan between approximately 30° and 70°N latitude. European stickseed occurs in comparable southern hemisphere regions in South Africa and Australia (Frick 1984). It is known from arctic Norway (Lid and Lid 1994).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
European stickseed has been reported from every Canadian province and nearly all American states (Royer and Dickinson 1999, USDA 2002). It is declared a federal noxious weed in Canada. This species is a restricted noxious weed in Alaska (Alaska Administrative Code 1987, Royer and Dickinson 1999).	
Total for Ecological Amplitude and Distribution	17/25

Feasibility of Control	**Score**
Seed banks (0–3)	2
Although 95% of European stickseed seedlings emerge in the first year, seedling emergence may continue for 4 years (Chepil 1946).	
Vegetative regeneration (0–3)	1
Mowing or grazing frequently results in forming numerous axillary inflorescences produced below the injury, which can increase seed production (Frick 1984).	
Level of effort required (0–4)	2
European stickseed is easily pulled up by hand, although several weedings may be necessary to eliminate population (Densmore et al. 2001). In cultivated crops it may be controlled by a wide range of commonly used herbicides. Mowing or grazing is usually not effective (Frick 1984).	
Total for Feasibility of Control	5/10
Total score for 4 sections	44/100

§

Lepidium densiflorum var. densiflorum Schrad. — common names: common pepperweed
L. densiflorum var. elongatum (Rydb.) Thellung. — tall pepperweed

Ranking Summary

Ecoregion known or expected to occur in

South Coastal	Yes
Interior Boreal	Yes
Arctic Alpine	Yes

	Potential Max.	*Score*
Ecological Impact	30	1
Biological Characteristics and Dispersal	23	9
Amplitude and Distribution	25	8
Feasibility of Control	10	4
Relative Maximum		**25**

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	No	Yes
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Lepidium densiflorum has been documented in the interior boreal ecogeographic region in Alaska (Hultén 1968, AKEPIC 2005, UAM 2004). The CLIMEX matching program indicates the climatic similarity between arctic alpine and south coastal ecogeographic regions of Alaska and areas where common pepperweed has been introduced is moderately high. This species' range includes Dombås, Norway and Sarna and Östersund, Sweden (Natur Historiska Riksmuseet Database 2005), which have a 63%, 61% and 57% climatic match with Nome respectively. The introduced range of this species also includes Bergen, Kristiansand, and Stavanger, Norway, which have 73%, 60%, and 52% climatic match with Juneau, respectively. Thus establishment of common pepperweed in arctic alpine and south coastal ecogeographic regions is likely.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 0
Common pepperweed does not occur in natural areas in Alaska (UAM 2005, AKEPIC 2006). This species has little or no effect on natural ecosystem processes (Densmore et al. 2001).

Impact on Natural Community Structure (0–10) — 1
Common pepperweed establishes in an existing layer and increases total percent cover in open, disturbed sites (I. Lapina pers. obs.).

Impact on Natural Community Composition (0–10) — 0
Common pepperweed has not been observed in undisturbed areas in Alaska (Densmore et al. 2001, UAM 2005, AKEPIC 2006) and no perceived impacts on native populations have been documented.

Impact on Higher Trophic Levels (0–10) — U
Impact on higher trophic levels has not been documented.

Total for Ecological Impact — 1/30

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3
Common pepperweed reproduces by seeds only. Each plant is capable of producing up to 5,000 seeds (Royer and Dickinson 1999).

Long-distance dispersal (0–3) — 1
At maturity, the plant can break off at the base and tumble in the wind, spreading seeds (Rutledge and McLendon 1996).

Spread by humans (0–3) — 2
Common pepperweed is a weed of cultivated crops and can be spread as a commercial seed contaminant (USDA, ARS 2006).

Allelopathic (0–2) — U
No data on allelopathic potential of common peppergrass were found during this review.

Competitive Ability (0–3) — 0
Although common pepperweed is a frequent crop weed, it competes poorly with vigorous plants (Chepil 1946, Densmore et al. 2001).

Thicket-forming/Smothering growth form (0–2) — 0
Common pepperweed is a branched plant up to 1.5 feet tall, and it does not posses a climbing or smothering growth habit (Douglas et al. 1998, Royer and Dickinson 1999).

Germination requirements (0–3) — 0
Common pepperweed requires disturbance and open soil for germination (Densmore et al. 2001).

Other invasive species in the genus (0–3) — 3
Lepidium campestre (L.) Ait. f. is noxious weed in several American states. *Lepidium latifolium* L. and *L. perfoliatum* L. are listed as invasive plants (USDA, NRCS 2006).

Aquatic, wetland or riparian species (0–3) — 0
Common pepperweed is a plant of disturbed soils: roadsides, waste areas, farm yards, and cultivated fields (Welsh 1974, Royer and Dickinson 1999).

Total for Biological Characteristics and Dispersal — 9/23

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 3
Common pepperweed is a serious weed of cultivated fields and can substantially reduce crop yields (Chepil 1946).

Known level of impact in natural areas (0–6) — 0
Common pepperweed has not been documented in natural habitats in Alaska, and its impact on natural communities has not been documented. It is not listed as an invader in any other natural areas (Rutledge and McLendon 1996, Densmore et al. 2001).

Role of anthropogenic and natural disturbance in establishment (0–5) — 0
Common pepperweed occurrence is especially associated with human disturbances. Plants may appear on sites of previous human use, particularly when the soil is disturbed by construction or trampling (Densmore et al. 2001).

Current global distribution (0–5) — 0
Today the distribution of common pepperweed includes Canada, United States, and countries of North and Middle Europe (Hultén 1968).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) — 5
Common pepperweed is widely distributed in nearly all American states and Canadian provinces (Hulten 1968, USDA, NRCS 2006). *Lepidium densiflorum* is not listed as a prohibited weed (Rice 2006, USDA, NRCS 2002).

Total for Ecological Amplitude and Distribution — 8/25

Feasibility of Control	Score
Seed banks (0–3)	3
The majority of seeds germinate in the first 4 years, but some viable seeds remain in the soil for more than 6 years (Chepil 1948).	
Vegetative regeneration (0–3)	0
Common pepperweed has no ability to resprout (Densmore et al. 2001).	
Level of effort required (0–4)	1
Common pepperweed can be easily control by hand pulling or herbicide applications. Due to the large, long lived seed bank, several treatments may be necessary (Densmore et al. 2001).	
Total for Feasibility of Control	**4/10**
Total score for 4 sections	**22/88**

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Lepidium latifolium L. common names: perennial pepperweed, tall whitetop

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		No
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	28
Biological Characteristics and Dispersal	22	17
Amplitude and Distribution	25	16
Feasibility of Control	7	6
Relative Maximum		71

Climatic Comparison	*Collected in Alaska regions?*	*CLIMEX similarity?*
South Coastal	No	No
Interior Boreal	No	Yes
Arctic Alpine	No	Yes

Lepidium latifolium has not been documented in Alaska (Hultén 1968, Welsh 1974, AKEPIC 2004, UAM 2004). The native range of *Lepidium latifolium* includes southwestern Russia and western Siberia (Gubanov et al 2003). The CLIMEX matching program shows that climatic similarity between Alaska and areas where the species is documented is high. Kazan, Penza, and Gorkiy, Russia have 72%, 68%, and 67% similarity with Anchorage, and 59%, 53%, and 53% with Fairbanks, respectively. Nome has 58%, 56%, and 57% climatic similarity with Kazan, Penza, and Gorkiy, respectively. Climatic similarity between Juneau and areas where the species is documented is low. This suggests that establishment of perennial pepperweed may be possible in the interior boreal and arctic alpine ecogeographic region of Alaska.

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	7
Perennial pepperweed may retard natural succession on previously disturbed areas. The roots of this species fragment easily, allowing soil erosion to occur more frequently in infested areas (Renz 2000). This plant also takes salt ions from deep in the soil profile, and transports them near the soil surface, drastically increasing soil salinity (Blank and Young 2002, Blank and Young 2004).	
Impact on Natural Community Structure (0–10)	7
Perennial pepperweed creates a large monospecific layer and displaces native plants (Corliss 1993, Renz 2000).	
Impact on Natural Community Composition (0–10)	7
Perennial pepperweed can displace native plant and animal species. It particularly interferes with regeneration of riparian plant species such as willows and cottonwoods (Young et al. 1995). Stands of perennial pepperweed increase soil salinity; this favors halophytes and reduces other species, thereby shifting plant composition and diversity (Renz 2000). Perennial pepperweed creates a litter layer that prevents the emergence and establishment of annual native plants (Renz 2000).	
Impact on Higher Trophic Levels (0–10)	7
Perennial pepperweed degrades nesting and foraging sites for waterfowl by outcompeting grasses. It also prevents willow and cottonwood regeneration, altering riparian species' habitats (Howald 2000).	
Total for Ecological Impact	**28/40**

Biological Characteristics and Dispersal	Score
Mode of Reproduction (0–3)	3
Perennial pepperweed reproduces by seed or vegetatively from an intact root system or from pieces of the underground stems. The plant is capable of producing thousands of seeds annually (Howald 2000, Renz 2000).	
Long-distance dispersal (0–3)	2
The seeds have no adaptations for long-distance dispersal; however, they are capable of being transported by wind, water, and possibly by waterfowl (Howald 2000). Root fragments can be transported in streams and establish new populations (Renz 2000).	
Spread by humans (0–3)	2
It was likely introduced to North America as a contaminant of sugar beet seed. Recent infestations in California are due to seed or plant fragments contaminating rice straw bales (Howald 2000).	
Allelopathic (0–2)	0
Allelopathic potential has not been recorded.	
Competitive Ability (0–3)	3
Infestations of perennial pepperweed are extremely competitive and very few plant species can establish within these stands (Renz 2000). Extensive creeping root system enhances the competitiveness of perennial pepperweed for water and nutrients. Allocation of carbohydrate reserves to below ground organs is important for rapid shoot development in the spring (Renz 2000).	
Thicket-forming/Smothering growth form (0–2)	1
Perennial pepperweed creates large monospecific stands that can grow to over 3 feet in height (Corliss 1993, Douglas et al. 1998, Renz 2000, Whitson et al. 2000).	

Germination requirements (0–3)	U
The seeds rapidly germinate in laboratory conditions, but few seedlings are observed in the field. Reasons for this are unknown. Population is mostly maintained by vegetative growth from root segments (Renz 2000).	
Other invasive species in the genus (0–3)	3
Lepidium campestre (L.) Ait.f., *L. densiflorum* Schrad., *L. perfoliatum* L., and *L. ruderale* L. (Royer and Dickinson 1999, USDA 2002).	
Aquatic, wetland or riparian species (0–3)	3
This species can invade a wide range of habitats including riparian areas, wetlands, marshes, estuaries, irrigation channels, and flood plains, as well as meadows, crop fields, roadsides, and rangelands (Renz 2000).	
Total for Biological Characteristics and Dispersal	**17/22**

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	2
Perennial pepperweed is primarily a weed of rangeland, pastures, and hay meadows. It can occasionally invade croplands (Whitson et al. 2000).	
Known level of impact in natural areas (0–6)	1
Perennial pepperweed invades brackish to saline wetlands and native hay meadows throughout California. It is well established in marshes of the San Francisco Bay (Howald 2000).	
Role of anthropogenic and natural disturbance in establishment (0–5)	5
Perennial pepperweed can established on disturbed areas and may disperse into minimally managed or undisturbed habitats. This plant is known to establish in areas with no natural or anthropogenic disturbances (Howald 2000).	
Current global distribution (0–5)	3
Perennial pepperweed is native to Southeastern Europe and Southwestern Asia. It is naturalized throughout Europe, North America, and Australia (Renz 2000).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Perennial pepperweed is found in all western states. It is reported from three Canadian provinces. *Lepidium latifolium* is declared a noxious weed in 13 American states, including Alaska (Alaska Administrative Code 1987, Invaders Database System 2003, USDA 2002).	
Total for Ecological Amplitude and Distribution	**16/25**

Feasibility of Control	**Score**
Seed banks (0–3)	U
Seeds lack a hard coat and do not seem to be capable of surviving long periods in the soil, thus seed viability is likely to be short (Renz 2000), but seed longevity remains unknown.	
Vegetative regeneration (0–3)	2
Perennial roots can remain dormant in the soil for several years. New plants readily grow from pieces of rootstock less than 1-inch long (Wotring et al. 1997 cited in Howald 2000).	
Level of effort required (0–4)	4
Once established, perennial pepperweed can be very difficult to remove. Mechanical methods are unlikely to control perennial pepperweed because new plants quickly regenerate from pieces of rootstock. Chemical methods have been used successfully; however, most effective herbicides cannot be applied near or over water. No biological control agents have been introduced to control perennial pepperweed due to several important cultivated crops within this family (canola, mustard, cabbage, and kale), and several threatened and endangered native species of *Lepidium* in the United States. Old stems and litter take several years to degrade, and it may be necessary to remove the litter, which prevents germination and establishment of desirable plant species. If soil salinities are dramatically increased, an intensive soil remediation program may be necessary before native species can reestablish. Areas must be monitored since it can recover from dormant root fragments (Howald 2000, Renz 2000).	
Total for Feasibility of Control	**6/7**
Total score for 4 sections	**67/93**

§

Leucanthemum vulgare Lam. — common names: oxeye daisy

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	20
Biological Characteristics and Dispersal	25	15
Amplitude and Distribution	25	18
Feasibility of Control	10	8
Relative Maximum		61

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Oxeye daisy has been collected in the south coastal region in Juneau, Seward, Ketchikan and in the interior boreal region in Anchorage and Fairbanks (Hultén 1968, Welsh 1974, Densmore et al. 2001, Furbish et al. 2001, UAM 2003). Using the CLIMEX matching program, climatic similarity between Nome and areas where the species is documented is high. Range of the species includes Kirov, Russia and Fort McMurray, Alberta (Hultén 1968), which has a 66% and 63% climatic match with Nome, respectively.

Ecological Impact — **Score**

Impact on Ecosystem Processes (0–10) — 5
Oxeye daisy increases the potential for soil erosion in heavily infested areas (Densmore et al. 2001, Noxious Weed Control Board 2005).

Impact on Natural Community Structure (0–10) — 3
Oxeye daisy can form dense populations (Noxious Weed Control Board 2005) and form a tall-forb layer above a graminoid and low-forb layer in Alaska (M. Carlson pers. obs.)

Impact on Natural Community Composition (0–10) — 5
Oxeye daisy can decrease native plant species diversity. It is able to replace up to 50% of the grass species in pastures (Royer and Dickinson 1999, Warner et al. 2003).

Impact on Higher Trophic Levels (0–10) — 7
The entire plant has a disagreeable odor and grazing animals avoid it. Moreover, the plant contains polyacetylenes and thiophenes that are generally highly toxic to insect herbivores. Oxeye daisy can host chrysanthemum stunt, aster yellows, and tomato aspermy viruses (Royer and Dickinson 1999), and several nematode species (Townshend and Davidson 1962).

Total for Ecological Impact — 20/40

Biological Characteristics and Dispersal — **Score**

Mode of Reproduction (0–3) — 3
Oxeye daisy can spread both vegetatively and by seed. Stevens (1932) found the number of seeds per plant with 3 heads was 510. Dorph-Peterson (cited in Howarth and Welliams 1968) reported seed production of 1,300–4,000 fruits per plant, and up to 26,000 fruits for a vigorous plant.

Long-distance dispersal (0–3) — 2
The seeds have no special adaptations to aid dispersal, but they are small and water, wind, and animals can carry the seeds into new areas (Noxious Weed Control Board 2005, Warner et al. 2003).

Spread by humans (0–3) — 3
The seeds can be dispersed with timber, contaminated forage grass, and legume seed. Plants also continue to appear for sale in nurseries (Noxious Weed Control Board 2005, Warner et al. 2003).

Allelopathic (0–2) — 0
Oxeye daisy is not allelopathic (USDA, NRCS 2002).

Competitive Ability (0–3) — 3
Oxeye daisy is highly competitive for limiting factors (Rutledge and McLendon 1996).

Thicket-forming/Smothering growth form (0–2) — 2
Oxeye daisy forms dense colonies up to 2 feet tall (Hultén 1968, Royer and Dickinson 1999, Whitson et al. 2000).

Germination requirements (0–3) — 2
Studies indicate that 90 to 95% of germination occurs at 68 °F. Seedling germination is greater under increased moisture and is inhibited by continuous darkness. Dense ground cover can prevent establishment. Chilling and drought appear to have no effect on germination rates (Howarth and Welliams 1968).

Other invasive species in the genus (0–3) — 0
A number of *Leucanthemum* species has been introduced into United States. None of them are listed as a weed (USDA, NRCS 2002).

Aquatic, wetland or riparian species (0–3) — 0
Oxeye daisy is common in pastures, waste areas, meadows, and roadsides (Hultén 1968, Welsh 1974).

Total for Biological Characteristics and Dispersal — 15/25

Ecological Amplitude and Distribution — **Score**

Highly domesticated or a weed of agriculture (0–4) — 4
Oxeye daisy was introduced to North America as an ornamental and it is currently used and often sold commercially. Oxeye daisy is also a serious weed of 13 crops in 40 countries (Warner et al. 2003, Noxious Weed Control 2005). The flowers are showy, making the plant a popular ornamental species.

Known level of impact in natural areas (0–6) — 4
Oxeye daisy readily spreads into a variety of plant communities in California, including prairie, scrub, wet meadows, riparian forests, and open-canopy forests (Warner et al. 2003). It also is having minor impacts on ecological processes in natural communities in Rocky Mountain National Park, Colorado (Rutledge and McLendon 1996).

Role of anthropogenic and natural disturbance in establishment (0–5) — 0
Oxeye daisy is a weed of disturbed areas. It requires disturbance for establishment and persistence (Densmore et al. 2001).

Current global distribution (0–5) — 5
Oxeye daisy is native to Europe (Mediterranean to Scandinavia), and Siberia. Populations have established in eastern Asia, Iceland, Greenland, North and South America, Hawaii, Australia, and New Zealand (Hultén 1968).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) — 5
Oxeye daisy is noxious in Colorado, Indiana, Kentucky, Minnesota (Secondary Noxious Weed), Montana (Cat. 1), Ohio (Cat.1), Washington (Class B), and Wyoming. In the U.S. it is found in every state. It is a noxious weed in Canada (Alberta, British Colombia, Manitoba, and Quebec) (Invaders Database System 2003, Royer and Dickinson 1999, USDA, NRCS 2002).

Total for Ecological Amplitude and Distribution — 18/25

Feasibility of Control	Score
Seed banks (0–3)	3
The seeds of oxeye daisy may survive extended periods in the soil. Bossard et al. (2000) suggest that most oxeye daisy seeds remain viable for 20 years in the soil. Toole (1946) determine the viability of oxeye daisy seeds as 39 years. Chippindale and Milton (1934) found 8-, 22-, 24-, 50-, and 68-years old seeds in the soil beneath pastures.	
Vegetative regeneration (0–3)	2
According to the PLANTS Database (USDA, NRCS 2002), oxeye daisy has no resprout ability. However, Densmore et al. (2001) report that it sprouts from roots and stumps.	
Level of effort required (0–4)	3
If infestations are small one or two chemical or mechanical treatments are required. Eradication of a large, well established populations can be difficult because of the abundant seed production and ability of rhizomes to resprout (Densmore et al. 2001, Warner et al. 2003).	
Total for Feasibility of Control	**8/10**
Total score for 4 sections	**61/100**

§

Linaria dalmatica L.

common names: Dalmatian toadflax

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		No
Interior Boreal		Yes
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	16
Biological Characteristics and Dispersal	25	14
Amplitude and Distribution	25	19
Feasibility of Control	10	9
Relative Maximum		58

Climatic Comparison	*Collected in Alaska regions?*	*CLIMEX similarity?*
South Coastal	No	No
Interior Boreal	No	Yes
Arctic Alpine	N0	No

Linaria dalmatica has not been documented in Alaska (Hultén 1968, AKEPIC 2004, UAM 2004). It was recently found in southeastern Yukon Territory, Canada (B. Bennett pers. com.) The native range of *Linaria dalmatica* extends from Croatia, Moldavia, and Romania, southward and eastward around the Black Sea in the countries of Bulgaria, Albania, Greece, Crete, Turkey, Syria, Iran, and Iraq (Alex 1962). The CLIMEX matching program shows that climatic similarity between Anchorage and areas where the species is documented is high. Anchorage has a 56% and 52% overlap of climate similarity with Erzurum and Sivas, Turkey, and 74% and 73% with Banff and Calgary, Alberta, Canada, respectively. The introduced range of the species also includes Saskatoon and Regina, Saskatchewan (Vujnovic and Wein 1977), which have a 65% and 63% climate match with Fairbanks, respectively. Climatic similarity between Nome and Juneau and areas where the species is documented is low. This suggests that establishment of Dalmatian toadflax may be possible in the interior boreal ecogeographic region of Alaska.

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	3
Dalmatian toadflax stands may reduce soil moisture and nutrient availability. Infestations of Dalmatian toadflax lead to the dominance by other invasive species in the community (Zouhar 2003).	
Impact on Natural Community Structure (0–10)	5
The plant is capable of forming dense colonies by creeping rhizomes (Carpenter and Murray 1998). On disturbed sites it can form a new vegetation layer.	
Impact on Natural Community Composition (0–10)	3
Dense colonies of Dalmatian toadflax can push out native grasses and other perennials, thereby altering the species composition in native communities (Carpenter and Murray 1998).	
Impact on Higher Trophic Levels (0–10)	5
Dalmatian toadflax is considered unpalatable for grazing animals. Severe infestations likely reduces forage quality. Flowers are attractive to bumblebee and halictid bees and may alter pollination ecology of sites where it occurs (Carpenter and Murray 1998). It hybridizes with other members of the genus (Vujnovic and Wein 1977).	
Total for Ecological Impact	**16/40**

Biological Characteristics and Dispersal	Score
Mode of Reproduction (0–3)	3
Dalmatian toadflax reproduces by seed and by vegetative buds on the roots. New infestations usually originate from seed. Robocker (1970) found that the plant produces from 140 to 250 seeds per capsule and one Dalmatian toadflax plant could potentially produce 500,000 seeds. New plants can be produced when vegetative buds sprout from lateral roots that are found in the upper 2-12 inches of soil (Alex 1962).	
Long-distance dispersal (0–3)	2
Most of the seeds fall within short distances of the parent plant. When seeds fall onto crusted snow, they can be blown across the surface (Zouhar 2003). Dalmatian toadflax may also be dispersed by cattle, deer, and other browsing animals (Robocker 1970, Vujnovic and Wein 1997).	
Spread by humans (0–3)	2
Dalmatian toadflax was probably introduced to North America as an ornamental, and it is still used as a garden plant in many areas (Alex 1962, Vujnovic and Wein 1997).	
Allelopathic (0–2)	0
No records were found concerning allelopathy.	

Competitive Ability (0–3)	2
Dalmatian toadflax seedlings are easily outcompeted by established perennial species; however, once it is established toadflax suppresses other vegetation by competition for limited soil moisture (Carpenter and Murray 1998, Robocker 1970). The taproots of mature Dalmatian toadflax may reach depths of 4–10 feet, and lateral roots can extend 12 feet from the plant (Zouhar 2003). This extensive root system improves water resource efficiency and provides an effective anchor, preventing destruction by grazing animals or cultivation (Saner et al. 1995).	
Thicket-forming/Smothering growth form (0–2)	1
Dalmatian toadflax is capable of forming dense colonies through adventitious buds from creeping root systems; however, it does not have a climbing or smothering growth habit (Carpenter and Murray 1998).	
Germination requirements (0–3)	0
Germination and seedling establishment requires open ground with reduced competition from native vegetation (Grieshop and Nowierski 2002).	
Other invasive species in the genus (0–3)	3
Linaria vulgaris P. Mill. and *L. genistifolia* (L.) P. Mill. (Royer and Dickinson 1999, USDA 2002, Whitson et al. 2000).	
Aquatic, wetland or riparian species (0–3)	1
Dalmatian toadflax is most commonly found on roadsides, waste areas, clearcuts, overgrazed pastures, and rangelands, and in plant communities that are open or disturbed (Beck 2001). It also has been reported from gravel bars and riparian pastures in Colorado and Utah (Carpenter and Murray 1998, Zouhar 2003).	
Total for Biological Characteristics and Dispersal	**14/25**

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
Cultivation of the Dalmatian toadflax in England occurred as early as the 19th century. The species is still sold in Europe and Asia (Alex 1962).	
Known level of impact in natural areas (0–6)	4
Dalmatian toadflax invades shrub–steppe communities in Washington and likely displaces native grass and forbs. It is found in ponderosa pine communities in Washington and Idaho. In Oregon, Dalmatian toadflax is found in grasslands and on gravel bars in riparian communities. In Colorado, this species invades gravel bars, riparian pastures, and open meadows, and spreads along rivers. It may compete with cottonwood seedlings for establishment sites on gravel bars. It may also invade mountain shrubland and shortgrass prairie communities adjacent to riparian corridors (Rutledge and McLendon 1996). In Utah, Dalmatian toadflax is found in oak, quaking aspen, sagebrush, mountain brush, and riparian communities (Carpenter and Murray 1998, Saner et al. 1995, Zouhar 2003).	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
Disturbance promotes toadflax invasion and it may be necessary for establishment to occur. Dalmatian toadflax can invade communities with anthropogenic and naturally-occurring disturbances. However, once it is established, toadflax readily spreads into adjacent nondisturbed areas (Beck 2001, Zouhar 2003).	
Current global distribution (0–5)	3
Dalmatian toadflax is native of Southeastern Europe and Southwestern Asia. The present world distribution includes most of Europe and Asia, and it has been introduced to Japan, Australia, New Zealand, South Africa, and South and North America (Alex 1962, Royer and Dickinson 1999, Saner et al. 1995).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
This species occurs throughout the continental U.S. and in almost every Canadian province (Alex 1962, Royer and Dickinson 1999, Saner et al. 1995, USDA 2002). *Linaria dalmatica* is declared a noxious weed in nine American states and three Canadian provinces (Invader Database System 2003).	
Total for Ecological Amplitude and Distribution	**19/25**

Feasibility of Control	**Score**
Seed banks (0–3)	3
Seeds stored at room temperature remain viable for 13 years, under field conditions in Washington seed longevity was 10 years (Robocker 1970).	
Vegetative regeneration (0–3)	2
This species is capable of resprouting from the vegetative buds in lateral roots that are found in the upper 2–12 inches of soil (Alex 1962). Vegetative spread is possible from root fragments as short as 0.5 inches (Zouhar 2003).	
Level of effort required (0–4)	4
Successful control can be obtained by pulling or herbicide applications. Five insect species have been approved by the USDA for release as biological control agents. Since the seeds can remain dormant for up to 10 years and the plant also spreads through vegetative propagation, control measures must be repeated every year for at least 10 years to completely remove a stand (Beck 2001, Carpenter and Murray 1998).	
Total for Feasibility of Control	**9/10**
Total score for 4 sections	**58/100**

§

Linaria vulgaris P. Miller. common names: yellow toadflax, butter and eggs, wild snapdragon

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	22
Biological Characteristics and Dispersal	25	17
Amplitude and Distribution	25	21
Feasibility of Control	10	9
Relative Maximum		61

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Linaria vulgaris has been collected in the south coastal [Seward, Sitka, Juneau, and Skagway (Hultén 1968, UAM 2004)] and interior boreal [Anchorage, Wasilla, and Fairbanks (AKNHP 2003, Hultén 1968, UAM 2004)] ecoregions in Alaska. It has not been documented in the arctic alpine ecoregion. Using the CLIMEX matching program, climatic similarity between Nome and areas where the species is documented is high. The native range of the species includes Røros, Norway, Zlatoust, Russia, and Stensele, Sweden (Hultén 1968), which has a 76%, 71%, and 70% climatic match with Nome, respectively.

Ecological Impact — **Score**

Impact on Ecosystem Processes (0–10) — 5

Yellow toadflax likely reduces soil moisture and nutrient availability and appears to alter soil texture (M.L. Carlson pers. obs.) This rhizomatous plant often grows at very high densities in dry and nutrient poor soils in Alaska and very likely it is reducing essential resources for other species. Additionally, a large volume of below ground biomass is produced in generally organic poor soils, which also tends to bind the soils.

Impact on Natural Community Structure (0–10) — 5

Yellow toadflax is capable of forming dense colonies through adventitious buds on creeping rhizomes (Carpenter and Murray 1998). Along trails and other disturbed sites in south-central Alaska it forms a new layer apparently excluding both tall herbaceous and shorter graminoid native species (M.L. Carlson pers. obs.).

Impact on Natural Community Composition (0–10) — 7

This plant can displace native perennial species (Carpenter and Murray 1998, Whitson et al. 2000).

Impact on Higher Trophic Levels (0–10) — 5

Yellow toadflax produces a poisonous glucoside that is reported to be unpalatable to moderately poisonous for livestock. It can reduce foraging sites (Whitson et al. 2000). Toadflax is an alternate host for tobacco mosaic virus (Royer and Dickinson 1999). This species is highly attractive to bumblebee (*Bombus* spp.) and halictid bee (*Halictus* spp.) pollinators and may alter pollination ecology of sites where it occurs (M.L. Carlson pers. obs.). Flowers are also attacked by number of insect predators (Arnold 1982, M.L. Carlson pers. obs., Goltz 1988)

Total for Ecological Impact — 22/40

Biological Characteristics and Dispersal — **Score**

Mode of Reproduction (0–3) — 3

Yellow toadflax reproduces by seeds and vegetatively. Seed count per individual is difficult as the definition of individual is unclear due to its clonal propagation. Darwent et al. (1975) in Alberta recorded up to 824 seeds per stem. Stevens (1932) reported 2,280 seeds per plant with nine stems. Nadeau and King (1991) found seed production of 210,000 seed per m^2. Common toadflax also has the ability to reproduce vegetatively from adventitious buds on the roots (Bakshi and Coupland 1960, Nadeau et al. 1991, Nadeau et al. 1992).

Long-distance dispersal (0–3) — 3

Seeds can be carried by the wind (Royer and Dickinson 1999); however, Nadeau and King (1991) report that 80% of seeds fell within 50 cm and a tiny fraction fell more than 1.5 m of the parent plant. This species may also be dispersed by water and ants (Rutledge and McLendon 1996). The seeds are small (1–2 mm long), flattened with papery wings.

Spread by humans (0–3) — 3

Yellow toadflax is an ornamental plant and has escaped cultivation (Rutledge and McLendon 1996). Toadflax can spread along highways (Densmore et al. 2001). It has been found as a contaminant in commercial seed, hay, and ship ballast. It is still sold by some nurseries (Beck 2001, Zouhar 2001).

Allelopathic (0–2) — 0

None

Competitive Ability (0–3) — 3

This species is a strong competitor for soil moisture with established perennials and winter annuals. It is adapted to a wide range of environmental conditions (Carpenter and Murray 1998, Rutledge and McLendon 1996).

Thicket-forming/Smothering growth form (0–2) — 1

Yellow toadflax is capable of forming colonies through buds from creeping rhizomes (Carpenter and Murray 1998). However, in general, it is not taller than the surrounding vegetation (M.L. Carlson pers. obs.). In a study of common toadflax in Alberta, a density of 180 stems per m^2 was recorded; but, in most areas this plant occurs at densities of 20 stems per m^2 or less (Darwent et al. 1975).

Germination requirements (0–3) — 0

Yellow toadflax requires open soil for germination (Densmore et al. 2001). Germination success is generally low, especially with competition (Rutledge and McLendon 1996, Zouhar 2003).

Other invasive species in the genus (0–3) — 3

Linaria dalmatica (L.) P. Mill. is declared noxious in some American states and Canadian provinces (Invader Database System 2003, USDA, NRCS 2002).

Aquatic, wetland or riparian species (0–3) — 1

Yellow toadflax is most commonly found along roadsides, fences, rangelands, croplands, clearcuts, and pastures (Carpenter and Murray 1998). But, it has been reported from cottonwood and spruce dominated riparian habitats in Colorado (Carpenter and Murray 1998, Zouhar 2003); and it is found along the shoreline of Cook Inlet and Turnagain Arm (AKEPIC 2004, M. Shephard pers. comm.).

Total for Biological Characteristics and Dispersal — 17/25

Ecological Amplitude and Distribution	Score
Highly domesticated or a weed of agriculture (0–4)	4
The species was introduced to North America in the late 1600s as a garden ornamental (Beck 2001, Carpenter and Murray 1998). At present, it is a weed of rangeland and pastures (Darwent et al. 1975, Whitson et al. 2000).	
Known level of impact in natural areas (0–6)	4
Yellow toadflax invades high quality areas with no known disturbance for the last 100 years in Rocky Mountain National Park, Colorado and has the potential to modify existing native communities (Rutledge and McLendon 1996). This invasive species has invaded Coconino National Forest in northern Arizona (Zouhar 2001). Yellow toadflax was found in jack pine–lichen woodland of the upper boreal forest in northern Quebec; and in a ponderosa pine–bluebunch wheatgrass community in Montana (Zouhar 2001	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
Disturbance may be necessary for establishment to occur. Once established, it readily spreads into adjacent nondisturbed areas (Beck 2001). It can invade communities with naturally-occurring disturbances (Arnold 1982). This taxon persisted for at least 30 years in Manitoba, following an initial disturbance (Zouhar 2003).	
Current global distribution (0–5)	5
Linaria vulgaris is a native of Southeastern Europe and Southwestern Asia. The present world distribution includes most of Europe and Asia, Australia, New Zealand, South Africa, Jamaica, Chile, and North and South America, including subarctic regions (Hultén. 1968).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
This weed is declared noxious in nine states and four Canadian provinces (Invader Database System 2003). This species is a restricted noxious weed in Alaska (Alaska Administrative Code). It is found throughout the continental United States and in every Canadian province (Carpenter and Murray 1998, USDA 2002).	
Total for Ecological Amplitude and Distribution	**21/25**

Feasibility of Control	Score
Seed banks (0–3)	3
The seeds can remain dormant for up to 10 years (Carpenter and Murray 1998, Rutledge and McLendon 1996).	
Vegetative regeneration (0–3)	2
Vegetative regeneration is possible from root fragments as short as 1 cm (Carpenter Murray 1998, Rutledge and McLendon 1996).	
Level of effort required (0–4)	4
Successful control can be obtained by mechanical and chemical treatment. The treatments must be repeated every year for at least 10 years due to vegetative propagation and longevity of the seed bank (Carpenter and Murray 1998).	
Total for Feasibility of Control	**9/10**
Total score for 4 sections	**69/100**

§

Lolium perenne ssp. *multiflorum* (Lam.) Husnot

common names: annual ryegrass, Italian ryegrass, perennial ryegrass

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	14
Biological Characteristics and Dispersal	25	10
Amplitude and Distribution	25	15
Feasibility of Control	10	2
Relative Maximum		41

Climatic Comparison		
	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Lolium perenne ssp. *multiflorum* has been collected in all ecogeographic regions of Alaska (Hultén 1968, UAM 2004).

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	3
Despite being widely planted for erosion control, seeding of this species may increase erosion in the following years. It addition, Italian ryegrass may increase the frequency and severity of fire (Carey 1995, Zedler et al. 1983). Observations in Alaska indicate that its impacts are minimal. Seedings in Denali National Park do not persist. No reduction in native species is recorded at intermediate densities (Densmore et al. 2000).	
Impact on Natural Community Structure (0–10)	3
Some varieties of ryegrass are capable of forming dense stands (Densmore et al. 2000, Facelli et al. 1987).	
Impact on Natural Community Composition (0–10)	3
In seeded plots in burned chaparral California, there was a 40% reduction in species diversity relative to unseeded plots. Italian ryegrass can hinder woody species establishment through resource competition and increased fire potential (Carey 1995, Facelli et al. 1987). However, in numerous habitats in the West (including Alaska), it appears that this species is readily replaced by tall herbaceous and woody species (Carey 1995 and references therein, Densmore et al. 2000).	

Impact on Higher Trophic Levels (0–10)	5
This species is highly palatable and nutritious for all types of livestock and most wild ruminants (Carey 1995). It is highly desirable to moose (M. Shephard pers. com., J. Snyder pers. com.). It hybridizes with other ryegrass species (Beddows 1973, Wilken 1993, Rutledge and McLendon 1996). Gopher populations increase in areas seeded with Italian ryegrass, possibly because of increased cover (Carey 1995). A number of animal herbivores and parasites have been recorded for Italian ryegrass (Beddows 1973).	
Total for Ecological Impact	14/40

Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	1
Italian ryegrass regenerates entirely by seed (Beddows 1973, Royer and Dickinson 1999). In two seasons in California fecundity ranged from 6.5 to 15 seeds per plant (Gulmon 1979).	
Long-distance dispersal (0–3)	1
Seeds are relatively heavy and compact, and dispersal is limited (Beddows 1973, Rutledge and McLendon 1996).	
Spread by humans (0–3)	2
Ryegrass is often used for soil stabilization, a rotation crop, range, pasture, hay, and turf. Many cultivars have been developed (Carey 1995, USDA 2002). Italian ryegrass is a problematic weed in cereal crops and grass seed crops (Carey 1995).	
Allelopathic (0–2)	2
Ryegrass releases some allelopathic chemicals that reduce the growth of other species (McKell et al. 1963).	
Competitive Ability (0–3)	1
Italian ryegrass competes well with native species (Carey 1995, McKell et al. 1969). However, it is highly shade intolerant and is quickly replaced if overtopped by tall herbaceous or shrubby vegetation.	
Thicket-forming/Smothering growth form (0–2)	0
Some varieties of ryegrass form dense stands (Facelli et al. 1987), but it generally does not form thickets.	
Germination requirements (0–3)	0
Italian ryegrass is a shade intolerant species. Seedling survival was poor under the oak canopy in experiments in California (Maranon and Bartolome 1993).	
Other invasive species in the genus (0–3)	3
Lolium perenne ssp. *perenne* L., *Lolium persicum* Boiss. & Hohen., and *L. temulentum* L. (Hultén 1968, USDA 2002).	
Aquatic, wetland or riparian species (0–3)	0
Italian ryegrass is cultivated in pastures, hayfields, and lawns. It escapes from cultivation and becomes naturalized on disturbed sites such as waste places and roadsides (Royer and Dickinson 1999).	
Total for Biological Characteristics and Dispersal	10/25

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
Ryegrass is widely planted as an agricultural crop and for lawns in North America. Numerous cultivars have been developed (Carey 1995, USDA 2002).	
Known level of impact in natural areas (0–6)	1
Italian ryegrass causes a reduction of plant diversity in California's chaparral (Zedler et al. 1983). It does not appear to invade intact communities.	
Role of anthropogenic and natural disturbance in establishment (0–5)	0
Italian ryegrass readily colonizes disturbed areas and adjacent border habitats (Beddows 1973).	
Current global distribution (0–5)	5
Italian ryegrass is native to Central and Southern Europe, Northwest Africa and Southwest Asia. It now occurs in nearly all states of the United States. It has been introduced into South America, New Zealand, Tasmania, and Central and Southern Africa (Beddows 1973, Hultén 1968, USDA 2002).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Italian ryegrass now occurs in nearly all of the United States (USDA 2002). This species is not considered noxious in North America (Invaders Database System 2003).	
Total for Ecological Amplitude and Distribution	15/25

Feasibility of Control	**Score**
Seed banks (0–3)	0
The seed bank for ryegrass is limited and transient (Thompson and Grime 1979). Percent germination rapidly dropped off after 4 years for stored seeds (Beddows 1973, Rutledge and McLendon 1996).	
Vegetative regeneration (0–3)	0
Italian ryegrass does not spread by vegetative means (Beddows 1973, USDA 2002).	
Level of effort required (0–4)	2
In crops herbicides have been used to control established plants and prevent seed production, but this species is gaining resistance to several herbicides (Carey 1995). In Alaska, this species does not appear to persist in sites where it was planted.	
Total for Feasibility of Control	2/10
Total score for 4 sections	41/100

§

Lonicera tatarica L.common names: bush honeysuckle, Tatarian honeysuckle

Ranking Summary

Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	22
Biological Characteristics and Dispersal	23	19
Amplitude and Distribution	25	18
Feasibility of Control	10	6
Relative Maximum		66

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	No

Cultivated ornamental in southern Alaska (Welsh 1974). Planted as ornamental in Anchorage (I. Lapina pers. obs.). In the Arctic Alpine ecoregion, there is a high climatic match between Nome and areas where the species occurs such as Kirov (66%), Russia. However, the minimum temperatures and number of frost-free days are too low for those required by *Lonicera tatarica* (120 frost-free days, -38 °F; USDA 2002).

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 5
Tatarian honeysuckle can decrease light availability and deplete soil moisture and nutrients (DCR 2004). It can reduce tree regeneration in early to mid-successional forests (Batcher and Stiler 2005).

Impact on Natural Community Structure (0–10) — 7
Tatarian honeysuckle forms a dense layer that shades many native woody and herbaceous species (Charles 2001, DCR 2004).

Impact on Natural Community Composition (0–10) — 5
Tatarian honeysuckle reduces the richness and cover of herbaceous communities, and may entirely replace native species (Batcher and Stiles 2005). It is potentially allelopathic, preventing the growth of other species (Charles 2001, WDNR 2004).

Impact on Higher Trophic Levels (0–10) — 5
Fruits of Tatarian honeysuckle are highly attractive to birds. All honeysuckles are relatively free of known significant diseases and insect or other predators (Batcher and Stiles 2001).

Total for Ecological Impact — 22/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 2
Tatarian honeysuckle has moderate seed production and is capable of vegetative spread (Batcher and Stiles 2001, Butterfield et al. 1996, ODNR 2003).

Long-distance dispersal (0–3) — 3
The seeds of Tatarian honeysuckle are dispersed by birds and perhaps, small mammals (Batcher and Stiles 2001, Charles 2001, Hoppes 1988).

Spread by humans (0–3) — 3
Tatarian honeysuckle has been widely used in horticultural plantings (Batcher and Shelly 1985, WDNR 2003).

Allelopathic (0–2) — U
Tatarian honeysuckle has been recorded as nonallelopathic (USDA 2002), but possible allelopathy potential has been reported (WDNR 2004, Charles 2001).

Competitive Ability (0–3) — 3
Tatarian honeysuckle is able to outcompete native forbs for light and other resources (ODNR 2003, WDNR 2003). Honeysuckles begin photosynthizing earlier in the spring than most other plants, giving them an advantage over other species (Batcher and Stiles 2001).

Thicket-forming/Smothering growth form (0–2) — 2
Tatarian honeysuckle is a shrub that grows up to 10 feet tall and forms a dense layer (Welsh 1974, DCR 2004).

Germination requirements (0–3) — 2
Seedlings of Tatarian honeysuckle establish most readily on barren ground or in areas with a sparse understory. It also establishes in late-successional sites (Butterfield et al. 1996). Light promotes germination but is not necessary (Batcher and Stiles 2001).

Other invasive species in the genus (0–3) — 3
Lonicera maackii (Rupr.) Maxim, *L. morrowii* A. Gray, and *L.* x *bella* Zabel (Batcher and Shelly 2001).

Aquatic, wetland or riparian species (0–3) — 1
Tatarian honeysuckle occurs most often along roadsides and forest edges, pastures, and abandoned fields (DCR 2004). It is recorded as occurring in marshes in Ohio (ODNR 2004)

Total for Biological Characteristics and Dispersal — 19/23

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 4
Tatarian honeysuckle has been cultivated as an ornamental in the United States since the 1800s. Some varieties were developed and planted for wildlife food source and revegetation (DCR 2004). Many state and private nurseries sell bush honeysuckles (Batcher and Stiles 2001).

Known level of impact in natural areas (0–6) — 3
Tatarian honeysuckle occurs along forest edges in Iowa, where it has the potential to modify existing native plant communities (Butterfield et al. 1996). It is found in the understory of woodlands and marshes in Ohio (ODNR 2004).

Role of anthropogenic and natural disturbance in establishment (0–5) — 3
Tatarian honeysuckle can invade disturbed sites as well as intact forests (Batcher and Stiles 2001). Areas with disturbances are most vulnerable to invasion (WDNR 2003).

Current global distribution (0–5) — 3
Tatarian honeysuckle is a native of Europe and Eastern Asia, occurring in North America more recently (DCR 2004).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) — 5
Tatarian honeysuckle is common in most northeastern and mid-Atlantic states and in some midwestern and western states, and in south-central Canada (Batcher and Stiles 2001). This species is listed as noxious in Vermont and declared as an invasive weed in Wisconsin (USDA 2002).

Total for Ecological Amplitude and Distribution — 18/25

Feasibility of Control — Score

Seed banks (0–3) — 1
The seeds of Tatarian honeysuckle can remain viable for 2 or more years (Butterfield et al. 1996).

Vegetative regeneration (0–3) — 2
Cutting of Tatarian honeysuckle facilitates vigorous resprouting (Batcher and Stiles 2001, WDNR 2004).

Level of effort required (0–4)	3
Mechanical and chemical control methods can be used for control of Tatarian honeysuckle. Treatment must be repeated for at least 3–5 years in order to stop new plants emerging from the seed bank (Batcher and Stiles 2001, Butterfield et al. 1996, WDNR 2004).	
Total for Feasibility of Control	**6/10**
Total score for 4 sections	**65/98**

§

Lupinus polyphyllus ssp. *polyphyllus* Lindl. common names: bigleaf lupine, marsh lupine

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	14
Biological Characteristics and Dispersal	25	16
Amplitude and Distribution	25	17
Feasibility of Control	10	8
Relative Maximum		**55**

Climatic Comparison	*Collected in Alaska regions?*	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Special Note–nativity: *Lupinus polyphyllus* is native to western North America (USDA, ARS 2004) and has now become naturalized in Europe (Jennersten et al. 1988, Lid & Lid 1994). Most authors consider bigleaf lupine to be non-native in Alaska (Hultén 1968, Welsh 1974, Densmore et al. 2001). It has been widely seeded on roadsides in south-central Alaska (Densmore et al. 2001). It is well-established in open to dense mixed forests, often near habitations from Fairbanks to southern Alaska where it is especially common in the Anchorage vicinity (Hultén 1968, Welsh 1974). This species is particularly abundant in burns in Matanuska–Susitna Valley (Lapina pers. obs.). It is present in disturbed areas in Seward (Densmore et al. 2001), has been reported from Mitkof Island and the Kenai Peninsula (UAM 2003). Greater study, using collection records, molecular and morphological markers, and paleoecological methods are necessary to confirm the suspected non-nativity of this species in Alaska.

Lupinus polyphyllus has been collected in Seward, Denali National Park and Preserve, (Densmore et al. 2001), Kenai Peninsula, Mitkof Island, Matanuska–Susitna Valley (UAM 2004). It has been reported established in mixed forest from Fairbanks to Anchorage (Welsh 1974). Using the CLIMEX matching program, climatic similarity between Nome and areas where the species is documented is high. Range of the species includes Anchorage and Fairbanks (Welsh 1974), which has a 61% and 56% climatic match with Nome respectively.

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	5
Bigleaf lupine is likely to delay the establishment of native species in disturbed sites (Densmore et al. 2001). As a nitrogen-fixer, it likely alters soil conditions (USDA 2002).	
Impact on Natural Community Structure (0–10)	3
Bigleaf lupine establishes in an existing layer and increases the density of the layer (Lapina pers. obs.).	
Impact on Natural Community Composition (0–10)	1
Bigleaf lupine appears to integrate into native populations at a relatively low density. Other species do not seem to be strongly impacted by its presence (M.L. Carlson pers. obs.)	
Impact on Higher Trophic Levels (0–10)	5
Bigleaf lupine hybridizes freely with Nootka lupine (*L. nootkatensis* Donn ex Sims) (Welsh 1974). Bigleaf lupine is an important floral resource for bumblebees (Jennersten et al. 1988), potentially impacting other native plants.	
Total for Ecological Impact	**14/40**

Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	2
The plant reproduces from moderate amounts of seed and also forms extensive clones from creeping rhizomes (Densmore et al. 2001).	
Long-distance dispersal (0–3)	0
The pods open explosively, scattering seeds a few meters. There is no potential for long-distance dispersal (Densmore et al. 2001).	
Spread by humans (0–3)	3
Bigleaf lupine is cultivated as an ornamental, often escaping and becoming locally well-established (Densmore et al. 2001, Welsh 1974). It is spreading along the roads in Alaska (Hultén 1968).	
Allelopathic (0–2)	0
Unknown	
Competitive Ability (0–3)	3
Bigleaf lupine is moderately competitive for limiting factors; also it has the ability to fix nitrogen (Densmore et al. 2001, USDA 2002).	
Thicket-forming/Smothering growth form (0–2)	0
Bigleaf lupine is a perennial herb with stems to 5-feet tall (Pojar and MacKinnon 1994). In Alaska it rarely grows that tall and does not grow very densely (M.L. Carlson pers. obs.)	
Germination requirements (0–3)	2
Bigleaf lupine can germinate in vegetated areas (Densmore et al. 2000, I. Lapina pers. obs.). The seeds require scarification for successful germination.	

Other invasive species in the genus (0–3)	3
Lupinus arboreus Sims is considered as an invasive wildland pest plant in California (CalEPPC 1999). *Lupinus nootkatensis* Donn ex Sims is a North American species that is invasive in Northern Europe (Lid and Lid 1994).	
Aquatic, wetland or riparian species (0–3)	3
This species can be found in moist to wet, open habitats (seashore, streamside, and wet meadows), and disturbed sites (Pojar and MacKinnon 1994). It may invade sandy river terraces in south-central Alaska (M.L. Carlson pers. obs.).	
Total for Biological Characteristics and Dispersal	16/25

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
Bigleaf lupine is cultivated as an ornamental (Densmore et al. 2001, Welsh 1974).	
Known level of impact in natural areas (0–6)	3
It is well-established in open to dense mixed forests in Alaska (Hultén 1968, Welsh 1974). It may invade sandy river terraces in southcentral Alaska (M.L. Carlson pers. obs.).	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
Bigleaf lupine establishes in disturbed sites along roadways. This species has been observed in areas with natural disturbances (M.L. Carlson pers. obs., I. Lapina pers. obs.).	
Current global distribution (0–5)	3
Bigleaf lupine is native to the western United States and western Canada (USDA, ARS 2004). It has naturalized in Scandinavia (Jennersten et al. 1988, Lid & Lid 1994), Austria, France, Germany, and Russia (Gubanov et al. 1995, Flora Europaea 2004). It has been recorded from Asia (Pakistan), South America (Chile), and New Zealand (ILDIS 2003).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	4
Bigleaf lupine is found in the Pacific states, the upper Midwest, and northeastern states. The species is not considered noxious in North America (Invaders Database System 2003, USDA 2002).	
Total for Ecological Amplitude and Distribution	17/25

Feasibility of Control	**Score**
Seed banks (0–3)	3
The seeds of bigleaf lupine remain viable for many years (M. Gisler pers. com.).	
Vegetative regeneration (0–3)	2
Bigleaf lupine has the ability to resprout after removal of aboveground growth (Densmore et al. 2001).	
Level of effort required (0–4)	3
Bigleaf lupine can be eradicated when the populations are small by digging up rhizomes. However, several weedings may be necessary to eliminate plants sprouting from rhizomes and the seed bank (Densmore et al. 2001).	
Total for Feasibility of Control	8/10
Total score for 4 sections	55/100

§

Lythrum salicaria L. & *Lythrum virgatum* L.

common names: purple loosestrife

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		No
Interior Boreal		Yes
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	34
Biological Characteristics and Dispersal	25	20
Amplitude and Distribution	25	21
Feasibility of Control	10	8
Relative Maximum		83

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	No	No
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Lythrum salicaria has been planted in gardens in Anchorage (M.L. Carlson pers. obs., J. Riley pers. obs.) and has naturalized in Westchester Lagoon, Anchorage (M.L. Carlson pers. obs., J. Snyder pers. obs.). Climatic similarity is low between the South Coastal ecoregion and where this species is known (CLIMEX 1999). Climatic similarity between Nome (Arctic Alpine ecoregion) and areas where the species is documented is high. The range of the species includes Bogolovsk and Kirov, Russia (Gubanov et al. 1995), which has a 67% and 66%, climatic match with Nome, respectively. However, germination requires "high temperatures" (WDNR 2004) and it is not found in truly Arctic or alpine regions in its native range (Blossey 2002). We suggest that it may be possible for loosestrife to establish in some portions of the Arctic Alpine ecoregion. Additionally, although we did not observe a high climate match between the South Coastal ecoregion and known locations, we recommend caution be taken with this species in that region.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 8

Purple loosestrife alters biogeochemical and hydrological processes in wetlands (lowers phosphates in the summer). The leaves of the plant decompose quickly in the fall resulting in a nutrient flush, whereas leaves of native species decompose in the spring. This results in significant alterations of wetland communities adapted to decomposition of plant tissues in spring. Wetland bird communities and ecology are altered by its presence (Blossey 2002).

Impact on Natural Community Structure (0–10) — 8

This species forms very dense monospecific stands that displacing other emergent and submerged layers (Bender and Rendall 1987, Mann 1991).

Impact on Natural Community Composition (0–10) — 8

Purple loosestrife infestations cause reductions in native plant species diversity, eliminating cattails and pond weeds, for example. Native animals avoid nesting and foraging in these stands (Blossey 2002).

Impact on Higher Trophic Levels (0–10) — 10

Purple loosestrife likely is degrading salmon and waterfowl habitats (M. Carlson pers. com.). Native animals avoid nesting and foraging in stands of purple loosestrife (Bender 1987). But moose has been observed browsing on this plant (J. Riley pers. obs.). It has been reported as an alternate host for cucumber mosaic virus (Royer and Dickinson 1999).

Total for Ecological Impact — 34/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3

Plants are capable of producing over 100,000 seeds (Shamsi and Whitehead 1974). It can spread vegetatively by resprouting from cut stems and regenerating from root fragments and pieces of the stem (Bender and Rendall 1987, Royer and Dickinson 1999).

Long-distance dispersal (0–3) — 3

The seeds are small, weighing 0.06 mg each (Shamsi and Whitehead 1974). Thus, dispersal is mainly by wind, but seeds can also be transported by waterfowl or other wetland animals. Further, seeds and seedlings are buoyant and can be dispersed by water (Bender and Rendall 1987, Blossey 2002).

Spread by humans (0–3) — 3

Introductions into North America have occurred through ship ballast, wool, and most likely as ornamental plantings. Humans carry seeds inadvertently on clothing and shoes, and beekeepers have purposely sown seeds to provide a source of nectar. It was and continues to be widely planted in gardens (Bender and Rendall 1987, Royer and Dickinson 1999).

Allelopathic (0–2) — 0

There is no known allelopathic potential.

Competitive Ability (0–3) — 3

Purple loosestrife is competitively superior over native wetland plant species (Blossey 2002).

Thicket-forming/Smothering growth form (0–2) — 2

Purple loosestrife forms dense stands that shade out other plants (Bender and Rendall 1987). Densities as high as 80,000 stalks/acre have been recorded (Heidorn 1991).

Germination requirements (0–3) — 0

Germination of purple loosestrife is restricted to open soils and requires high temperature (WDNR 2004). Seedlings are not able to survive in the dense shade of the grass cover (Thompson 1991).

Other invasive species in the genus (0–3) — 3

Lythrum hyssopifolia L., *L. maritimum* Kunth, *L. portula* (L.) D.A. Webber, *L. thymifolia* L., *L. tribracteatum* Salzm. ex Spreng, and *L. virgatum* L.

Aquatic, wetland or riparian species (0–3) — 3

Purple loosestrife is found in cattail marshes, sedge meadows, and open bogs, and it along stream and riverbanks and lakeshores (Bender and Rendall 1987, WDNR 2003).

Total for Biological Characteristics and Dispersal — 20/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 4

In North America, it was first reported in 1814. Further introductions have occurred most likely as ornamental plantings. It continues to be widely planted in gardens (Royer and Dickinson 1999).

Known level of impact in natural areas (0–6)	4

Purple loosestrife displaced grass cover in aquatic communities in New York State (Thompson 1991). In wetlands in Wisconsin it forms monospecific stands that reduce biotic diversity (WDNR 2003).

Role of anthropogenic and natural disturbance in establishment (0–5)	3

Purple loosestrife flourishes in disturbed and degraded habitats, for example, wetlands that suffered from draining, natural drawdown, bulldozing, siltation, shore manipulation, cattle trampling, or dredging (Bender and Rendall 1987, WDNR 2003). But it also can colonize undisturbed wetland (Bossard et al. 2000). J. Snyder (pers. com.) observed this plant establishing in a pond and stream system in Michigan with no perceived disturbances.

Current global distribution (0–5)	5

This species is distributed all over the world except in the extremely cold and arctic regions. Purple loosestrife is native to Eurasia, extending from Great Britain across Western Europe into Central and Southern Europe along the Mediterranean Basin. Japan is the core of the species native range in Asia; populations extend to Southeast Asia and India (Blossey 2002). It is present in North Africa and North America. It also is found in southeast temperate Australia (Bender and Rendall 1987).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5

Purple loosestrife occurs in nearly all states of the United States (USDA 2002). It is a noxious weed in 25 states and 2 Canadian provinces (Invaders Database System 2003).

Total for Ecological Amplitude and Distribution	**21/25**

Feasibility of Control	**Score**
Seed banks (0–3)	2

Viability of seeds decreased from 99% to 80% after 2 years of storage in a natural body of water (Bender and Rendall 1987). Seeds under cold dry storage remain highly viable for at least 3 years, but longevity under field conditions is unknown (DiTomaso and Healy 2003).

Vegetative regeneration (0–3)	2

Purple loosestrife can resprout from cut stems and regenerate from root fragments and pieces of the stem (Bender and Rendall 1987, Heidorn 1991, Royer and Dickinson 1999).

Level of effort required (0–4)	4

Current methods for eradication of large, dense populations of loosestrife are not totally effective. Mechanical control methods are ineffective, and most herbicides are nonselective. Follow-up treatments are recommended for 3 years after plants are removed (Bender and Rendall 1987). Biological controls have been developed in North America (Swearing 2002).

Total for Feasibility of Control	**8/10**
Total score for 4 sections	**84/100**

§

Marticaria discoidea DC. common names: disc mayweed, pineappleweed

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	5
Biological Characteristics and Dispersal	25	9
Amplitude and Distribution	25	15
Feasibility of Control	10	3
Relative Maximum		**32**

Climatic Comparison		
	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Marticaria discoidea has been collected in Fairbanks, Anchorage, Iditarod, Seward, Juneau, Kodiak, and Baird Inlet (Hultén 1968, University of Alaska Museum 2003, Welsh 1974). It also is known from Denali National Park and Preserve, Kenai Fjords National Park, Katmai National Park and Preserve, and Wrangell–St. Elias National Park and Preserve (Densmore 2001, Fubrish 2001), and in right-of-way of the Trans Alaska Pipeline (McKendrick 1987).

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	1

Though pineappleweed is only found in highly disturbed environments (Densmore et al. 2001, Hultén 1968, Welsh 1974) it has potential to retard natural succession in sites after it has established (J. Conn pers. com.).

Impact on Natural Community Structure (0–10)	1

Pineappleweed establishes in an existing layer and changes the density of the layer (M.L. Carlson pers. obs., I. Lapina pers. obs.).

Impact on Natural Community Composition (0–10)	0

None. Pineappleweed has not been observed in undisturbed areas in Alaska, no perceived impact on native populations has been documented (Densmore et al. 2001).

Impact on Higher Trophic Levels (0–10)	3

Pineappleweed may have possible minor alterations due to disease transference (Royer and Dickinson 1999).

Total for Ecological Impact	**5/40**

Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	3

Pineappleweed reproduces by seeds only. A single plant is capable of producing as many as 850 seeds (Stevens 1932).

Long-distance dispersal (0–3)	3

The seeds are gelatinous when wet, and may be dispersed by rainwash (Rutledge and McLendon 1996).

Spread by humans (0–3)	3

The achenes disperse in mud attached to motor vehicles and can contaminate topsoil (Baker 1974, Densmore et al. 2001, Hodkinson and Thompson 1997).

Allelopathic (0–2)	0
None	
Competitive Ability (0–3)	0
Pineappleweed does not compete well with native species (Densmore et al. 2001, Royer and Dickinson 1999).	
Thicket-forming/Smothering growth form (0–2)	0
Pineappleweed is an annual with leafy stems up to 1 foot tall. Usually it does not form dense stands and if formed they do not shade other species (I. Lapina pers. obs.).	
Germination requirements (0–3)	0
Pineappleweed requires open soil and disturbance to germinate. Disturbance is necessary for breaking of seed dormancy (Densmore et al. 2001).	
Other invasive species in the genus (0–3)	0
None	
Aquatic, wetland or riparian species (0–3)	0
Pineappleweed can be found in grains fields, farms, farm yards, waste places, and roadsides (Royer and Dickinson 1999, Rutledge and McLendon 1996).	
Total for Biological Characteristics and Dispersal	**9/25**

Ecological Amplitude and Distribution	Score
Highly domesticated or a weed of agriculture (0–4)	4
Pineappleweed is a weed of cultivated fields (Rutledge and McLendon 1996). This is the most common weed in Alaska (J. Conn pers. com.).	
Known level of impact in natural areas (0–6)	1
Pineappleweed appears to be having minor effects on native communities in Rocky Mountain National Park, Colorado (Rutledge and McLendon 1996).	
Role of anthropogenic and natural disturbance in establishment (0–5)	0
Soil disturbance breaks seed dormancy. Plants emerge from sites altered by construction or trampling, especially if the area has a history of previous human use (Densmore et al. 2001).	
Current global distribution (0–5)	5
Pineappleweed is a native of western North America, now it is found in Europe, Asia, Greenland, Iceland, South America, and New Zealand (Hultén 1968).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Pineappleweed is found in 45 states. It is listed as a weed in Kentucky and Nebraska in the United States and Manitoba, Canada (Royer and Dickinson 1999, USDA 2002).	
Total for Ecological Amplitude and Distribution	**15/25**

Feasibility of Control	Score
Seed banks (0–3)	3
Roberts and Neilson (1981) found 7.8% to 9.6% of seeds remain viable after 5 years in the soil. Viability of seeds was 20% after 6.7 years, and 1% after 9.7 years in seed viability experiment conducted in Fairbanks (Conn and Deck 1995).	
Vegetative regeneration (0–3)	0
Pineappleweed has no resprouting ability following removal of aboveground growth (Densmore et al. 2001).	
Level of effort required (0–4)	0
This species does not persist without repeated anthropogenic disturbance. However, multiple weeding treatments across years may be necessary to eliminate plants germinating from buried seeds. Hand pulling may be inefficient and ineffective for large and dense populations. It is resistant to a number of standard herbicides (J. Conn pers. com., Densmore et al. 2001, Rutledge and McLendon 1996).	
Total for Feasibility of Control	**3/10**
Total score for 4 sections	**32/100**

§

Medicago lupulina L.

common names: black medick

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	10
Biological Characteristics and Dispersal	25	18
Amplitude and Distribution	25	15
Feasibility of Control	10	5
Relative Maximum		**48**

Climatic Comparison	*Collected in Alaska regions?*	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Medicago lupulina has been documented in all ecogeographic regions of Alaska (Hultén 1968, AKEPIC 2005, UAM 2004).

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	5
Black medick alters edaphic conditions due to fixation of atmospheric nitrogen (USDA 2002). This species has not been observed in undisturbed areas in Alaska. It is unlikely that significant impacts to ecosystem processes occur due to its presence.	
Impact on Natural Community Structure (0–10)	1
Black medick establishes in an existing layer and increases the density of the layer to a minor degree (I. Lapina pers. obs.).	
Impact on Natural Community Composition (0–10)	1
Black medick has been observed only on disturbed ground and presumably has little or no impact on natural community composition (I. Lapina pers. obs.).	
Impact on Higher Trophic Levels (0–10)	3
Flowers of black medick are visited by bees and other pollinating insects (Lammerink 1968). Black medick is an alternate host for number of viruses and fungus (Royer and Dickinson 1999).	
Total for Ecological Impact	**10/40**

Biological Characteristics and Dispersal	Score
Mode of Reproduction (0–3) Black medick reproduces by seed only (USDA 2002). The number of fruits produced per plant was 68–115 in a study in Ontario (Pavone and Reader 1985). Stevens (1932) reported that the mean number of seed produced by individual plant was 2,350.	3
Long-distance dispersal (0–3) Seeds of black medick can be dispersed over great distances by birds and grazing animals (Sidhu 1971, Lammerink 1968). Seeds and seedlings can float in water (Turkington and Cavers 1979). The seeds are heavy and wind dispersal is unimportant (Pavone and Reader 1982, Pavone and Reader 1985).	3
Spread by humans (0–3) Black medick is a frequent contaminant of alfalfa and clover seed (USDA, ARS 2005, Rutledge and McLendon 1996, Sidhu 1971). The seeds can adhere to dry and especially to damp clothing (Turkington and Cavers 1979).	3
Allelopathic (0–2) Black medick is not allelophathic (USDA 2002).	0
Competitive Ability (0–3) Black medick is fairly successful on dry soils, but it does not compete strongly with perennials (Foulds 1978). This species has high nitrogen-fixing ability (USDA 2002).	3
Thicket-forming/Smothering growth form (0–2) Black medick is a low trailing plant. It does not possess climbing or smothering growth habit (Whitson et al. 2000, Royer and Dickinson 1999).	0
Germination requirements (0–3) Turkington and Cavers (1979) found that germination of black medick is usually promoted by cultivation or animal digging. But in another study germination was significantly greater on vegetated soils (Wolfe-Bellin and Moloney 2000).	3
Other invasive species in the genus (0–3) *Medicago sativa* L., *M. polymorpha* L., and *M. minima* (L.) L. (Gubanov et al. 2003, USDA 2002, Whitson et al. 2000, Royer and Dickinson 1999).	3
Aquatic, wetland or riparian species (0–3) Black medick is a weed of lawns, gardens, roadsides, and pastures. It is most adapted to dry sites (Gubanov et al. 2003, Foulds 2000, Royer and Dickinson 1999)	0
Total for Biological Characteristics and Dispersal	18/25

Ecological Amplitude and Distribution	Score
Highly domesticated or a weed of agriculture (0–4) Black medick is a weed of roadsides and pastures. It is occasionally found in cultivated crops and gardens (Royer and Dickinson 1999).	2
Known level of impact in natural areas (0–6) No documented negative impacts on natural areas were found.	0
Role of anthropogenic and natural disturbance in establishment (0–5) Seedlings of black medick are most likely to survive on bare soil or in small areas of disturbance created by animals or erosion (Wolfe-Bellin and Maloney 2000, Turkington and Cavers 1997, Pavone and Reader 1985, Pavone and Reader 1982, Sidhu 1971).	3
Current global distribution (0–5) The native range of black medick includes Europe, temperate and tropical Asia, and northern Africa (USDA, ARS 2005). Today this species is now established in North America, Central Africa, Australia, New Zealand, and the Philippines (Hultén 1968).	5
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) Black medick is found throughout United States and Canada (USDA 2002, Royer and Dickinson 1999). *Medicado lupulina* is listed as a weed in Manitoba, and it is declared a noxious weed seed in Alaska (Alaska Administrative Code 1987).	5
Total for Ecological Amplitude and Distribution	15/25

Feasibility of Control	Score
Seed banks (0–3) Most seeds germinate within 2 or 2.5 years (Van Assche et al. 2003, Leishman et al. 2000, Pavone and Reader 1982, Chepil 1946, Brenchley and Warington 1930). Medvedev (1973, cited in Turkington and Cavers 1979) reported that storage for 10–11 years had little effect on viability of seeds. Less than 1% seeds were viable after 20 years (Lewis 1973).	3
Vegetative regeneration (0–3) Black medick showed no vegetative regeneration in natural conditions (Sidhu 1971).	0
Level of effort required (0–4) Black medick can be controlled easily by the use of herbicides (Turkington and Cavers 1997).	2
Total for Feasibility of Control	5/10
Total score for 4 sections	48/100

§

Medicago sativa ssp. *falcata* (L.) Arcang. common names: yellow alfalfa

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	30	15
Biological Characteristics and Dispersal	25	17
Amplitude and Distribution	19	15
Feasibility of Control	10	7
Relative Maximum		64

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Medicago sativa ssp. *falcata* has been collected in the south coastal (Seward and Exit Glacier) and interior boreal (Anchorage, Fairbanks, Wasilla, Palmer, Gakona, and Haines Junction) ecogeographic regions in Alaska (Hultén 1968, AKEPIC 2005, UAM 2005). The CLIMEX matching program indicates the climatic similarity between Nome and areas where yellow alfalfa is well established is moderately high. The range of yellow alfalfa includes Røros, Norway, and Zlatoust and Kirov, Russia (Gubanov et al. 2003, Hultén 1968). The climate of these townss has a 76%, 71%, and 66% match with Nome, respectively. The similar climates suggest that the establishment of yellow alfalfa in arctic alpine ecogeographic region of Alaska may be possible.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 5

Yellow alfalfa in symbiosis with the bacteria *Rhizobia*, increases soil nitrogen levels by fixing atmospheric nitrogen (USDA 2002). The alteration of soil condition may facilitate colonization by other plant species. Alfalfa increases the growth of aspen seedlings (Powell and Bork 2004). In Saskatchewan ranchlands seeded with alfalfa were susceptible to regrowth of aspen and prickly rose (*Rosa acicularis*) (Bowes 1981, Sullivan 1992).

Impact on Natural Community Structure (0–10) — 3

Yellow alfalfa establishes in an existing layer of vegetation and subsequently increases the density of the layer (I. Lapina pers. obs., Klett et al. 1984, Duebbert et al. 1981). There are no records concerning the elimination of existing layers of vegetation by the presence of alfalfa.

Impact on Natural Community Composition (0–10) — U

Documentation specific to the alteration of community composition was not found in this review.

Impact on Higher Trophic Levels (0–10) — 7

A total of 27 species of birds and 46 mammals are known to use alfalfa (Graham 1941). Yellow alfalfa is consumed by most big game animals, including moose and mule deer (Kufeld 1973, Leach 1956). Many small mammals, including marmots, mice, and ground squirrels graze alfalfa. Waterfowl such as the American wigeon and mallards eat the leaves, flowers, or seeds. Seeds are also consumed by rodents, rabbits, and upland birds. Yellow alfalfa is a source of nectar and pollen for insects (Graham 1941, Stanton 1974) and it is particularly attractive to solitary bees (Carlson pers. obs.). Dabbling ducks (mallards, blue-winged teals, northern pintail, northern shovelers, and American wigeons) will nest in yellow alfalfa stands (Klett et al. 1984). Undisturbed alfalfa fields provide food and cover for a variety of birds, including sharp-tailed grouse, American bitterns, marsh hawks, short-eared owls, and passerines (Duebbert et al. 1981). Alfalfa is a host for numerous pathogens (Sullivan 1992).

Total for Ecological Impact — 15/30

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3

Yellow alfalfa reproduces by seed only (USDA 2002). The mean number of seeds produced by an individual plant has been documented at 5,320 (Stevens 1932).

Long-distance dispersal (0–3) — 2

Yellow alfalfa seeds are large and not easily dispersed. Herbivores likely facilitate the spread of the plant's seeds (Duebbert et al. 1981, Kufeld 1973, Leach 1956).

Spread by humans (0–3) — 3

Yellow alfalfa is cultivated worldwide and is used in erosion-control projects, for rangeland and wildlife habitat restoration, and for hay production. The utility of the plant probably contributes to its spread (Klett et al. 1984, McLean et al. 1971).

Allelopathic (0–2) — 0

Yellow alfalfa is not allelophathic (USDA 2002).

Competitive Ability (0–3) — 3

Yellow alfalfa seedlings have faster root extension and greater total root length than other perennial legumes (Bell 2004). Established alfalfa plants can be very competitive (Sullivan 1992). However, in Saskatchewan ranchlands seeded with alfalfa were outcompeted by aspen and prickly rose (*Rosa acicularis*) (Bowes 1981).

Thicket-forming/Smothering growth form (0–2) — 1

Yellow alfalfa can grow very densely from 3 to 5 feet high and can be taller than surrounding forbs and grasses (USDA 2002, Royer and Dickinson 1999).

Germination requirements (0–3) — 2

Although seed germination can be inhibited by the presence of pine and juniper litter (Sullivan 1992), seeding in undisturbed rangelands and woodlands can be successful (MAFRI 2004).

Other invasive species in the genus (0–3) — 3

Medicago sativa ssp. *sativa* L., *Medicago lupulina* L., *M. polymorpha* L., and *M. minima* (L.) L. (USDA 2002, Royer and Dickinson 1999, Hultén, E. 1968).

Aquatic, wetland or riparian species (0–3) — 0

Yellow alfalfa has established along roadsides, in waste areas, (Hitchcock and Cronquist 1973, Hultén 1968) and in active and abandoned agricultural fields (Royer and Dickinson 1999). It is not known to invade wetlands or riparian communities.

Total for Biological Characteristics and Dispersal — 17/25

Ecological Amplitude and Distribution	Score
Highly domesticated or a weed of agriculture (0–4)	4
Yellow alfalfa is one of the most widely grown forage crops in the world (Powell and Bork 2004, Sullivan 1992). A number of agricultural varieties have been developed.	
Known level of impact in natural areas (0–6)	U
The ecological impact of yellow alfalfa in other natural areas is unknown.	
Role of anthropogenic and natural disturbance in establishment (0–5)	1
Yellow alfalfa readily establishes on natural rangelands and burned areas (MAFRI 2004). This species failed to establish in areas disturbed by grazing (Sullivan 1992, Smith 1963).	
Current global distribution (0–5)	5
Yellow alfalfa is native to Southwestern Asia and northern Africa (USDA, ARS 2005). It was first cultivated in Iran, and now has a worldwide distribution as an agricultural crop (Sullivan 1992).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Yellow alfalfa is planted in all 50 states and is widely planted in Canada (USDA 2002, Sullivan 1992).	
Total for Ecological Amplitude and Distribution	15/19

Feasibility of Control	Score
Seed banks (0–3)	3
A study of crop and weed seed longevity showed that seeds of alfalfa can remain viable for 20 years in the soil (Lewis 1973).	
Vegetative regeneration (0–3)	2
Alfalfa is capable of sprouting from stumps. In Utah, increased herbivore access was correlated with increased lateral shoots sprouting (Rosenstock and Stevens 1989).	
Level of effort required (0–4)	2
Control measures have not been developed due to the value of this plant as an agricultural crop. It is known to persist on fields that were previously cultivated for forage or hay (Royer and Dickinson 1999). Alfalfa is susceptible to herbicides (Bowes 1982, Cogliastro et al. 1990).	
Total for Feasibility of Control	7/10
Total score for 4 sections	54/84

§

Medicago sativa ssp. *sativa* L. — common names: alfalfa

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	30	13
Biological Characteristics and Dispersal	25	17
Amplitude and Distribution	25	16
Feasibility of Control	10	7
Relative Maximum		59

Climatic Comparison	*Collected in Alaska regions?*	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Medicago sativa ssp. *sativa* has been collected in south coastal (Seward, Exit Glacier, and Juneau) and interior boreal (Anchorage, Wasilla, and Palmer) ecogeographic regions in Alaska (Hultén 1968, AKEPIC 2005, UAM 2005). The CLIMEX matching program indicates the climatic similarity between Nome and areas where alfalfa is well established is moderately high. The range of alfalfa includes Røros, Norway and Zlatoust and Kirov, Russia (Gubanov et al. 2003, Hultén 1968). The climate of these towns has a 76%, 71%, and 66% match with Nome, respectively. The similar climates suggest that the establishment of alfalfa in arctic alpine ecogeographic region of Alaska may be possible.

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	5
Alfalfa in symbiosis with the bacteria *Rhizobia*, increases soil nitrogen levels by fixing atmospheric nitrogen (USDA 2002). The alteration of soil condition may facilitate colonization by other plant species. Alfalfa increases the growth of aspen seedlings (Powell and Bork 2004). In Saskatchewan ranchlands seeded with alfalfa were susceptible to regrowth of aspen and prickly rose (*Rosa acicularis*) (Bowes 1981, Sullivan 1992).	
Impact on Natural Community Structure (0–10)	1
Alfalfa establishes in an existing layer of vegetation and subsequently increases the density of the layer (I. Lapina pers. obs., Klett et al. 1984, Duebbert et al. 1981). There are no records concerning the elimination of existing layers of vegetation by the presence of alfalfa.	
Impact on Natural Community Composition (0–10)	U
Documentation specific to the alteration of community composition was not found in this review.	

Impact on Higher Trophic Levels (0–10) — 7

A total of 27 species of birds and 46 mammals are known to use alfalfa (Graham 1941). Alfalfa is consumed by most big game animals, including moose and mule deer (Kufeld 1973, Leach 1956). Many small mammals, including marmots, mice, and ground squirrels graze alfalfa. Waterfowl such as the American wigeon and mallards eat the leaves, flowers, or seeds. Seeds are also consumed by rodents, rabbits, and upland birds. Alfalfa is a source of nectar and pollen for insects (Stanton 1974, Graham 1941) and it is particularly attractive to solitary bees (Carlson pers. obs.). Dabbling ducks (mallards, blue-winged teals, northern pintail, northern shovelers, and American wigeons) will nest in alfalfa stands (Klett et al. 1984). Undisturbed alfalfa fields provide food and cover for a variety of birds, including sharp-tailed grouse, American bitterns, marsh hawks, short-eared owls, and passerines (Duebbert et al. 1981). Alfalfa is a host for numerous pathogens (Sullivan 1992).

Total for Ecological Impact — **13/30**

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3

Alfalfa reproduces by seed only (USDA 2002). The mean number of seeds produced by an individual plant has been documented at 5,320 (Stevens 1932).

Long-distance dispersal (0–3) — 2

Alfalfa seeds are large and not easily dispersed. Herbivores likely facilitate the spread of the plant's seeds (Duebbert et al. 1981, Kufeld 1973, Leach 1956).

Spread by humans (0–3) — 3

Alfalfa is cultivated worldwide and is used in erosion-control projects, for rangeland and wildlife habitat restoration, and for hay production. The utility of the plant probably contributes to its spread (Klett et al. 1984, McLean et al. 1971).

Allelopathic (0–2) — 0

Alfalfa is not allelophathic (USDA 2002).

Competitive Ability (0–3) — 3

Alfalfa seedlings have faster root extension and greater total root length than other perennial legumes (Bell 2004). Established alfalfa plants can be very competitive (Sullivan 1992). However, in Saskatchewan ranchlands seeded with alfalfa were outcompeted by aspen and prickly rose (*Rosa acicularis*) (Bowes 1981)

Thicket-forming/Smothering growth form (0–2) — 1

Alfalfa can grow very densely from 3 to 5 feet high and can be taller than surrounding forbs and grasses (USDA 2002, Royer and Dickinson 1999).

Germination requirements (0–3) — 2

Although seed germination can be inhibited by the presence of pine and juniper litter (Sullivan 1992), seeding undisturbed rangelands and woodlands can be successful (MAFRI 2004).

Other invasive species in the genus (0–3) — 3

Medicago sativa ssp. *falcata* (L.) Arcang., *M. lupulina* L., *M. polymorpha* L., and *M. minima* (L.) L. (USDA 2002, Royer and Dickinson 1999, Hultén, E. 1968).

Aquatic, wetland or riparian species (0–3) — 0

Alfalfa has established along roadsides, in waste areas, (Hitchcock and Cronquist 1973, Hultén 1968) and active and abandoned agricultural fields (Royer and Dickinson 1999). It is not known to invade wetlands or riparian communities.

Total for Biological Characteristics and Dispersal — **17/25**

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 4

Alfalfa is one of the most widely grown forage crops in the world (Powell and Bork 2004, Sullivan 1992). A number of agricultural varieties have been developed.

Known level of impact in natural areas (0–6) — 1

Modest impacts of *Medicago sativa* ssp. *sativa* have been observed in sagebrush deserts of the Great Basin (Carlson pers. obs.)

Role of anthropogenic and natural disturbance in establishment (0–5) — 1

Alfalfa readily establishes on natural rangelands and burned areas (MAFRI 2004). This species failed to establish in areas disturbed by grazing (Sullivan 1992, Smith 1963). In Alaska this taxon does not persist (J. Conn pers. com.).

Current global distribution (0–5) — 5

Alfalfa originates from Southwestern Asia. It was first cultivated in Iran, and now has a worldwide distribution as an agricultural crop (Sullivan 1992).

Extent of the species US range and/or occurrence of formal state or provincial listing (0–5) — 5

It is planted in all 50 states and is widely planted in Canada (USDA 2002, Sullivan 1992).

Total for Ecological Amplitude and Distribution — **16/25**

Feasibility of Control — Score

Seed banks (0–3) — 3

A study of crop and weed seed longevity showed that seeds of alfalfa remain viable for 20 years in soil (Lewis 1973).

Vegetative regeneration (0–3) — 2

Alfalfa is capable of sprouting from stumps. In Utah, increased herbivore access was correlated with increased lateral shoots sprouting (Rosenstock and Stevens 1989).

Level of effort required (0–4) — 2

Control measures have not been developed due to the value of this plant as an agricultural crop. It is known to persist on fields that were previously cultivated for forage or hay (Royer and Dickinson 1999). Alfalfa is susceptible to herbicides (Bowes 1982, Cogliastro et al. 1990).

Total for Feasibility of Control — **7/10**

Total score for 4 sections — **53/90**

§

Melilotus alba Medikus

common names: white sweetclover

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	29
Biological Characteristics and Dispersal	25	22
Amplitude and Distribution	25	21
Feasibility of Control	10	9
Relative Maximum		81

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Adjacent	Yes

Melilotus alba has been collected in the south coastal [Skagway (Hultén 1968)] and interior boreal [Anchorage and Fairbanks (UAM 2004, Hultén 1968); Wasilla (AKNHP 2003); Yukon River Bridge (AKEPIC 2006)], ecogeographic regions of Alaska. It has been collected at the edge of the arctic alpine ecogeographic region near Coldfoot (AKEPIC 2006). The climatic similarity between Nome and areas where the species is documented has a moderate match (CLIMEX 1999). There is a 57% similarity between Nome and the high elevation, northerly city of Östersund, Jämtland, Sweden, where records of collections exist (Natur Historiska Riksmuseet Database, 2004). Additionally, *Melilotus alba* has been collected from Fort McMurray, Alberta; Churchill, Manitoba; and Kirov, Russia (Hultén 1968) which have high climatic matches with Nome. This, in addition to known populations north of the Arctic Circle on the Dalton Highway, suggests that establishment in arctic and alpine regions of Alaska may be possible.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 10

White sweetclover is known to alter soil conditions due to nitrogen fixation and reducing erosion (USDA 2002). It is possible it may affect the ecology and presence of early successional habitats (Rutledge & McLendon 1996). It has potential to alter sedimentation rates of river ecosystems (M. Shephard pers. obs.).

Impact on Natural Community Structure (0–10) — 7

White sweetclover forms dense monospecific stands in Alaska (Conn 2003, Conn et al. in press), and is known to degrade natural grassland communities (Eckhardt 1987, Wisconsin DNR 2003)

Impact on Natural Community Composition (0–10) — 5

No known documentation of alteration of community composition, but based on personal observation (I. Lapina pers. obs., M. Carlson pers. obs.) very few native species occur under the canopy of white sweetclover. Experimental studies suggest that early successional plants along interior rivers in Alaska are negatively affected by shading (Spellman 2007). Spellman (2007) showed reduced growth and survivorship of forbs and *Salix alaxensis* when grown under similar light conditions in the greenhouse.

Impact on Higher Trophic Levels (0–10) — 7

White sweetclover is reported to be toxic to horses, cattle, and sheep when improperly dried (CUPPID 2003). This species has high palatability for wildlife herbivores (birds as well as small and large mammals) (Uchytil 1992). Though moose do not browse on white sweetclover (Conn pers. obs., Shephard pers. obs. D. Spalinger unpublished data). In the Yukon Territory there are reports of moose, elk, and deer eating the dried stems in late spring (B. Bennett pers. com.). White sweetclover is visited by introduced honeybees, native solitary bees, wasps, and flies (Eckardt 1987). It is associated with over 28 viral diseases (Royer and Dickinson 1999). It contains coumarin and dicoumarol.

Total for Ecological Impact — 29/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3

White sweetclover produces 14,000 to 350,000 seeds per plant, no vegetative reproduction (Royer and Dickinson 1999, Rutledge and McLendon 1996, USDA 2002).

Long-distance dispersal (0–3) — 2

Rainwater runoff and streamflow are probably the most important means of seed dispersal (Eckardt 1987, Rutledge and McLendon 1996, Shephard pers. com.).

Spread by humans (0–3) — 3

White sweetclover has spread from cultivation (Eckhardt 1987, Wisconsin DNR 2003). It also contaminates cereal grains (Royer & Dickinson 1999) and can spread from vehicle tires (Densmore et al. 2001). Used as forage crop, soil builder, erosion stabilizer, and nectar source for honeybees.

Allelopathic (0–2) — 2

White sweetclover is allelopathic (USDA, NRCS 2002). The original source of this information could not be located in this literature search.

Competitive Ability (0–3) — 3

White sweetclover competes for resources with native species and has high nitrogen-fixing ability (Eckardt 1987, USDA, NRCS 2002).

Thicket-forming/Smothering growth form (0–2) — 2

White sweetclover forms dense tall thickets elsewhere (Lloyd 1912, Westgate and Vinall 1912) and in Alaska (I. Lapina pers. obs.).

Germination requirements (0–3) — 1

White sweetclover has only been observed in areas with predominantly mineral soil (Conn 2003, I. Lapina pers. obs., M. Carlson pers. obs.). Plants are shade intolerant as well (USDA 2002). Experimental studies show that seed germination is possible (but at much reduced rates) in vegetated humic substrates (Rzeczycki T., unpublished data).

Other invasive species in the genus (0–3) — 3

Melilotus officinalis (L.) Lam is listed as a weed (Eckardt 1987, USDA, NRCS 2002).

Aquatic, wetland or riparian species (0–3)	3
White sweetclover has been observed invading thousand of acres along river systems: Nenena, Stikine, and Matanuska (Conn 2003, Shephard pers. com.). The tendency of seed to disperse by water indicates that herbaceous riverine communities can be altered by invasion of *M. alba*. However, this taxon is intolerant of consistently wet, non-well drained substrates (Heffernan et al. 2001)	
Total for Biological Characteristics and Dispersal	22/25

Ecological Amplitude and Distribution	Score
Highly domesticated or a weed of agriculture (0–4)	4
White sweetclover has been extensively used as a forage crop, soil builder, and a nectar source for honeybees (Turkington 1978, Eckardt 1987). A cold tolerant variety has been bred and is establishing in Alaskan parks (Densmore et al. 2001)	
Known level of impact in natural areas (0–6)	4
White sweetclover has invaded sand dunes and gravel bars along the Stikine River, Tongass National Forest (Stensvold 2000, Spencer pers. obs.); and Nenena and Matanuska River in south-central (Conn 2003). It has invaded rivers systems in Alaska and aspen woodlands in Rocky Mountain National Park, Colorado (Rutledge and McLendon 1996). It has been found in mid-successional sites that were disturbed in the last 11–50 years (Pipestone National Monument, Minnesota Butterfield et al. 1996).	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
White sweetclover readily invades open areas. Natural or human-caused fires promote invasion by scarifying seeds and stimulating germination. The clearings in forested land are easily colonized by *Melilotus*. It resprouts readily when cut or grazed (Eckardt 1987, Wisconsin DNR 2003). Soil disturbance from road construction is known to facilitate invasion of this species (Parker 1993).	
Current global distribution (0–5)	5
White sweetclover is native to the Mediterranean area through Central Europe to Tibet. It is introduced into South Africa, North and South America, New Zealand, Australia, and Tasmania (Hultén 1968).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
White sweetclover is found in all 50 states and all but two Canadian provinces. It is listed as "exotic pest" in Tennessee, "ecologically invasive" in Wisconsin, "weed" in Kentucky and Quebec, Canada (Royer and Dickinson 1999, USDA, NRCS 2002).	
Total for Ecological Amplitude and Distribution	21/25

Feasibility of Control	Score
Seed banks (0–3)	3
Seeds of white sweetclover can remain viable in the soil for 11–50 years and up to 81 years (Stoa 1933, Butterfield et al. 1996, J. Conn pers. com., Royer and Dickinson 1999, Rutledge and McLendon 1991).	
Vegetative regeneration (0–3)	2
White sweetclover resprouts readily when burn, cut, or grazed (Butterfield et al., 1996, Wisconsin DNR 2003). However, Densmore et al. (2001) reports that it does not resprout.	
Level of effort required (0–4)	4
Management requires a long-term investment due to long seed viability and density patches. Plant can be managed using mechanical and chemical control methods. Several treatments may be necessary. Sites must be monitored. Remote sites especially difficult to control (J. Conn pers. com., Eckardt 1987).	
Total for Feasibility of Control	9/10
Total score for 4 sections	81/100

§

Melilotus officinalis (L.) Lam. common names: yellow sweetclover

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	24
Biological Characteristics and Dispersal	25	18
Amplitude and Distribution	25	19
Feasibility of Control	10	8
Relative Maximum		69

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Yellow sweetclover has been collected in Anchorage, Fairbanks, and McCarthy [interior boreal ecoregion (Hultén 1968)] and Seward and Whittier [south coastal ecoregion (AKEPIC 2005, UAM 2004)]. It does not appear to have been documented in the arctic alpine ecoregion. The climatic similarity between Nome and areas where the species is documented has a moderate to high match (CLIMEX 1999). There is a 76% similarity between Nome and Røros, Norway, (CLIMEX 1999) where the species is documented (Hultén 1968). The range of *M. officinalis* includes Zlatoust, Russia and Stensele, Sweden (Hultén 1968) which have 71% and 70% of climatic matches with Nome respectively. Additionally, there is a 57% similarity between Nome and Östersund, Sweden where this species has been collected (Natur Historiska Riksmuseet Database 2004). This suggests that establishment in arctic and alpine regions of Alaska may be possible.

Ecological Impact **Score**

Impact on Ecosystem Processes (0–10) 7

Yellow sweetclover is known to alter soil conditions due to nitrogen fixation and reducing erosion. It has the potential to inhibit natural succession processes (Rutledge and McLendon 1996). Sweetclover appears to promote the establishment of other non-native plants (Wolf et al. 2003)

Impact on Natural Community Structure (0–10) 5

Yellow sweetclover is known to degrade natural grassland communities (Wisconsin DNR 2003) and is a persistent part of the understory vegetation in cottonwood and juniper woodlands, but does not form a major component of the ground cover (Sullivan 1992). Yellow sweetclover can form a new high forb layer in grassland prairies (Lesica and Deluca 2003)

Impact on Natural Community Composition (0–10) 5

Yellow sweetclover has the ability to shade out native herbaceous species (Townsend 2001). Sites with established sweetclover had lower numbers of native species (Wolf et al. 2003).

Impact on Higher Trophic Levels (0–10) 7

Yellow sweetclover is eaten by elk, deer, and domestic livestock (Sullivan 1992). It is visited by introduced honeybees, native solitary bees, wasps, and flies (Eckardt 1987).It is moderately toxic to animals (Whitson et al. 2000) and allelopathic (USDA 2002). Yellow sweetclover provides cover for upland gamebirds and ducks and is highly palatable to grazing wildlife (Lesica and DeLuca 2000)

Total for Ecological Impact 24/40

Biological Characteristics and Dispersal **Score**

Mode of Reproduction (0–3) 3

Yellow sweetclover reproduces copious amounts of seeds. Plant can produce 14,000–350,000 seeds per year (Rutledge and McLendon 1996). It does not reproduce vegetatively.

Long-distance dispersal (0–3) 2

Seeds of yellow sweetclover may be dispersed by water, although wind can blow seeds up to several meters (Eckardt 1987, Rutledge and McLendon. 1996).

Spread by humans (0–3) 3

Yellow sweetclover has spread from cultivation (Densmore et al. 2001, Welsh 1974). It may contaminate cereal grains and can spread from vehicle tires. (Densmore et al. 2001). Yellow sweetclover is sometimes promoted for soil stabilization or soil improvement (Whitson 2000). It is used as a forage crop, soil builder, erosion stabilizer, and nectar source for honeybees.

Allelopathic (0–2) 2

Yellow sweetclover is listed as an allelopathic in PLANTS Database (USDA 2002). Sweetclover roots contain substances allelopathic to *Agropyron cristatum*, *Bromus inermis*, and *Phleum pratense* (Sullivan 1992).

Competitive Ability (0–3) 2

Yellow sweetclover may compete with native species (Densmore et al. 2001, Eckardt 1987), and has high nitrogen-fixing ability (USDA 2002). Yellow sweetclover reduced the yield of crested wheatgrass when grown together, probably due to competition for soil moisture (Lesica and DeLuca 2000)

Thicket-forming/Smothering growth form (0–2) 2

Yellow sweetclover is a plant with stems up to 6 feet tall (Welsh 1974, Whitson 2000), forming dense monospecific stands that shade all other vegetation of open or grassland sites (Lesica and Deluca 2000).

Germination requirements (0–3) 0

Yellow sweetclover requires open soil for germination (Densmore et al. 2001).

Other invasive species in the genus (0–3) 3

Melilotus alba Medikus

Aquatic, wetland or riparian species (0–3) 1

Yellow sweetclover is a weed of pastures, roadsides, neglected fields, and waste places. It can be found in open disturbed, upland habitats such as prairies, savannas, and dunes (Wisconsin DNR 2003, Whitson 2000). However, one site of infestation was an acidic wetland in the lower Susitna Valley, Alaska (AKEPIC 2005, I. Lapina pers. obs.)

Total for Biological Characteristics and Dispersal 18/25

Ecological Amplitude and Distribution	Score
Highly domesticated or a weed of agriculture (0–4)	4
Yellow sweetclover is an important forage, hay, and pasture species and has spread from cultivation Also it is widely used for stabilization of disturbed sites (Densmore et al. 2001, Sullivan 1992, Whitson 2000). It has been recommended for grassland revegetation by a number of federal agencies (Lesica and DeLuca 2000).	
Known level of impact in natural areas (0–6)	4
Yellow sweetclover invades valleys and prairies in Illinois, Iowa, Minnesota, Missouri, North Dakota, and Wisconsin (Eckardt 1987) as well as Douglas fir, lodgepole pine, and grasslands of the West and Midwest (Sullivan 1992)	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
Yellow sweetclover tends to be eliminated in shaded sites, although it will persist on sites with periodic disturbances (Sullivan 1992). Burning stimulates germination by scarifying seeds and yellow sweetclover will colonize areas disturbed by fire (Wisconsin DNR 2003).	
Current global distribution (0–5)	3
Yellow sweetclover is a native to the Mediterranean area through Central Europe to Tibet (Eckardt 1987). It was introduced into North and South America (Hultén 1968).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
The species is found in all 50 states (Wisconsin DNR 2003). It is declared noxious in Quebec (Invaders Database System 2003).	
Total for Ecological Amplitude and Distribution	**19/25**

Feasibility of Control	Score
Seed banks (0–3)	3
Seeds can remain viable in the soil for 11–50 years (Cole 1991, Eckardt 1987, Rutledge and McLendon 1996).	
Vegetative regeneration (0–3)	1
Plants usually do not resprout when the stems are cut close to the ground (Cole 1991).	
Level of effort required (0–4)	4
Yellow sweetclover can be managed using mechanical or burning methods. Due to the long viability of seeds, sites must be managed on continuous basis (Cole 1991, Wisconsin DNR 2003).	
Total for Feasibility of Control	**8/10**
Total score for 4 sections	**65/100**

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Mycelis muralis (L.) Dumort. common names: wall lettuce

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		No
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	7
Biological Characteristics and Dispersal	23	11
Amplitude and Distribution	25	8
Feasibility of Control	10	4
Relative Maximum		31

Climatic Comparison		
	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	No	No
Arctic Alpine	No	No

Mycelis muralis has been reported from Ketchikan, Wrangell, and Kuiu Island in south coastal Alaska (AKEPIC 2004). The species' range includes Røros and Dombås, Norway (Lid and Lid 1994), which has a 76% and 63% climatic match with Nome, and 55% and 52% climatic match with Fairbanks, respectively (CLIMEX 1999). However, its northern limit in Europe approximately follows the 19.4 °F mean January isotherm (Clabby and Osborne 1958). These conditions are not typical for arctic alpine and interior boreal ecogeographic regions. We suggests that establishment of *Mycelis muralis* in interior boreal and arctic alpine ecogeographic regions is unlikely.

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	1
Wall lettuce is an early successional species with minimal cover (Clabby and Osborne 1999), which is likely to have minimal impacts on ecosystem processes.	
Impact on Natural Community Structure (0–10)	2
Wall lettuce cover in vegetation is low, often less then 10%, but can approach 40%. The numbers of plants ranged from 1 to 16 per m^2 in Irish woodland (Clabby and Osborn 1999).	
Impact on Natural Community Composition (0–10)	1
There are no records concerning the alteration of community composition.	
Impact on Higher Trophic Levels (0–10)	3
A number of insects and parasites have been observed for wall lettuce. Mycorrhizal relationships are known to occur on wall lettuce. Latex production may act as an antiherbivory device (Clabby and Osborn 1999).	
Total for Ecological Impact	**7/40**

Biological Characteristics and Dispersal	Score
Mode of Reproduction (0–3)	3
Wall lettuce reproduces exclusively by seed. A plant may produce up to 500 seeds in shaded sites and up to 11,500 seeds in more open sites (Clabby and Osborne 1999).	
Long-distance dispersal (0–3)	3
Achenes possess pappus and may by dispersed by wind (Douglas 1955).	
Spread by humans (0–3)	2
Wall lettuce can be dispersed along the transportation corridors (M. Shephard pers. com.).	

Allelopathic (0–2)	U
There is no data concerning allelopathy. The small volume of literature on this species suggests that it has not been tested.	
Competitive Ability (0–3)	1
Wall lettuce almost always occurs as a component of sparse vegetation and is rarely found in closed swards. It may compete with co-occurring species in closed woodland vegetation (Clabby and Osborn 1999).	
Thicket-forming/Smothering growth form (0–2)	0
Wall lettuce does not form thickets or patches. It usually occurs in small groups or as scattered individuals (Clabby and Osborne 1999).	
Germination requirements (0–3)	2
Wall lettuce germinates mainly on barren or sparsely vegetated sites (Clabby and Osborn 1999).	
Other invasive species in the genus (0–3)	0
The genus *Mycelis* is monotypic (USDA 2002).	
Aquatic, wetland or riparian species (0–3)	0
Wall lettuce is a species of moist to mesic forests in the lowland and montane zones. It is commonly found in open woods, wood margins, and woodland clearings, but also occurs in scrub and on walls and rock outcrops (Clabby and Osborne 1999, Cronquist 1955, Douglas et al. 1998, Gubanov et al. 1995).	
Total for Biological Characteristics and Dispersal	**11/23**
Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	0
The species is not known as an agricultural weed.	
Known level of impact in natural areas (0–6)	1
Though wall lettuce occurs mainly on disturbed sites (Clabby and Osborn 1999), it has been observed to invade forest communities in Oregon (M.L. Carlson pers. obs.). Wall lettuce has been found along old logging roads in southeast Alaska (AKEPIC 2004).	
Role of anthropogenic and natural disturbance in establishment (0–5)	0
Wall lettuce habitats are often associated with natural or anthropogenic disturbances such as storms, fires, and clearcuts (Clabby and Osborne 1999).	
Current global distribution (0–5)	5
Wall lettuce is native to most of temperate continental Europe. Its distribution extends eastward to Turkey and the Caucasus Mountains and north in Norway at 68.5°N. Wall lettuce also occurs in North Africa, North America, and New Zealand (Clabby and Osborn 1999).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	2
Wall lettuce has been found in Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New York, Oregon, Vermont, and Washington (USDA 2002). *Mycelis muralis* is exotic to North America but is not listed as noxious (Invaders Database System 2003, USDA 2002).	
Total for Ecological Amplitude and Distribution	**8/25**
Feasibility of Control	**Score**
Seed banks (0–3)	2
In laboratory experiments, dry seeds stored in a refrigerator remained viable for at least 3 years. Seeds stored at room temperature lost viability after 2 years (Clabby and Osborne 1999). In Kellman's (1974) study the number of viable seeds declined during the 3 years of monitoring, suggesting a short period of seed viability.	
Vegetative regeneration (0–3)	0
Wall lettuce does not regenerate vegetatively (Clabby and Osborn 1999).	
Level of effort required (0–4)	2
Control options have not been investigated. Kellman (1974) suggested that wall lettuce will not persist on sites with established perennials.	
Total for Feasibility of Control	**4/10**
Total score for 4 sections	**30/98**

§

Myriophyllum spicatum L. common names: Eurasian watermilfoil, myriophylle en epi, spike watermilfoil

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	38
Biological Characteristics and Dispersal	22	20
Amplitude and Distribution	25	20
Feasibility of Control	10	9
Relative Maximum		90

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	No	Yes
Interior Boreal	No	Yes
Arctic Alpine	No	Yes

Special Note: This taxonomy and identification of Eurasian watermilfoil is problematic. It is often synonymized with *M. sibiricum* Komarov, which is native to Alaska (ITIS Database 2004) and the two taxa are known to hybridize (Moody and Les 2007). Hultén (1968) and the UAM database treat the native taxon in Alaska broadly and as *M. spicatum*; however, it appears that Eurasian watermilfoil in the strict sense is not known from any locations in Alaska.

The very closely related *Myriophyllum sibiricum* (synonymized by many authors) has been collected in the south coastal, interior boreal, and arctic alpine ecoregions in Alaska (Hultén 1968). The species' range includes the Norland province in Norway, where it is only occasionally found (Lid and Lid 1994), the climatic similarity of this region is similar to the interior boreal and arctic alpine ecoregions of Alaska (CLIMEX 1999). It is known from southwestern Norway which tends to have a strong climatic similarity with the Alaskan south coastal ecoregion (Bergen has a 73% climatic match with Juneau). Last, the closely related *M. sibiricum* has similar range in Europe and is widespread in Alaska. We suggests that establishment of *M. subspicatum* in the south coastal, interior boreal, and arctic alpine ecogeographic regions is possible.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 8

Dense Eurasian watermilfoil mats alter water quality by raising pH, decreasing dissolved oxygen under the mats, and increasing temperature. The dense mats of vegetation can increase the sedimentation rate by trapping sediments (Jacono and Richerson 2003, Washington State Department of Ecology 2003).

Impact on Natural Community Structure (0–10) — 10

Eurasian watermilfoil forms dense floating mats of vegetation, preventing light penetration for native aquatic plants (Jacono and Richerson 2003, Remaley 1998, Washington State Department of Ecology 2003).

Impact on Natural Community Composition (0–10) — 10

This aquatic plant is able to displace and reduce natural diversity (Bossard 2004, Jacono and Richerson 2003, Washington State Department of Ecology 2003).

Impact on Higher Trophic Levels (0–10) — 10

Monospecific stands of Eurasian watermilfoil provide poor habitat for waterfowl, fish, and other wildlife (Jacono and Richerson 2003). Loss of nutrient-rich native plants reduces food sources for waterfowl; it impacts fish spawning; and it disrupts predator-prey relationships by fencing out larger fish. Stagnant water created by Eurasian watermilfoil mats provides good breeding grounds for mosquitoes (Bossard 2004).

Total for Ecological Impact — 38/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3

Reproduction is by seeds, rhizomes, fragmentation, and winter buds. Young populations of Eurasian watermilfoil averaged a seed set of 112 seeds per stalk. Despite the high seed production, it is propagated predominantly by vegetative fragments (Aiken 1981, Bossard 2004, Remaley 1998, Washington State Department of Ecology 2003).

Long-distance dispersal (0–3) — 3

Fragments can be spread by floating downstream, waterfowl, and other wildlife. Fruits are buoyant for short period and can be dispersed by water (Bossard 2004).

Spread by humans (0–3) — 3

It is spread from lake to lake on boat trailers and fishing gear. A number of populations found in Oklahoma were introduced by earthworm farmers who packed their product in Eurasian watermilfoil (Jacono and Richerson 2003, Washington State Department of Ecology 2003). It could very likely be moved by floatplanes and small boats used in Alaska.

Allelopathic (0–2) — 0

No records of allelopathy.

Competitive Ability (0–3) — 3

Eurasian watermilfoil competes aggressively with native aquatic plants (Bossard 2004, Jacono and Richerson 2003). Eurasian watermilfoil is an extremely adaptable plant, able to tolerate and even thrive in a variety of environmental conditions. It grows in still to flowing waters, survives under ice, tolerates pH from 5.4 to 11, and can grow over a broad temperature range. This plant begins spring growth earlier than other aquatic plants, quickly grows to the surface and forming dense canopies (Jacono and Richerson 2003).

Thicket-forming/mothering growth form (0–2) — 2

This aquatic plant forms a large, dense canopy of vegetation (Jacono and Richerson 2003, Remaley 1998).

Germination requirements (0–3) — N/A

Germination of seed is not a significant factor in reproduction. (Remaley 1998, Washington State Department of Ecology 2003).

Other invasive species in the genus (0–3) — 3

Myriophyllum exalbescens Fern. (Royer and Dickinson 1999). *M. aquaticum* (Vell.) Verdc. (Anderson and Spencer 1999, USDA 2002).

Aquatic, wetland or riparian species (0–3) — 3

The typical habitat for Eurasian watermilfoil includes fresh to brackish water of fishponds, lakes, slow-moving streams, reservoirs, estuaries, and canals (Bossard 2004, Jacono and Richerson 2003).

Total for Biological Characteristics and Dispersal — 20/22

Ecological Amplitude and Distribution	Score
Highly domesticated or a weed of agriculture (0–4) *Myriophyllum spicatum* is not an agricultural weed. It likely has been used in aquatic gardens and aquariums (Bossard 2004).	1
Known level of impact in natural areas (0–6) *Myriophyllum spicatum* is abundant, aggressive, and caused high impacts in streams, ponds, and lakes of Massachusetts, Connecticut, California, Minnesota, Virginia, Washington, and many other states (Anderson and Spenser 1999, Bossard 2004, Jacono and Richerson 2003, Remaley 1998, Welling 2004).	6
Role of anthropogenic and natural disturbance in establishment (0–5) The plant thrives in areas that have been subjected to various kinds of natural and manmade disturbance (Jacono and Richerson 2003, Remaley 1998, Welling 2004). It is particularly troublesome in water bodies with nutrient loading, intense plant management, and abundant motorboat use. Motorboat traffic contributes to natural seasonal fragmentation and the distribution of fragments throughout lakes (Jacono and Richerson 2003).	3
Current global distribution (0–5) Eurasian watermilfoil is native to Europe, Asia, and northern Africa. It now occurs in North and South America, Australia, Greenland, Central and South Africa (Hultén 1968).	5
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) It had been found in 33 states of the United States, and the Canadian provinces of British Columbia, Ontario, and Quebec (Jacono and Richerson 2004, USDA 2002). *Myriophyllum spicatum* is declared noxious in 12 states of the United States and 1 Canadian province (Invaders Database System 2003).	5
Total for Ecological Amplitude and Distribution	20/25

Feasibility of Control	Score
Seed banks (0–3) Eurasian watermilfoil produces long-viable, often dormant seeds. Despite the high seed production, it is thought that germination of seed is not a significant factor in reproduction (Bossard 2004, Remaley 1998).	2
Vegetative regeneration (0–3) New plants develop from fragments of former plants (Bossard 2004).	3
Level of effort required (0–4) Once milfoil becomes well-established within a water body, it is difficult or impossible to remove. In smaller water bodies, there is some limited success using an aquatic herbicide. Other control methods include: harvesting, rotovation, installation of bottom barriers, and diver hand pulling (Anderson and Spenser 1999, Bossard 2004, Welling 2004).	4
Total for Feasibility of Control	9/10
Total score for 4 sections	87/97

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Nymphaea odorata ssp. *odorata* Ait.

common names: white waterlily

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		No
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	36
Biological Characteristics and Dispersal	25	18
Amplitude and Distribution	25	18
Feasibility of Control	7	6
Relative Maximum		80

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	No	No
Arctic Alpine	No	No

One individual of *Nymphaea odorata* ssp. *odorata* has been recorded in a muskeg pool on Baranof Island near Sitka in 1997 (UAM 2004). The site has been monitored since then and no spreading of the species has been observed (M. Shephard pers. com.). *Nymphaea odorata* ssp. *odorata* is native to eastern half of North America, including southern Canada. It has been introduced into British Columbia, Oregon, Washington, Idaho, Montana, and other western states. It also is documented in Manitoba and Saskatchewan (Wiersema 1997). The CLIMEX climate matching program indicates the climatic similarity between the interior boreal and arctic alpine ecoregions of Alaska and areas where the species occurs is low. Similarity between Anchorage, Fairbanks, and Nome, and areas of species native range is 25% to 35%. Similarity between the Anchorage, Fairbanks, and Nome climates with areas in Washington and British Columbia where waterlily has been introduced is 30% to 40%. Thus establishment of *Nymphaea odorata* in interior boreal and arctic alpine ecogeographic regions of Alaska is unlikely. Climatic similarity between Juneau and Grand Banks and St. Johns, Newfoundland where white waterlily occurs is high (55% and 54% respectively). White waterlily is expected to expand its range in the south coastal region of Alaska.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 8

Macrophytes generally change water quality. Extensive infestations of white waterlily creates low oxygen conditions beneath the dense canopy. It has the ability to alter nutrient dynamics by uptake from the sediments, and later release (Moore et al. 1994). Infestations of waterlily may promote other exotic species such as carp, which have the ability to tolerate low oxygen conditions (Frodge et al. 1995, Moore et al. 1994). Dense infestations may accelerate the natural siltation process in shallow bodies of water. Waterlily can clog irrigation ditches or streams, thus slowing waterflow and hastening water loss through transpiration (Else and Riemer 1984).

Impact on Natural Community Structure (0–10) — 8

White waterlily tends to form dense floating mats of vegetation that prevent light penetration to native aquatic plants (Washington Department of Ecology 2005). Distribution of macrophytes mats influences the distribution of phyto- and zooplankton, aquatic insects, and fish populations (Frodge et al. 1995, Moore et al. 1994). Frodge and others (1995) in a study of fish mortality in two western Washington lakes observed that fish avoid heavily vegetated areas and move to unaffected parts of the lake.

Impact on Natural Community Composition (0–10) — 10

White waterlily infestations may shift microorganism species composition toward anaerobic species. These infestations may cause a reduction of fish population size and lead to extirpation of fish species over the long term. Marcophyte beds create conditions favorable for rotifers and exotic fish species such as carp (Frodge et al. 1995, Moore et al. 1994).

Impact on Higher Trophic Levels (0–10) — 10

White waterlily provides important habitat for fish, frogs, and invertebrates. However, a decline in the positive influences on fish production occurs once a threshold of approximately 40% of the surface area cover is exceeded. Wildlife including beaver, moose, muskrat, porcupine, and deer eat waterlily leaves and roots. Waterfowl eat the seeds (Washington Department of Ecology 2005). Aquatic and semiaquatic insects use this species both for habitat and food (Dorn et al. 2001, Cronin et al. 1998). Beetles and bees have been observed visiting the flowers of waterlily. Dead insects were frequently found in flowers of *Nymphaea odorata* (Schneider and Chaney 1981). A change in nutrient regime may alter phyto- and zooplankton community composition and productivity (Murray and Hodson 1986). Fish population distribution also appears to be strongly influenced by waterlily infestations. In addition, waterfowl utilization of lakes has declined with the expansion of the white waterlily. Aqueous extracts from leaves, petioles, and rhizomes of white waterlily have strong allelopathy potential (Quayyum et al. 1999, Spence 1998). Sometimes other noxious plants such as Hydrilla can be introduced to lakes when waterlilies are planted (Washington Department of Ecology 2005, Moore et al. 1994). A lake restoration diagnostic study in Washington indicated that game fish populations are stressed by high temperatures, low summer oxygen concentration, and predation from carp. The stress resulted in reproductive failure and lower growth rates, in contrast to a population typically observed in lakes with less macrophyte biomass (Moore et al. 1994). Concentrations of dissolved oxygen in dense beds of *Nymphaea odorata* in two western Washington lakes were measured below lethal limits for largemouth bass and steelhead trout. Although, no significant mortality occurred in the surface water, all the fish found at 1 m in dense macrophyte beds were dead within 12 hours (Frodge et al. 1995). Schneider and Chaney (1981) considered that insects may drown in fluid in the cup-like center of the flower. The death of the insects may be because of asphyxiation due to the heavy floral odor or the accumulation of carbonic acid. Insects also died from drowning in closed flowers.

Total for Ecological Impact — 36/40

Biological Characteristics and Dispersal	Score
Mode of Reproduction (0–3) Waterlilies reproduce through both seeds and rhizomes (Washington Department of Ecology 2005).	2
Long-distance dispersal (0–3) Mature seeds are released into the water. The seeds are able to float for a few days, by retaining air in the aril. Seeds are transported to other areas and other lakes by water currents and ducks that eat the seeds (Washington Department of Ecology 2005, Schneider and Chaney 1981).	3
Spread by humans (0–3) White waterlily is an extremely popular plant for cultivation in ornamental ponds. It has been intentionally introduced into many lakes. Cultivars with color variations have been developed and can be readily obtained at nurseries. (Washington Department of Ecology 2005).	2
Allelopathic (0–2) Aqueous extracts from leaves, petioles, and rhizomes of white waterlily exhibit high allelopathy potential and are reported to inhibit seed germination and root growth of other aquatic plants (Quayyum et al. 1999, Spence 1998).	2
Competitive Ability (0–3) No studies on competitive ability of *Nymphaea odorata* were found. Since established white waterlily is able to dominate and replace native macrphytes (Washington Department of Ecology 2005), it is likely to outcompete other aquatic species.	1
Thicket-forming//Smothering growth form (0–2) White waterlily forms dense floating mats of vegetation (Washington Department of Ecology 2005).	2
Germination requirements (0–3) The seeds require light for germination. Seedlings are rarely observed in the field, when the adult population is high. However, a large number of seeds germinate after removal of adult plants when light breaks dormancy and stimulates germination (DiTomaso and Healy 2003, Else and Riemer 1984, Welker and Riemer 1982).	0
Other invasive species in the genus (0–3) *Nymphaea mexicana* Zucc. is a noxious weed in California (DiTomaso and Healy 2003, USDA 2002).	3
Aquatic, wetland or riparian species (0–3) White waterlily grows in shallow ponds, lakes, ditches, slow streams, sloughs, and pools in marshes (Washington Department of Ecology 2005, Woods 2005, Wiersema 1997).	3
Total for Biological Characteristics and Dispersal	**18/25**

Ecological Amplitude and Distribution	Score
Highly domesticated or a weed of agriculture (0–4) White waterlily is a popular plant for cultivation in ornamental ponds. Many cultivars with color variations have been developed (Washington Department of Ecology 2005).	4
Known level of impact in natural areas (0–6) A number of small lakes in Washington have been choked with white waterlily (Washington Department of Ecology 2005, City of Federal Way 2004). Alteration of water quality, nutrient dynamics, and plant and animal species composition has been documented for infested lakes (Frodge et al. 1995, Moore et al. 1994).	6
Role of anthropogenic and natural disturbance in establishment (0–5) White waterlily has been introduced into lakes with various levels of human disturbances (Washington Department of Ecology 2005).	3
Current global distribution (0–5) White waterlily is native to the eastern half of North America, including southern Canada. It has been introduced as an ornamental in many parts of the world and it is expected to expand its range. It is naturalized in South America (Washington Department of Ecology 2005, Woods 2005, Wiersema 1997).	0
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) White waterlily distribution includes nearly all American states and most Canadian provinces (Woods et al. 2005, USDA 2002, Wiersema 1997). *Nymphaea odorata* ssp. *odorata* is listed as a noxious weed in Washington (Invaders Database System 2003, USDA 2002).	5
Total for Ecological Amplitude and Distribution	**18/25**

Feasibility of Control	Score
Seed banks (0–3) Unknown	U
Vegetative regeneration (0–3) White waterlily is able to resprout from rhizomes (Washington Department of Ecology, City of Federal Way 2004). Cutting of rhizomes into 4 inches or larger pieces is recommended for propagation in cultivation (Washington Department of Ecology 2005).	2
Level of effort required (0–4) White waterlily can be controlled by cutting, harvesting, covering with bottom barrier materials, and aquatic herbicides (City of Federal Way 2004, Washington Department of Ecology 2005, Welker and Riemer 1982). Persistent picking of emerging leaves every other day during two to three growing seasons will eventually kill the plants. After control treatments dead and decomposing leaves and rhizomes may form floating mats in the lake. Removing all dead materials from the water is recommended. All control methods are time consuming and labor intensive. There are no effective biological control agents available at this time for waterlily (Washington Department of Ecology 2005).	4
Total for Feasibility of Control	**6/7**
Total score for 4 sections	**78/97**

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Persicaria maculosa Gray (*Polygonum persicaria* L.) — common names: spotted ladysthumb
Persicaria lapathifolia (Linnaeus) Gray (*Polygonum lapathifolium* L.) — curlytop knotweed

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	6
Biological Characteristics and Dispersal	25	16
Amplitude and Distribution	19	15
Feasibility of Control	10	7
Relative Maximum		47

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Polygonum persicaria has been documented in south coastal and interior boreal ecogeographic regions of Alaska (Weeds of Alaska Database 2005, Hultén 1968, UAM 2004). *Polygonum lapathifolium* has been documented in south coastal, interior boreal, and arctic alpine ecogeographic regions of Alaska (Weeds of Alaska Database 2005, Hultén 1968, UAM 2004). *Polygonum persicaria* and *P. lapathifolia* are known to occur as far north in Europe as the northern province in Norway (Finnmark) at 70ºN (Lid and Lid 1994). This region is recognized as having arctic tundra vegetation (CAFF Circumpolar Arctic Vegetation Map), Using the CLIMEX matching program, the climatic similarity between Nome and areas where the species is documented is fairly high. The range of the species includes Røros and Dombås, Norway, which have a 76% and 63% of climatic match with Nome respectively. It is possible for these two species to establish in the arctic alpine ecoregion of Alaska.

Ecological Impact — **Score**

Impact on Ecosystem Processes (0–10) — 0

Spotted ladysthumb and curlytop knotweed reduce soil, water, and nutrient availability (Royer and Dickinson 1999). Stands of plants of these species may prevent the waterflow in canals and irrigated ditches (DiTomaso and Healy 2003). However, impact on natural ecosystem processes has not been documented.

Impact on Natural Community Structure (0–10) — 0

Spotted ladysthumb and curlytop knotweed are able to colonize disturbed ground and change the density of the layer (I. Lapina pers. obs.). No impact on the natural community structure has been documented.

Impact on Natural Community Composition (0–10) — 1

Spotted ladysthumb and curlytop knotweed have not been observed in native communities in Alaska (Welsh 1974, I. Lapina pers. obs.). It is unlikely that measurable impacts on native community composition occur due to its presence.

Impact on Higher Trophic Levels (0–10) — 5

Both spotted ladysthumb and curlytop knotweed provide important cover and food source for many species of birds and mammals (DiTomaso and Healy 2003, Wilson et al. 1999). Flowers are frequently visited by insects (Simmons 1945a). These weeds are also a host for number of fungi, viruses, and nematode species (Edwards and Taylor 1963, Townshend and Davidson 1962). Hybrids of *Polygonum persicaria* with *P. lapathifolium* and *P. hidropiper* have been recorded (Simmons 1945a, b).

Total for Ecological Impact — 6/40

Biological Characteristics and Dispersal — **Score**

Mode of Reproduction (0–3) — 3

Spotted ladysthumb plant can produce up to 1,550 seeds per season (Mertens and Jansen 2002, Stevens 1932). Curlytop knotweed is capable of producing up to 19,300 seeds per season (Stevens 1932). Askew and Wilcut (2002) estimated achene production of curlytop knotweed as 63,000 to 25,000 per m^2.

Long-distance dispersal (0–3) — 3

Achenes can be dispersed by birds and animals after ingestion. Seeds also can be carried in mud on the feet of birds and animals. The seeds can float for one day and thus can be dispersed by irrigation water, rain, streams, and watercourses (Simmonds 1945a, b).

Spread by humans (0–3) — 3

Seeds of spotted ladysthumb and curlytop knotweed can be eaten and passed through the digestive tracts of domestic animals and birds. Wet seeds can stick to clothes, domestic animal fur, or to agricultural equipment (DiTomaso ans Healy 2003, Simmonds 1945a, b). Seeds of these species also can contaminate commercial seeds (Dorph-Petersen 1925) and soil (Hodkinson and Thompson 1997).

Allelopathic (0–2) — 0

Spotted ladysthumb has no allelopathy potential (USDA, NRCS 2006). Curlytop knotweed is closely related to spotted ladysthumb and very likely it also is not allelopathic.

Competitive Ability (0–3) — 1

Although spotted ladysthumb and curlytop knotweed are extremely tolerant of a wide range of environmental conditions, they appear to require reduction of competition for successful growth and persistence (Simmonds 1945b). Curlytop knotweed was a weak competitor with crops in experiments of O'Donovan (1994) and Askew and Wilcut (2002).

Thicket-forming/Smothering growth form (0–2) — 0

Spotted ladysthumb and curlytop knotweed do not form dense thickets in Alaska. Both species do not have climbing or smothering growth habit (DiTomaso and Healy 2003).

Germination requirements (0–3) — 0

Since spotted ladysthumb and curlytop knotweed are always found in disturbed communities (Simmonds 1945a, b, Staniforth and Cavers 1979), disturbed soil can be important requirement for germination of seeds.

Other invasive species in the genus (0–3)	3
Polygonum cuspidatum Sieb. & Zucc., *P. perfoliatum* L., *P. polystachyum* Wallich ex Meisn., and *P. sachalinense* F. Schmidt ex Maxim. are declared noxious in a number of American states. Also *Polygonum arenastrum* Jord. ex Boreau, *P. caespitosum* Blume, *P. convolvulus* L., *P. orientale* L., and *P. aviculare* L. are listed as weeds in the PLANTS Database (USDA, NRSC 2006). A number of *Polygonum* species are native to North America. *Polygonum* species have a weedy habit and are listed as noxious weeds in some of the American states. Although the latest taxonomy considers these species as members of three different genus: *Polygonum*, *Fallopia*, and *Persicaria* (FNA 1993+), they are closely related taxa and can be considered as congeneric weeds.	
Aquatic, wetland or riparian species (0–3)	3
Although spotted ladysthumb and curlytop knotweed are typically plants of fields, roadsides, gardens, and waste grounds, they often occur together on riverbanks, edges of ponds, lakes, streams, and marshes (DiTomaso and Healy 2003, Staniforth and Cavers 1979).	
Total for Biological Characteristics and Dispersal	**16/25**

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
Both, spotted ladysthumb and curlytop knotweed have long been associated with agricultural activities (Staniforth and Cavers 1979).	
Known level of impact in natural areas (0–6)	U
Spotted ladysthumb and curlytop knotweed are commonly found on naturally disturbed sites, such as riverbanks, lakeshores, or exposed mud (DiTomaso and Healy 2003, Staniforth and Cavers 1979). However, ecological impact in natural communities is poorly documented.	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
Spotted ladysthumb and curlytop knotweed establish in disturbed communities only (Simmonds 1945a, b). In Ontario curlytop knotweed is commonly found in naturally disturbed sites such as riverbanks, sandy beaches, exposed mud (Staniforth and Cavers 1979).	
Current global distribution (0–5)	3
Spotted ladysthumb and curlytop knotweed are distributed throughout Europe to 70°N in Norway (Lid and Lid 1994) and Russia; and in Asia, North Africa, North and South America, Australia and New Zealand (Hultén 1968).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Spotted ladysthumb and curlytop knotweed are found throughout the United States and Canada (Royer and Dickinson 1999, USDA, NRCS 2006). *Polygonum lapathifolium* is declared a weed in Manitoba and Quebec (Royer and Dickinson 1999).	
Total for Ecological Amplitude and Distribution	**15/19**

Feasibility of Control	**Score**
Seed banks (0–3)	3
Dorph-Petersen (1925) found that seeds of spotted ladysthumb and curlytop knotweed remained viable for up to 5–7 years. Toole (1946) reported 30 years of viability for spotted ladysthumb seeds buried in the soil. Chippindale and Milton (1934) found seeds remaining viable in different fields for 6, 8, 22, and 68 years.	
Vegetative regeneration (0–3)	2
Vegetative regeneration has not been recorded for both species. However, Simmonds (1945a) reported its ability to persist into a second year after cutting.	
Level of effort required (0–4)	2
Mechanical methods (hand pulling and mowing) can control populations. Improving the drainage will discourage these weeds from reestablishment (DiTomaso and Healy 2003).	
Total for Feasibility of Control	**7/10**
Total score for 4 sections	**44/94**

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Phalaris arundinacea L. common names: reed canarygrass

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	33
Biological Characteristics and Dispersal	25	20
Amplitude and Distribution	25	24
Feasibility of Control	10	6
Relative Maximum		83

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Special Note–nativity: Some populations of *Phalaris arundinacea* L. are possibly native in Alaska. Four sites that may harbor native forms are from hot springs of interior Alaska (Big Windy, Kanuti, Kilo, and Manley Hot Springs; "N?" in figure). Active mining occurred in these areas in the early 20th century and seeds may have been brought in with livestock. If these populations are native they represent important and likely unique components to the biodiversity and biogeographic history of Alaska and Beringia. *Phalaris arundinacea* in these remote locations should not be removed. However, monitoring may be critical as introgression with other cultivated and weedy forms can result in substantial increases in invasiveness (Merigliano and Lesica 1998). Populations south of the Alaska Range are generally associated with anthropogenic disturbance and are most likely introduced or introgressed genotypes as in the Pacific Northwest (see Merigliano and Lesica 1998). These introduced populations pose a serious threat to communities and ecosystem function.
Phalaris arundinacea has been documented in the south coastal [Skagway, Craig, and Petersburg (Hultén 1968) and Juneau, Seward, Sitka, and Ketchikan (UAM 2004)], interior boreal [Fairbanks, Anchorage, and Talkeetna (Hultén 1968) and Circle, Tanana, Big Windy, Kilo, Manley, and Kanuti (UAM 2004)], and arctic alpine [Bettles (UAM 2004)] ecoregions in Alaska.

Ecological Impact — **Score**

Impact on Ecosystem Processes (0–10) — 9
Reed canarygrass promotes silt deposition and causes serious constrictions of waterways and irrigation canals. Additionally, it may alter soil hydrology (Lyons 1998) and increase water temperatures (Lantz. 2000).

Impact on Natural Community Structure (0–10) — 7
Reed canarygrass can form dense, persistent, monospecific stands (Lyons 1998), eliminating low herbaceous layers and inhibiting woody seedling growth (M.L. Carlson pers. obs.).

Impact on Natural Community Composition (0–10) — 9
The stands of *Phalaris arundinacea* exclude and displace native plants and animals (Hutchison 1992, Lyons 1998, WSDE 2003). It apparently inhibits the growth of other species for 3–5 months, eventually eliminating these species (Rutledge and McLendon 1996). Canarygrass has invaded the emergent vascular plant communities in Iowa. Eleven species disappeared on these sites (Apfelbaum and Sams 1987).

Impact on Higher Trophic Levels (0–10) — 8
Waterfowl, upland game birds, riparian mammals, and fish all use reed canarygrass for cover and food (Snyder 1992). Lyons (1998) suggested that reed canarygrass grows too densely to provide adequate cover for small mammals and waterfowl. It can also overgrow irrigation ditches and small natural watercourses, impacting aquatic species. Reed canarygrass contributes to increased water temperatures and decreased habitat values for salmon and other wildlife. Dense stands can form a physical barrier to migrating salmon (Lantz 2000, Whatcom Weeds 2003).

Total for Ecological Impact — 33/40

Biological Characteristics and Dispersal — **Score**

Mode of Reproduction (0–3) — 2
Reproduction is from seed and vegetatively by stout creeping rhizomes (Lyons 1998, Rutledge and McLendon 1996).

Long-distance dispersal (0–3) — 2
The seeds have no adaptations for long-distance dispersal. Both rhizome fragments and seeds may wash downstream along streams and rivers (Rutledge and McLendon 1996).

Spread by humans (0–3) — 3
Reed canarygrass has been planted widely for forage and for erosion control (Lyons 1998, WSDE 2003). It also is a seed contaminant (USDA, ARS).

Allelopathic (0–2) — 0
Reed canarygrass is not known to be allelopathic.

Competitive Ability (0–3) — 3
Reed canarygrass is highly competitive with other species (Lyons 1998, Rutledge and McLendon 1996). *Phalaris arundinacea* is tolerant of freezing temperatures and begins to grow very early in the spring.

Thicket-forming/Smothering growth form (0–2) — 2
Reed canarygrass forms dense and impenetrable mats of vegetation (Lyons 1998). It can reach 3–6 feet in height (Welsh 1974).

Germination requirements (0–3) — 2
The seeds of reed canarygrass germinate immediately after ripening, there are no known dormancy requirement (Apfelbaum and Sams 1987).

Other invasive species in the genus (0–3) — 3
Phalaris aqatica L., *P. brachystacys* Link, *P. canariensis* L., *P. caroliana* Walter, *P. minor* Retz., and *P. paradoxa* L.

Aquatic, wetland or riparian species (0–3) — 3
Reed canarygrass occurs in marshes, fens, wet meadows and prairies, flood plains, old fields, roadsides, and ditches (Hutchison 1992, Lyons 1998, Rutledge and McLendon 1996).

Total for Biological Characteristics and Dispersal — 20/25

Ecological Amplitude and Distribution — **Score**

Highly domesticated or a weed of agriculture (0–4) — 4
Reed canarygrass has a long agronomic history. It was cultivated for forage as early as 1830s. There are 11 reed canarygrass cultivars used as forage, ornamental, and for erosion control (Hutchison 1992, Lyons 1998, Merigliano and Lesica 1998).

Known level of impact in natural areas (0–6) — 6
Reed canarygrass may threaten populations of many species in wetlands in Ohio, Oregon, and Montana (Lyons 1998). It threatens upland oak savannas in south-central Wisconsin (Snyder 1992). Canarygrass has invaded the emergent vascular plant communities in Iowa. Eleven species disappeared on these sites (Apfelbaum and Sams 1987).

Role of anthropogenic and natural disturbance in establishment (0–5)	4
Reed canarygrass prefers disturbed areas, but can easily move into native wetlands. Invasion is promoted by disturbances such as ditching of wetlands and stream channelization, overgrazing, intentional planting, and alteration of water levels (Lyons 1998, WDNR 2004).	
Current global distribution (0–5)	5
Reed canarygrass is a native to Europe and some forms are likely to be native to Asia and North America as well. The present range extends throughout the Old and New Worlds primarily in northern latitudes (Hutchison 1992). It is introduced into New Zealand and Australia (Hultén 1968).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
In the U.S. reed canarygrass is found from Alaska to Maryland, and south to Kentucky, Illinois, Missouri, Oklahoma, New Mexico, and Arkansas. It is absent from Mississippi, Alabama, Georgia, Florida, and Louisiana (Lyons 1998, USDA 2002). Reed canarygrass is a noxious weed in Washington (Class C). Invasive weed in Nebraska, Tennessee, Wisconsin (USDA 2002). It is a notorious global weed.	
Total for Ecological Amplitude and Distribution	24/25

Feasibility of Control	**Score**
Seed banks (0–3)	0
Seeds of reed canarygrass are short-lived. Some seeds germinated after 10 days while others took 3 weeks. Rates of germination decrease through winter and are poor the following summer (Rutledge and McLendon 1996, WSDE 2003). Seeds stored in damp sand germinated after a year of alternating temperatures (Aphelbaum and Sams 1987).	
Vegetative regeneration (0–3)	2
Rapid regrowth occurs from rhizomes after mechanical removal (WSDE 2003). The species will also produce roots and shoots from the nodes and culms (APMS 2004).	
Level of effort required (0–4)	4
Control is difficult due to its extensive rhizomes. Mechanical methods may be too labor intensive and require a long-term time commitment. No herbicides are selective enough to be used in wetlands without the potential for injuring native species. Plants reestablish quickly from seeds after control methods are used (Apfelbaum and Sams 1987, Hutchison 1992, Lyons 1998, Rutledge and McLendon 1996).	
Total for Feasibility of Control	6/10
Total score for 4 sections	83/100

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Phleum pratense L. — common names: common timothy

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	14
Biological Characteristics and Dispersal	25	14
Amplitude and Distribution	25	19
Feasibility of Control	10	7
Relative Maximum		54

Climatic Comparison		
	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Phleum pratense has been collected in all ecogeographic regions in Alaska (Hultén 1968, UAM 2004, AKEPIC 2004).

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	3
Timothy has the potential to inhibit secondary successional processes, and may modify native communities (Rutledge and McLendon 1996).	
Impact on Natural Community Structure (0–10)	3
Timothy is capable of creating a new herbaceous layer and it can occur at very high densities (I. Lapina pers. obs.).	
Impact on Natural Community Composition (0–10)	3
Timothy often dominates areas, reducing the abundance and diversity of native graminoid species (Esser 1993, I. Lapina pers. obs., M. Shephard pers. obs.).	
Impact on Higher Trophic Levels (0–10)	5
Timothy provides habitat and nesting cover for game birds, small mammals, and waterfowl. It is highly palatable and nutritious forage for big game animals, and the seeds are consumed by birds. (Esser 1993, Forage Information System 2004, USDA 2002). Timothy seedlings may hinder conifer seedlings establishment through resource competition, allelopathy, attraction of harmful insects and animals, and increased fire potential (Esser 1993). Pollen of timothy is known as an allergen (Ohio State University 2004). Timothy is a host for a number of plant diseases and nematodes, which may be a problem for other species (Forage Information System 2004).	
Total for Ecological Impact	14/40

Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	2
Timothy reproduces mainly by seeds, and is a prolific seeder (Esser 1993, USDA 2002)	
Long-distance dispersal (0–3)	2
The small, hard seeds are dispersed by wind and livestock (Esser 1993, Forage Information System 2004). However, there are no particular adaptations for long-distance dispersal.	
Spread by humans (0–3)	3
Timothy is commonly grown for hay and escapes cultivation, becoming established in grasslands (Esser 1993, Rutledge and McLendon 1996, USDA 2002). It also is recommended for use in reclamation and erosion control (Elliott et al. 1987, USDA 2002).	
Allelopathic (0–2)	2
Timothy is allelopathic. Allelochemicals in the pollen reduce pollen germination of other wind-pollinated grasses (Murphy and Aarssen 1995).	

Competitive Ability (0–3)	2
Timothy has intermediate competitive abilities. It can suppress the growth of other grasses and dominate (Gasser 1968). Timothy has excellent cold tolerance and winter hardiness. It will tolerate high shade and thrives in partial shade (Esser 1993). It will tolerate flooding and high soil salinity levels (Forage Information System 2004).	
Thicket-forming/Smothering growth form (0–2)	1
This large grass can occur at high densities and shade out forbs and other grasses (I. Lapina pers. obs.).	
Germination requirements (0–3)	1
Open soil facilitates germination and establishment of timothy. Competition from other species may prevent seedlings establishment (Forages 2004).	
Other invasive species in the genus (0–3)	0
Few introduced species of *Phleum* are recorded in North America, but they are not listed as invasive (USDA 2004).	
Aquatic, wetland or riparian species (0–3)	1
Timothy can be found on roadsides, along waterways, and in dry to wet meadows (Gubanov et al. 1995, Rutledge and McLendon 1996).	
Total for Biological Characteristics and Dispersal	14/25

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
Timothy was introduced to North America for use as hay and continues to be widely used today (Rutledge and McLendon 1996, USDA 2002).	
Known level of impact in natural areas (0–6)	3
It is the most widely distributed non-native in Glacier National Park (Montana), reducing graminoid species in native fescue grasslands and moist subalpine forests. It has become established at medium to high elevations grasslands and aspen and conifer forests (Esser 1993). It can be found in aspen–spruce–fir communities, occasionally in oak–sagebrush, pinyon juniper, and mountain brush communities in Colorado (Rutledge and McLendon 1996).	
Role of anthropogenic and natural disturbance in establishment (0–5)	2
Timothy readily establishes in disturbed areas and may extend to adjacent undisturbed areas. Natural and human induced fires stimulate tilling (Esser 1993).	
Current global distribution (0–5)	5
Timothy is a native of Europe. It is now widespread in North and South America, South Africa, New Zealand, and Australia, including subarctic regions (Hultén 1968).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
It is found in all 50 states and throughout Canada (Esser 1993). It is a restricted weed seed in New Jersey and Virginia (Invader Database System 2004).	
Total for Ecological Amplitude and Distribution	**19/25**

Feasibility of Control	**Score**
Seed banks (0–3)	2
The seeds remain viable for 4–5 years in dry, cool places (Esser 1993).	
Vegetative regeneration (0–3)	2
Vegetative reproduction occurs through tilling. When plants are cut or plowed, rooting stems may develop new plants (Esser 1993).	
Level of effort required (0–4)	3
Hand pulling can be used for timothy control, and frequent cutting or mowing can weaken overall plant health (Rutledge and McLendon 1996). Timothy stands also become weak under continuous grazing (USDA 2002).	
Total for Feasibility of Control	7/10
Total score for 4 sections	54/100

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Plantago major L. common names: common plantain, broadleaf plantain

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	8
Biological Characteristics and Dispersal	25	13
Amplitude and Distribution	25	16
Feasibility of Control	10	7
Relative Maximum		44

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Special Note–Nativity: Many experts believe this taxon originated in Europe (Dempster 1993, Whitson et al. 2000) and it is now cosmopolitan in distribution. However, according to USDA Plants Database and ITIS (2003) this taxon is considered native to Alaska, Hawaii, and the continental U.S. Hultén (1968) reported a variety with upright leaves (var. *pilgeri*) as possibly native to Alaska. Hitchcock and Cronquist (1973) recognized a native variety (var. *pachyphylla* Piper) of saline habitats and introduced variety (var. *major* L.). Therefore, we treat this as a polymorphic taxon of primarily or exclusively non-native genotypes. Greater study, using molecular and morphological markers and paleoecological methods is necessary to tease apart the patterns of nativity of this species in Alaska.

Plantago major has been collected in all ecogeographic regions of Alaska (Hultén 1968, UAM 2004).

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 1

Common plantain has no perceivable effect on ecosystem process (Densmore et al. 2001). Though this plant is only found in highly disturbed environments it has potential for retarding succession after sites have been invaded.

Impact on Natural Community Structure (0–10) — 3

Common plantain establishes in a sparsely vegetated herbaceous layer, increasing the density of the layer in south-central Alaska (I. Lapina pers obs.).

Impact on Natural Community Composition (0–10) — 1

Common plantain has not been observed in undisturbed areas in Alaska, little or no impact on native populations has been observed (Densmore et al. 2001).

Impact on Higher Trophic Levels (0–10) — 3

Common plantain is an alternate host for number of viruses and fungi (MAFRI 2004, Royer and Dickinson 1999). Many insect species feed on this plant (Sagar and Harper 1964). The seeds contain a high percentage of oil and are desirable to birds (Ohio perennial and biennial weed guide 2004). It may hybridize with native species of *Plantago*.

Total for Ecological Impact — 8/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3

Common plantain reproduces by seeds and can resprout from root and root fragments. Each plant is capable of producing up to 14,000 seeds (Royer and Dickinson 1999, Rutledge and McLendon 1996, Sagar and Harper 1964).

Long-distance dispersal (0–3) — 3

The seeds are sticky when wet, causing them to adhere to soil particles, feathers, fur, skin, or vehicles (Ohio perennial and biennial weed guide 2004, Royer and Dickinson 1999, Rutledge and McLendon 1996).

Spread by humans (0–3) — 3

The plant travels widely with humans. Seeds can be spread by vehicles, contaminated topsoil, and commercial seeds (Hodkinson and Thompson 1997).

Allelopathic (0–2) — 0

Common plantain has no allelopathic effects (USDA 2002).

Competitive Ability (0–3) — 1

Common plantain is a moderate competitor if not overgrown by other vegetation (Densmore et al. 2001, Miao et al. 1991). It is known to suppress the growth of corn and oat seedlings (Manitoba Agriculture and Food 2002).

Thicket-forming/Smothering growth form (0–2) — 0

Common plantain does not form thickets. The stem is very short, leafless flowering stalks grow to 2 feet tall (Royer and Dickinson 1999). At high densities, common plantain responds by high mortality (Palmblad 1968).

Germination requirements (0–3) — 0

Common plantain is a colonizer of disturbed soil, requiring open soil for germination and establishment (Densmore et al. 2001). In experiments in Massachusetts (Miao et al. 1991) germination was significantly higher in open soil and seed germination was greatly reduced in established grass stands. Sagar and Harper (1964) report germination and establishment only on bare soil and sparse plant communities. No establishment was observed in any vegetated or sites with leaf litter.

Other invasive species in the genus (0–3) — 3

Plantago media L., *P. lanceolata* L., and *P. patagonica* Jacq. (Royer and Dickinson 1999, Whitson et al. 2000).

Aquatic, wetland or riparian species (0–3) — 0

Common plantain is common on cultivated fields, lawns, pastures, gardens, roadsides, and waste areas (Parker 1990, Royer and Dickinson 1999, Rutledge and McLendon 1996, Whitson et al. 2000).

Total for Biological Characteristics and Dispersal — 13/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 4

Common plantain is one of the most common weeds in gardens, pastures, lawns, and crop fields (MAFRI 2004, Ohio perennial and biennial weed guide 2004, Parker 1990, Royer and Dickinson 1999). A red-leaved form is occasionally grown as a cultivar (J. Riley pers. com.).

Known level of impact in natural areas (0–6) — 1

This plant appears to be having little effect on native plant communities or successional processes in Rocky Mountain National Park in Colorado (Rutledge and McLendon 1996).

Role of anthropogenic and natural disturbance in establishment (0–5)	1
Soil disturbances by animals, vehicles, and natural erosion provide suitable open areas for germination and establishment of this species (Densmore et al. 2000, Sagar and Harper 1964). This plant usually does not persist without redisturbance. In Alaska it is found primarily on sites disturbed within the last 10 years (Densmore et al. 2001, AKEPIC 2004).	
Current global distribution (0–5)	5
This taxon is generally believed to originate in Europe, but it is now cosmopolitan in distribution. Range of distribution includes arctic regions. (Dempster 1993, Hultén 1968, Sagar and Harper 1964, Whitson et al. 2000).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Common plantain has been recorded from all states of the United States. It is listed as an invasive weed in Connecticut, Washington, Manitoba, and Quebec (USDA 2002). *Plantago* species are restricted noxious weeds in Alaska (Alaska Administrative Code 1987).	
Total for Ecological Amplitude and Distribution	16/25

Feasibility of Control	**Score**
Seed banks (0–3)	3
Seeds buried in the soil remained viable for 3.5 years in Michigan (Duvel 1904). Chippendale and Milton's (1934) results suggest that viability is maintained for 50–60 years.	
Vegetative regeneration (0–3)	2
Common plantain has the ability to resprout from the crown, roots, or root fragments (Densmore et al. 2001, Rutledge and McLendon 1996).	
Level of effort required (0–4)	2
This species does not persist without repeated anthropogenic disturbance. However, multiple weeding treatments may be necessary to eliminate plants germinating from buried seeds and root fragments. It is easily controlled by herbicides (Densmore et al. 2001, Rutledge and McLendon 1996).	
Total for Feasibility of Control	7/10
Total score for 4 sections	44/100

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Poa annua L. common names: annual bluegrass

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	***Score***
Ecological Impact	40	8
Biological Characteristics and Dispersal	25	13
Amplitude and Distribution	25	18
Feasibility of Control	10	7
Relative Maximum		46

Climatic Comparison		
	Collected in Alaska regions?	***CLIMEX similarity?***
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–
Poa annua has been collected from all ecogiographic regions in Alaska (Hultén 1968).		

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	1
Annual bluegrass is a pioneer species that is often dominant and may hinder colonization by native species by reducing available nutrients in the soil surface (Bergelson 1990).	
Impact on Natural Community Structure (0–10)	3
Annual bluegrass may form dense mats and dominate, reducing the vigor of other plants (Hutchinson and Seymour 1982). Field experiments suggested that native seed germination and seedling survival is reduced in the presence of annual bluegrass litter	
Impact on Natural Community Composition (0–10)	1
Litter of annual bluegrass may inhibit other species germination reducing the number of individuals in the community (Bergelson 1990).	
Impact on Higher Trophic Levels (0–10)	3
The seeds of annual bluegrass are eaten by various species of bird. The plants are probably eaten by deer. A wide range of invertebrates feed on annual bluegrass. It forms hybrids with *P. glauca* and *P. pratensis* in Britain. (Hutchinson and Seymour 1982). Annual bluegrass is an alternate host for number of viruses (Royer and Dickinson 1999).	
Total for Ecological Impact	8/40

Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	3
Annual bluegrass reproduces primarily by seed, which is produced rapidly in the season. Seed production rate may exceed 20,000 in a season under ideal conditions (Hutchinson and Seymour 1982, Rutledge and McLendon 1996).	
Long-distance dispersal (0–3)	2
The seeds have no special adaptation for long-distance dispersal, but are likely dispersed by rain, wind, and birds. Seeds remain viable after passing through the digestive tracts of some animals such as cows, horses, and deer (Hutchinson and Seymour 1982, Rutledge and McLendon 1996).	
Spread by humans (0–3)	3
Seeds can be carried in mud on boots and vehicles. It is commonly transported as an impurity of lawn grass seed (Hodkinson and Thompson 1997, Hutchinson and Seymour 1982, Rutledge and McLendon 1996, Whitson et al. 2000).	
Allelopathic (0–2)	0
Annual bluegrass is not allelophathic (USDA 2002).	

Competitive Ability (0–3)	1
Annual bluegrass readily invades any available space. However, it generally does not compete strongly with established plants (Hutchinson and Seymour 1982, McNeilly 1981, Rutledge and McLendon 1996). Annual bluegrass is a very adaptable species. It has been found in a variety of climatic conditions. It tolerates trampling, mowing, and poorly aerated soils. It can grow and produce seeds almost all seasons, and several generations may succeed one another in a single year	
Thicket-forming/Smothering growth form (0–2)	0
Since much of the seeds falls near the parent plant, it often forms continuous patches (Hutchinson and Seymour 1982, Royer and Dickinson 1999). However, the plants are very small and easily overtopped by other grasses and forbs.	
Germination requirements (0–3)	1
Annual bluegrass is found in open habitats. It can grow in closed turf in lawns and pastures if trampling or other disturbance is severe (Hutchinson and Seymour 1982).	
Other invasive species in the genus (0–3)	3
Poa pratensis L., *P. compressa* L., and *P. trivialis* L. (Hultén 1968, Royer and Dickinson 1999, Whitson et al. 2000).	
Aquatic, wetland or riparian species (0–3)	0
Annual bluegrass usually inhabits lawns, gardens, cultivated fields, pastures, roadsides, and other open areas (Hutchinson and Seymour 1982).	
Total for Biological Characteristics and Dispersal	13/25

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	2
Annual bluegrass is one of the most common weeds of cultivated land. It also is a weed of lawns, gardens, and golf courses (Hutchinson and Seymour 1982, Royer and Dickinson 1999, Whitson et al. 2000).	
Known level of impact in natural areas (0–6)	3
Annual bluegrass has been recorded in sagebrush, oak–maple, aspen–fir, lodgepole pine, and meadow communities in Colorado (Ruttledge and McLendon 1996).	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
Annual bluegrass persists on sites that are kept open by trampling of livestock or by human activity (Hutchinson and Seymour 1982). This taxon readily establishes along introduced mineral substrates in south-central and southeast Alaska (M.L. Carlson and I. Lapina pers. obs.).	
Current global distribution (0–5)	5
Annual bluegrass is a native of Europe but is now distributed worldwide. It was introduced to North Africa, Mexico, Central and South America, New Zealand, Australia. It also is found above the Arctic Circle (Hultén 1968, Hutchinson and Seymour 1982).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Annual bluegrass has been found in nearly all states of the United States (USDA 2002). It is declared a noxious weed in Alaska, Connecticut, Kentucky, Massachusetts, New Jersey, New York, Texas, and Virginia (Alaska Administrative Code 1987, Invaders Database System 2003).	
Total for Ecological Amplitude and Distribution	18/25

Feasibility of Control	**Score**
Seed banks (0–3)	3
The longevity of seeds varies from about a year to about 6 years (Chippendale and Milton 1934, Hutchinson and Seymour 1982, Roberts and Feast 1973).	
Vegetative regeneration (0–3)	2
Annual bluegrass can resprout after cutting or grazing (Hutchinson and Seymour 1982).	
Level of effort required (0–4)	2
Manual control of annual bluegrass is very expensive and inefficient. A number of herbicides are available, but they are not specific to this species (Rutledge and McLendon 1996).	
Total for Feasibility of Control	7/10
Total score for 4 sections	46/100

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Poa compressa L. common names: Canada bluegrass

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	6
Biological Characteristics and Dispersal	25	10
Amplitude and Distribution	25	17
Feasibility of Control	7	5
Relative Maximum		39

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Poa compressa is documented in all ecogeorgaphic regions in Alaska (Hultén 1968, UAM 2004, AKEPIC 2005).

Ecological Impact **Score**

Impact on Ecosystem Processes (0–10) 1
Canada bluegrass is generally restricted to non-native communities and likely has little impact on native plant communities and ecological processes (I. Lapina pers. obs., Rutledge and McLendon 1996).

Impact on Natural Community Structure (0–10) 1
Canada bluegrass occurs in sparse stands and likely does not alter the density of the layer (I. Lapina pers. obs., Sather 1996).

Impact on Natural Community Composition (0–10) 1
In Alaska, Canada bluegrass is restricted to non-native communities and it does not seem to be changing species composition (I. Lapina pers. obs.).

Impact on Higher Trophic Levels (0–10) 3
Canada bluegrass is grazed by livestock and wildlife species (Gubanov et al. 2003, Dore and McNeill 1980). Canada bluegrass hybridizes with Kentucky bluegrass (Dale et al. 1975).

Total for Ecological Impact 6/40

Biological Characteristics and Dispersal **Score**

Mode of Reproduction (0–3) 2
Canada bluegrass reproduces by both seeds and rhizomes (Rutledge and McLendon 1973). In Alaska, it does not seem to be reproducing aggressively.

Long-distance dispersal (0–3) 2
Cattle and deer seem to carry the seeds widely (Dore and McNeill 1980). However, the grass does not have any specific adaptations for long-distance dispersal.

Spread by humans (0–3) 3
Canada bluegrass is used as a pasture grass and for erosion control (Rutledge and McLendon 1996, Hitchock and Cronquist 1973). It is also a common seed contaminant (USDA, ARS 2005).

Allelopathic (0–2) 0
This species is not listed as allelophathic (USDA 2002).

Competitive Ability (0–3) 0
Canada bluegrass appears to be a poor competitor with other exotic plants (Turkington 1994). In experiments by Turkington (1994) Canada bluegrass was the poorest invader and it was less resistant to invasion by other species. Invasive potential and resistance to invasion by other species decreases with the age of the Canada bluegrass stand. Canada bluegrass is also less adapted to grazing pressures (Sather 1996, Turkington 1994).

Thicket-forming/Smothering growth form (0–2) 0
Canada bluegrass does not form dense stands, and it does not possess climbing or smothering growth habit (Welsh 1974, Hultén 1968).

Germination requirements (0–3) 0
Canada bluegrass geminates better on bare soil (Turkington 1994). It does not appear capable of germinating in areas where plants are already established.

Other invasive species in the genus (0–3) 3
Poa annua L., *P. pratensis* L., and *P. trivialis* L. (USDA 2002, Whitson et al. 2000, Royer and Dickinson 1999, Hultén 1968).

Aquatic, wetland or riparian species (0–3) 0
Canada bluegrass is a weed of waste places, roadsides, and yards (Gubanov et al. 2003, Hultén 1968).

Total for Biological Characteristics and Dispersal 10/25

Ecological Amplitude and Distribution **Score**

Highly domesticated or a weed of agriculture (0–4) 4
Canada bluegrass is used as a pasture grass and for erosion control (Rutledge and McLendon 1996, Hitchock and Cronquist 1973). However, it is not used as widely as Kentucky bluegrass (USDA 2002).

Known level of impact in natural areas (0–6) 3
Canada bluegrass is known to cause little impact on native plant communities and successional processes in Rocky Mountain National Park, Colorado (Rutledge and McLendon 1996).

Role of anthropogenic and natural disturbance in establishment (0–5) 0
Canada bluegrass is much more capable of colonizing bare ground (Turkington 1994).

Current global distribution (0–5) 5
Canada bluegrass is native to Europe, Western Asia, and Northern Africa (USDA, ARS 2005). It is introduced to North and South America, New Zealand, and Eastern Asia (Gubanov et al. 2003, Hultén 1968).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) 5
Canada bluegrass is found in nearly all American states and Canadian provinces. This species is listed as an invasive weed in Connecticut (USDA 2002).

Total for Ecological Amplitude and Distribution 17/25

Feasibility of Control **Score**

Seed banks (0–3) U
Unknown

Vegetative regeneration (0–3) 2
Burning or grazing may result in increased resprouting (Rutledge and McLendon 1996).

Level of effort required (0–4) 3
Chemical methods and burning might be useful. Practices that will damage bluegrass may often harm the native species more (Butterfield et al. 1996, Sather 1996).

Total for Feasibility of Control 5/7

Total score for 4 sections 38/97

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Poa pratensis ssp. *pratensis* L. — common names: Kentucky bluegrass
Poa pratensis ssp. *irrigata* (Lindm.) Lindb. f. — spreading bluegrass
Poa trivialis L. — rough bluegrass

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	12
Biological Characteristics and Dispersal	25	14
Amplitude and Distribution	25	19
Feasibility of Control	10	7
Relative Maximum		52

Climatic Comparison

	Poa pratensis ssp. Pratensis Collected	*Poa pratensis ssp. Irrigate Collected*	*Poa trivialis Collected*	*CLIMEX similarity?*
South Coastal	Yes	Yes	Yes	–
Interior Boreal	Yes	Yes	No	Yes
Arctic Alpine	Yes	Yes	No	Yes

Rough bluegrass (*Poa trivialis*): The CLIMEX matching program indicates the climatic similarity between Fairbanks and areas where rough bluegrass is documented is high. Rough bluegrass is well established in Omsk, Tobolsk, and Tomsk, Russia (Malyschev and Peschkova 1990), which has 77%, 70% and 68% climatic matches with Fairbanks, respectively. *Poa trivialis* is documented in arctic areas of Ust-Tsilma and Arkhangelsk, Russia (Tolmachev et al. 1995), which have 78% and 76% of climate similarity with Nome, respectively. The establishment of rough bluegrass in interior boreal and arctic alpine ecogeographic regions of Alaska may be possible.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 3

Kentucky, spreading, and rough bluegrasses have the potential for long-term modification or retardation of succession (Butterfield et al. 1996). In Alaska these grasses are restricted to non-native communities (J. Conn pers. com.). Rough bluegrass likely increases soil–water content in sod (Glenn and Welker 1996).

Impact on Natural Community Structure (0–10) — 3

Poa pratensis is capable of creating uniform, dense mats, greatly increasing the density of lower herbaceous layers (Weaver and Darland 1948). *Poa trivialis* rarely occurs in pure stands, but is capable of changing the density of the layer (Uchytil 1993).

Impact on Natural Community Composition (0–10) — 3

Kentucky and rough bluegrass have the ability to dominate communities, replace prairie plant species, reducing species diversity, and altering the natural floristic composition (Marriott et al. 2003, Wisconsin DNR 2003, Rutledge and McLendon 1996, Sather 1996). However, these species are not observed in undisturbed areas in Alaska, and negative effects are likely minimal (J. Conn pers. com.).

Impact on Higher Trophic Levels (0–10) — 3

Bluegrasses can be an important part of the diets of elk, deer, and sheep (Rutledge and McLendon 1996). The leaves and seeds are eaten by numerous species of small mammals and birds. Kentucky-bluegrass-dominated grassland provide habitat for species of small mammals and birds. It naturally hybridizes with several other native and exotic bluegrasses (Uchytil 1993, Dale et al. 1975). It is a host for number of pest insects and diseases (Butterfield et al. 1996, Uchytil 1993).

Total for Ecological Impact — 12/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3

Kentucky and spreading bluegrass reproduce from both seed and rhizomes. Kentucky bluegrass can produce 100–200 seeds per panicle in the first year, and as many as 800,000 seeds per square meter. Production of 1,000 seeds per plant of rough bluegrass has been documented (Froud-Williams and Ferris 1985). Rhizomes expand horizontal growth as much as 2 square meters in 2 years (Rutledge and McLendon 1996, Sather 1996).

Long-distance dispersal (0–3) — 1

The seeds can spread short distances in clumps (Froud-Williams and Ferris 1986), but they lack specific adaptations for long-distance dispersal.

Spread by humans (0–3) — 3

Kentucky, spreading, and rough bluegrasses are commonly planted as lawn and pastures grasses (Butterfield et. al. 1996, Liskey 1999). They are used in Alaska, Colorado, and Wisconsin for soil stabilization along highway roadbanks (Uchytil 1993). They also contaminate commercial seeds (Liskey 1999). Hodkinson and Thompson (1997) found seeds of rough and spreading bluegrass on vehicles and with topsoil and horticultural stock.

Allelopathic (0–2) — 0

These species are not listed as allelophathic (USDA 2002).

Competitive Ability (0–3) — 1

Bluegrass can outcompete native grasses and forbs and dominate on high nitrogen soils (Wisconsin DNR 2003). These grasses do not appear to be competing with native species in Alaska (J. Conn pers. com.). Bluegrass is adapted to a wide range of environmental conditions, and is marginally flood tolerant (Lenssen et al. 2004, Rutledge and McLendon 1996). It grows early in the season, when most other species are still dormant. However, because it has a shallow root system it is susceptible to high soil temperatures and low soil moisture (Wisconsin DNR 2003). In experimental conditions rough bluegrass appeared to compete strongly with ryegrass (*Lolium perenne*) during first weeks of establishment (Haggar 1979).

Thicket-forming/Smothering growth form (0–2) — 0

Bluegrass is capable of forming dense sod in highly fertile soils (Sather 1996, Uchytil 1993). In Alaska, naturalized populations of bluegrass do not form dense stands (J. Conn pers. com.).

Germination requirements (0–3)	2
Generally, Kentucky and rough bluegrass requires light and open soil for germination and establishment (Butterfield et al. 1996, Sather 1996). However, some rough bluegrass cultivars do not require open surface and are recommended for overseeding in established lawns (Liskey 1999).	
Other invasive species in the genus (0–3)	3
Poa annua L. and *P. compressa* L. (Hultén 1968, Royer and Dickinson 1999, Whitson et al. 2000).	
Aquatic, wetland or riparian species (0–3)	1
These grasses often invade wetland and riparian habitats in addition to gardens, pastures, roadways, meadows, open woodlands, and prairies (Rutledge and McLendon 1996). In its native range Kentucky and rough bluegrass inhabits swamps and marshes, wet meadows, and streambanks (Gubanov et al. 2003, Tolmachev et al. 1995, Malyschev and Peschkova 1990).	
Total for Biological Characteristics and Dispersal	14/25

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
Kentucky bluegrass and spreading bluegrass were introduced as cultivars and have since undergone selective breeding. Over 100 cultivars of Kentucky bluegrass have been developed. It is commonly planted as a lawn and pastures grass (Butterfield et. al. 1996, Wisconsin DNR 2003).	
Known level of impact in natural areas (0–6)	3
Bluegrass has successfully invaded prairies and savannas in Wisconsin and Nebraska (Weaver and Darland 1948, Wisconsin DNR 2003). It is naturalized in dry to moist meadows in Oregon and Washington, and it is a major problem species in aspen communities in central Colorado and South Dakota (Uchytil 1993).	
Role of anthropogenic and natural disturbance in establishment (0–5)	2
Bluegrasses readily establish by seeds on disturbed sites. Kentucky bluegrass increases with grazing and burning (Sather 1996, Weaver and Darland 1948).	
Current global distribution (0–5)	5
These taxa are native to Europe. They have been introduced into North and South America, New Zealand, and Australia (Gubanov et al. 2003, Hultén 1968).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Kentucky, spreading, and rough bluegrasses are found naturalized in nearly all American states and in Canada from Labrador to the west coast. *Poa pratensis* is listed as an invasive weed in Nebraska and Wisconsin. *Poa trivialis* is a restricted weed seed in New Jersey and Virginia (Invaders Database System 2003, USDA 2002).	
Total for Ecological Amplitude and Distribution	19/25

Feasibility of Control	**Score**
Seed banks (0–3)	3
A maximum of 560 *Poa pratensis* seed/m2 in soil samples from a Netherlands pastures was reported. Seeds germinate within the first 4-years after burial (Sather 1996); however, other studies indicate that the seed is no longer dormant 6 months after harvest (Butterfield et al. 1996). Chippindale and Milton (1934) stated in their study that seeds of *Poa trivialis* may remain dormant in the soil for 24, 40 and even 68 years.	
Vegetative regeneration (0–3)	1
These grasses can resprout rapidly (Rutledge and McLendon 1996).	
Level of effort required (0–4)	3
Chemical methods and burning might be useful. Practices that will damage bluegrass may often harm the native species more (Butterfield et al. 1996, Sather 1996).	
Total for Feasibility of Control	7/10
Total score for 4 sections	52/100

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Polygonum aviculare L. common names: prostrate knotweed, yard knotweed

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	7
Biological Characteristics and Dispersal	25	15
Amplitude and Distribution	25	16
Feasibility of Control	10	7
Relative Maximum		45

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Polygonum aviculare has been documented in all ecogeographic regions of Alaska (Hultén 1968, UAM 2004, AKEPIC 2005).

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 1
Although toxins from the roots and leaves of prostrate knotweed may prevent native species establishment (Alsaadawi and Rice 1982a, Klott and Boyce 1982), in Alaska this species is always associated with anthropogenic disturbances (M. Carlson pers. obs., J. Conn pers. obs.), and likely does not have a significant impact on natural ecosystem processes.

Impact on Natural Community Structure (0–10) — 0
Prostrate knotweed is capable of colonizing disturbed ground and changing the density of the layer (I. Lapina pers. obs.). No impact on the natural community structure has been documented.

Impact on Natural Community Composition (0–10) — 1
Prostrate knotweed has not been observed in undisturbed areas in Alaska (Densmore et al. 2000, I. Lapina pers. obs.). It is unlikely that measurable impacts on native community composition occur due to its presence.

Impact on Higher Trophic Levels (0–10) — 5
Prostrate knotweed is a food and habitat for many bird and small mammal species (Firbank and Smart 2002, Watson et al. 2003). Sixty-one species of insects have been observed feeding on prostrate knotweed (Marshall et al. 2003). Flowers are frequently visited by insects, particularly by bees and flies. Prostrate knotweed is a host for number of fungi, viruses, and nematode species (Townshend and Davidson 1962).

Total for Ecological Impact — 7/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3
Prostrate knotweed reproduces by seed (Costea and Tardif 2005). A single plant may produce from 125–200 to 6,400 achenes (Stevens 1932).

Long-distance dispersal (0–3) — 3
The achenes can be dispersed by birds and animals after ingestion. The seeds float and can be dispersed by irrigation water, rain, streams, and watercourses (Costea and Tardif 2005).

Spread by humans (0–3) — 3
The seeds can be easily carried on footwear, motor vehicles, or farm machinery. Seeds can also contaminate harvested crops, seeds, topsoil, and horticultural stock (Hill et al. 1999, Hodkinson and Thompson 1997). Some seeds are not damaged after passing through digestive tracts of domestic animals and birds (Costea and Tardif 2005).

Allelopathic (0–2) — 2
Several chemical compounds from living plants and residues in the soil inhibit seed germination and seedling growth of most test species in experiments (Alsaadawi and Rice 1882a, Alsaadawi and Rice 1882b, Klott and Boyce 1982). Some of the allelopathic substances have an inhibitory role over some test strains of the nitrogen-fixing bacteria *Rhizobium* and *Azotobacter* (Alsaadawi and Rice 1982, Alsaadawi et al 1983).

Competitive Ability (0–3) — 1
Prostrate knotweed is more competitive than many other weed species (Alsaadawi and Rice 1982a, Alsaadawi and Rice 1982b). This species possesses extreme endurance and adaptability, multiple possibilities of seed dispersal, a persistent seed bank, high genetic polymorphism, and has allelopathic properties. Prostrate knotweed inhibits germination and growth of *Chenopodium album*, *Polygonum persicaria*, *Stellaria media*, and some other weeds (Alsaadawi and Rice 1982a, Alsaadawi and Rice 1982b).

Thicket-forming/Smothering growth form (0–2) — 0
Prostrate knotweed does not possess a climbing or smothering growth habit (Welsh 1974, Whitson et al. 2000).

Germination requirements (0–3) — 0
Prostrate knotweed requires open soil and disturbance to germinate (Densmore et al. 2000).

Other invasive species in the genus (0–3) — 3
Polygonum cuspidatum Sieb. & Zucc., *P. perfoliatum* L., *P. polystachyum* Wallich ex Meisn., and *P. sachalinense* F. Schmidt ex Maxim. are declared noxious in a number of American states (USDA, NRSC 2006). Also *Polygonum arenastrum* Jord. ex Boreau, *P. caespitosum* Blume, *P. convolvulus* L., P. orientale L., *P. persicaria* L., and *P. lapathifolium* L. are listed as a weeds in the PLANTS Database (USDA, NRSC 2006). A number of native to North America *Polygonum* species have a weedy habit and are listed as noxious weeds in some of the American states. Although some of the latest taxonomic treatments considers these species as members of three different genus: *Polygonum*, *Fallopia*, and *Persicaria* (FNA 1993+), they are closely related taxa and can be considered as congeneric weeds.

Aquatic, wetland or riparian species (0–3) — 0
Prostrate knotweed is one of the most common weeds along roadsides, sidewalks and paved areas. It also occurs in gardens and cultivated fields (Alex and Switzer 1976, Welsh 1974).

Total for Biological Characteristics and Dispersal — 15/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 4
Prostrate knotweed is a weed of roadsides and waste areas. It also occurs in gardens and cultivated fields (Alex and Switzer 1976).

Known level of impact in natural areas (0–6) — 0
Prostrate knotweed is a plant of disturbed areas. No records on the ecological impact of prostrate knotweed in natural areas were found.

Role of anthropogenic and natural disturbance in establishment (0–5)	2
Prostrate knotweed colonizes disturbed ground. Plants may appear on sites that have been redisturbed several decades after the last human disturbance (Densmore et al. 2000). Prostrate knotweed was dominant on patches of soil disturbed by animals in a study in Germany (Milton et al. 1997).	
Current global distribution (0–5)	5
Prostrate knotweed is one of the most widespread weeds in Europe and Asia. It has been introduced into Central and South Africa, South and North America, Australia, and New Zealand. It has been recorded in Alaska, including arctic regions (Gubanov et al. 2003, Hultén 1968).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Prostrate knotweed is found in nearly all American states and Canadian provinces (USDA, NRCS 2006). *Polygonum aviculare* is listed as a noxious weed in Quebec (Rice 2006).	
Total for Ecological Amplitude and Distribution	**16/25**

Feasibility of Control	**Score**
Seed banks (0–3)	3
Chepil (1946) found that although a significant proportion of prostrate knotweed seeds germinate in the year after they were produced, a smaller number of seedlings emerged 3–5 years after sowing. Two out of 1,000 seeds sown, emerged after 5 years. Viability of seeds was 7% after 4.7 years, and <1% after 9.7 years in seed viability experiment conducted in Fairbanks (Conn and Deck 1995). The number of years of seed viability was estimated to be 9 on a site with loam soil, and 20 on a site with clay soil (Lutman et al. 2002).	
Vegetative regeneration (0–3)	2
Plants have the capacity to regenerate from axillary buds if the apex is removed (Costea and Tardif 2005).	
Level of effort required (0–4)	2
Mechanical methods used for the control of prostrate knotweed are usually not efficient alone and are more effective in combination with chemical treatments. Several insect species have been suggested as a potential biocontrol agent for this weed (Costea and Tardif 2005).	
Total for Feasibility of Control	**7/10**
Total score for 4 sections	**45/100**

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Polygonum convolvulus L. (*Fallopia convolvulus* (Linnaeus) Á. Löve) common names: black bindweed

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	12
Biological Characteristics and Dispersal	25	16
Amplitude and Distribution	25	17
Feasibility of Control	10	5
Relative Maximum		**50**

Climatic Comparison		
	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Polygonum convolvulus has been documented in all ecogeographic regions of Alaska (Hultén 1968, Welsh 1974, UAM 2004, AKEPIC 2005).

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	3
Black bindweed quickly covers bare soil (Hume et al. 1983, Rutledge and McLendon 1996). It may prevent native species from establishing.	
Impact on Natural Community Structure (0–10)	3
Black bindweed is able to create a dense canopy, covering herbaceous plants (Friesen and Shebeski 1960, Royer and Dickinson 1999). However, dense stands of black bindweed have not been observed in native communities in Alaska (J. Conn pers. obs.).	
Impact on Natural Community Composition (0–10)	3
Black bindweed is a strong competitor (Fabricius and Nalewaja 1968, Friesen and Shebeski 1960, Pavlychenko and Harrington 1934, Welbank 1963) and it likely reduces the number of individuals in native species community.	
Impact on Higher Trophic Levels (0–10)	3
The seeds and leaves of black bindweed are important foods for granivorous birds (Wilson et al. 1999). It also is an alternate host for number of fungi, viruses, and nematode species (Cooper and Harrison 1973, Royer and Dickinson 1999, Townshend and Davidson 1962)	
Total for Ecological Impact	**12/40**

Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	3
Black bindweed reproduces by seed only. A single plant is capable of producing up to 11,900 to even 30,000 seeds (Stevens 1932, Forsberg and Best 1964).	
Long-distance dispersal (0–3)	1
The seeds have no adaptation for long-distance dispersal, but apparently they can be transported by water (Hume et al. 1983, Rutledge and McLendon 1996).	
Spread by humans (0–3)	2
The seeds of black bindweed are commonly dispersed by farm machinery. It also is a frequent cereal crop contaminant (Gooch 1963, Rutledge and McLendon 1996, J. Conn pers. obs.). Black bindweed seeds remain viable after digestion by ruminants, therefore, may be transported by animals (Blackshaw and Rode 1991).	
Allelopathic (0–2)	0
Black bindweed is not known to be allelopathic.	

Competitive Ability (0–3)	2
Black bindweed is able to compete with cultivated crops and other weeds for moisture, nutrients, and light (Friesen and Shebeski 1960, Welbank 1963, Fabricius and Nalewaja 1968, Royer and Dickinson 1999). In experimental studies black bindweed appears to be a stronger competitor than *Chenopodium album*, *Polygonum aviculare*, *P. persicaria*, *Stellaria media*, and *Capsella bursa-pastoris* (Pavlychenko and Harrington 1934, Welbank 1963).	
Thicket-forming/Smothering growth form (0–2)	2
Black bindweed climbs and smothers other plants and can form dense thickets (Rutledge and McLendon 1996). A density of 56–215 plants per m^2 has been observed in a number of studies (Friesen and Shebeski 1960)	
Germination requirements (0–3)	2
The germination of black bindweed seeds is greater on disturbed sites. The disturbance of soils apparently reactivates dormant seeds (Milton et al. 1997). However, germination in undisturbed soil was also recorded (Roberts and Feast 1973).	
Other invasive species in the genus (0–3)	3
Polygonum cuspidatum Sieb. & Zucc., *P. perfoliatum* L., *P. polystachyum* Wallich ex Meisn., and *P. sachalinense* F. Schmidt ex Maxim. are declared noxious weeds in a number of American states (USDA, NRSC 2006). Also *Polygonum arenastrum* Jord. ex Boreau, *P. caespitosum* Blume, *P. aviculare* L., *P. orientale* L., *P. persicaria* L., and *P. lapathifolium* L. are listed as a weeds in PLANTS Database (USDA, NRSC 2006). A number of *Polygonum* species native to North America have a weedy habit and are listed as noxious weeds in some of the American states. Although some of the recent taxonomic treatments considers these as a species of three different genera: *Polygonum*, *Fallopia*, and *Persicaria* (FNA 1993+), they are closely related taxa and can be considered as congeneric weeds.	
Aquatic, wetland or riparian species (0–3)	1
Black bindweed is a common weed in cultivated fields, gardens, roadsides, and waste areas. It may be occasionally found on river gravel bars (Hume et al. 1983).	
Total for Biological Characteristics and Dispersal	16/24

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
Black bindweed is a serious weed in crops (Friesen and Shabeski 1960, Forsberg and Best 1964).	
Known level of impact in natural areas (0–6)	1
Black bindweed has invaded natural communities in Rocky Mountain National Park (J. Conn pers. obs.).	
Role of anthropogenic and natural disturbance in establishment (0–5)	2
Black bindweed readily established on cultivated fields and disturbed grounds (Royer and Dickinson 1999, Welsh 1974). However, it is recorded to establish in grasslands with small-scale animal disturbances in Germany (Milton et al. 1997).	
Current global distribution (0–5)	5
Black bindweed originated from Eurasia. It has now been introduced into Africa, South America, Australia, New Zealand, and Oceania (Hultén 1968, USDA, ARS 2003). It has been collected from arctic regions in Alaska (Hultén 1068, UAM 2006).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Black bindweed is found throughout Canada and the United States. It is declared noxious in Alaska, Alberta, Manitoba, Minnesota, Oklahoma, Quebec, and Saskatchewan (Alaska Administrative Code 1987, Rice 2006, Royer and Dickinson 1999).	
Total for Ecological Amplitude and Distribution	17/25

Feasibility of Control	**Score**
Seed banks (0–3)	3
Most seeds of black bindweed germinate in their first year (Chepil 1946). However, seeds remain viable in the soil for up to 40 years (Chippendale and Milton 1934). Viability of seeds was 5% after 4.7 years, and <1% after 9.7 years in seed viability experiment conducted in Fairbanks (Conn and Deck 1995).	
Vegetative regeneration (0–3)	0
Black bindweed does not regenerate vegetatively (Hume et al. 1983).	
Level of effort required (0–4)	2
Mechanical methods have only limited success in controlling black bindweed. A number of chemicals are recommended for control of this weed. Several pathogenic fungi have been studied as a potential biocontrol agent for this weed (Dal-Bello and Carranza 1995, Mortensen and Molloy 1993).	
Total for Feasibility of Control	5/10
Total score for 4 sections	50/100

§

Polygonum cuspidatum Sieb. & Zucc. (*Fallopia japonica* (Houtt.) R. Decr.) *Polygonum sachalinense* F. Schmidt ex Maxim. (*Fallopia sachalinensis* (F. Schmidt ex Maxim.) R. Decr.) *Polygonum* ×*bohemicum* (J. Chrtek & Chrtkovß [cuspidatum × sachalinense]) Zika & Jacobson (*Fallopia* ×*bohemica* (Chrtek & Chrtková) J.P. Bailey)

Common name: Japanese knotweed, Japanese bamboo giant knotweed Bohemian knotweed

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	33
Biological Characteristics and Dispersal	25	21
Amplitude and Distribution	25	23
Feasibility of Control	7	7
Relative Maximum		87

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	No

Japanese knotweed has been collected from Sitka, Anchorage, Juneau, and Port Alexander (Densmore et al. 2001, UAM 2003). Using the CLIMEX matching program, climatic similarity between Nome and areas where the species is documented is modest. It does occur in gardens within Anchorage (UAM 2003), which has 61% climatic match with Nome. However, this species ranges only as far north as Nova Scotia and Newfoundland in Canada and is restricted to regions of high precipitation in the UK (Seiger 1991). In northern Europe it is restricted to areas with greater than 120 frost-free days (Beerling et al. 1994). Nome has 80 frost-free days. This information suggests that establishment in the arctic alpine ecoregion of Alaska is unlikely and establishment in the interior boreal region may only be possible under garden conditions.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 7

Japanese knotweed increases the risk of soil erosion following removal of stands. The dead stems and leaf litter decompose very slowly and form a deep organic layer which prevents native seeds from germinating, altering the natural succession of native plant species (Japanese Knotweed Alliance 2004, Seiger 1991). During dormancy, dried stalks can create a fire hazard (Ahrens 1975).

Impact on Natural Community Structure (0–10) — 10

Japanese knotweed forms an extremely dense mid-canopy layer as a single-species stand, and eliminates plants below by shading out native vegetation (Seiger 1991, Beerling et al. 1994, Maine Natural Areas Program 2004).

Impact on Natural Community Composition (0–10) — 9

Japanese knotweed prevents native seeds from germinating, and hinders the natural succession of native herbs, shrubs, and trees. It reduces species diversity (Seiger 1991, Beerling et al. 1994).

Impact on Higher Trophic Levels (0–10) — 7

Japanese knotweed clogs waterways and lowers the quality of habitat for wildlife and fish. It reduces the food supply for juvenile salmon in the spring (Seiger 1991). It reduces the diversity of phytophagous insects (Beerling & Dawah 1993). Hybridizes with the introduced *Polygonum sachalinense*.

Total for Ecological Impact — 33/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3

Reproduction is primarily vegetative [rhizomes and stem tissue] (Japanese Knotweed Alliance 2004). Plants can produce abundant seed. But a large proportion is nonviable when fertile male plants are rare or absent (Conolly 1977). Densmore et al. (2001) observed, however, that the *P. cuspidatum* in Sitka National Historical Park appears to have established from seed.

Long-distance dispersal (0–3) — 2

The fragments of plants are easily washed downstream where they can resprout. There are also documented occurrences of spread across sea water (Beerling et al. 1994). Fruits maintain a winged perianth and have an abscission zone on the pedicle suggesting adaptation for wind dispersal (Beerling et al. 1994).

Spread by humans (0–3) — 3

Japanese knotweed has been planted as an ornamental in southeast Alaska and in Anchorage and escapes from gardens. Transportation of soil containing rhizome fragments is likely to occur frequently (Seiger 1991, Densmore et al. 2001).

Allelopathic (0–2) — 0

Unknown. No records of allelopathy were found. Biochemical studies indicate it possesses antibacterial and antifungial properties, but no mention of allelopathic effects (Beerling et al. 1994)

Competitive Ability (0–3) — 3

Japanese knotweed effectively competes for light by emerging early in the spring and using its extensive rhizomatous reserves to quickly attain a height of 2–3 meters (Densmore et al. 2001, Seiger 1991).

Thicket-forming/Smothering growth form (0–2) — 2

It forms very dense thickets that are generally taller (4–9 feet) than the surrounding herbaceous and shrubby vegetation (Densmore et al. 2001, Seiger 1991, Whitson et al. 2000).

Germination requirements (0–3) — 2

Japanese knotweed can germinate in vegetated areas. The seeds require chilling to break dormancy (Beerling et al. 1994, Densmore et al. 2001).

Other invasive species in the genus (0–3)	3
Polygonum perfoliatum L., *P. polystachyum* Wallich ex Meisn., and *P. sachalinense* F. Schmidt ex Maxim. are declared noxious in a number of American states (Rice 2006, USDA, NRSC 2006). Also *Polygonum arenastrum* Jord. ex Boreau, *P. caespitosum* Blume, *P. convolvulus* L., *P. persicaria* L., *P. lapathifolium* L., *P. orientale* L., and *P. aviculare* L. are listed as a weeds in the PLANTS Database (USDA, NRSC 2006). A number of *Polygonum* species native to North America have a weedy habit and are listed as noxious weeds in some American states. Although the latest taxonomy considers these species as members of three different genus: *Polygonum*, *Fallopia*, and *Persicaria* (FNA 1993+), they are closely related taxa and can be considered as congeneric weeds.	
Aquatic, wetland or riparian species (0–3)	3
Japanese knotweed often is found near water sources, such as along streams and rivers, in waste places, utility rights-of-way, neglected gardens, and around old homesites (Beerling et al. 1994, Densmore et al. 2001, Seiger 1991).	
Total for Biological Characteristics and Dispersal	**21/25**

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
Japanese knotweed has been planted as ornamental (Densmore et al. 2001, Seiger 1991).	
Known level of impact in natural areas (0–6)	6
Japanese knotweed has invaded rivers bars in Sitka National Historical Park (Densmore et al. 2001) and has established additional infestations in the Tongass National Forest (Stensvold 2000). Large stands have been found along the riverbanks in Pennsylvania and Ohio (Seiger 1991).	
Role of anthropogenic and natural disturbance in establishment (0–5)	5
Japanese knotweed can establish in native habitats (Stensvold 2000, Shaw and Seiger 2002).	
Current global distribution (0–5)	3
Japanese knotweed is native of Japan, Northern China, Taiwan, and Korea. It is now a serious introduced pest in Europe, the United Kingdom, North America, and New Zealand. It is widely distributed in North America (found in at least 42 states and most Canadian provinces) (Seiger 1991, Shaw and Seiger 2002).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Japanese knotweed is noxious in California (List B), Oregon (List B), and Washington (List C) (Rice 2006, USDA, NRCS 2006).	
Total for Ecological Amplitude and Distribution	**23/25**

Feasibility of Control	**Score**
Seed banks (0–3)	U
Unknown. Hybrid seeds of *P. x bohemica*, stored at room temperature, retained viability for 4 years (Beerling et al. 1994).	
Vegetative regeneration (0–3)	3
Japanese knotweed is capable of regeneration from very small fragments of rhizome (as little as 0.7 grams) (Seiger 1991, Shaw and Seiger 2002).	
Level of effort required (0–4)	4
Japanese knotweed is extremely difficult and expensive to control (Child and Wade 2000, Seiger 1991, Shaw and Seiger 2002).	
Total for Feasibility of Control	**7/7**
Total score for 4 sections	**84/97**

§

Potentilla recta L. common names: sulphur cinquefoil

Ranking Summary

Ecoregion known or expected to occur in

South Coastal		Yes
Interior Boreal		Yes*
Arctic Alpine		No

* Southern portion of interior boreal region (see climate comparison below).

	Potential Max.	*Score*
Ecological Impact	40	20
Biological Characteristics and Dispersal	25	13
Amplitude and Distribution	25	17
Feasibility of Control	10	7
Relative Maximum		57

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	No	Yes
Interior Boreal	No	No
Arctic Alpine	No	No

Potentilla recta has not been collected in Alaska (Hultén 1968, Welsh 1974, AKEPIC 2004, UAM 2004). The climatic similarity between Fairbanks and Nome and areas where the species is documented is low (CLIMEX 1999, Gubanov et al. 2003, Lid and Lid 1994). Thus establishment in interior boreal and arctic alpine ecogeographic regions is unlikely. However, sulphur cinquefoil is known to invade grasslands in Montana (Rice 1991) where the climatic similarity between Anchorage (southern interior boreal ecoregion) and Harve and Kalispell, Montana is 66% and 64% respectively. Climatic similarity between Juneau and areas where the species is documented is high. The native range of *Potentilla recta* includes Bergen, Norway, which has 73% of climatic similarity with Juneau. Thus establishment in the south coastal and the southern part of interior boreal ecogeographic region may be possible.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 3

Natural successional processes may become altered in plant communities thoroughly infested by sulphur cinquefoil (Endress and Parks 2004, Powell 1996). As a pioneer species, it likely binds disturbed soil and prevents erosion (Werner and Soule 1976).

Impact on Natural Community Structure (0–10) — 3

Sulphur cinquefoil is capable of changing the density of the vegetative layer.

Impact on Natural Community Composition (0–10) — 7

Severe infestations of sulphur cinquefoil often decrease the native plant diversity and may compromise the reproductive success and abundance of the co-occurring native cinquefoils (Endress and Parks 2004). Sulphur cinquefoil typically produces more flowers than native *Potentilla* species; therefore, may attract more insect pollinators, causing reduced reproductive success of co-occurring native cinquefoils (Endress and Parks 2004).

Impact on Higher Trophic Levels (0–10) — 7

Although elk and deer have been observed browsing on sulphur cinquefoil, high tannin levels make this plant unpalatable to most wildlife (Endress and Parks 2004, Kadrmas and Johnsoon 2004, Werner and Soule 1976). A great number of phytophagous and pollinating insect species are associated with sulphur cinquefoil (Batra 1979, Powell 1996). *Potentilla* species do not readily hybridize (Acharya Goswami and Matfield 1975).

Total for Ecological Impact — 20/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3

Sulphur cinquefoil reproduces exclusively by seed. A single plant can produce approximately 1,650 seeds. At a population density of 2.7 plants per m^2 about 4,400 seeds per m^2 may be produced each year. (Endress and Parks 2004, Werner and Soule 2004).

Long-distance dispersal (0–3) — 2

Most seeds fall passively to the ground; however, longer distance seed dispersal can occur by attachment to, and consumption or movement by birds, small mammals, and grazing animals. Seeds can also be dispersed longer distances by wind or in melting snow and surface flows (Endress and Parks 2004, Powell 1996, Werner and Soule 2004).

Spread by humans (0–3) — 3

Seeds can be dispersed by attachment to clothes, boots, vehicles, and earth-moving equipment (Endress and Parks 2004), or in soil, hay and bedding for animals, and as plants collected for floral arrangement (Powell 1996).

Allelopathic (0–2) — 0

The species is not known to be allelopathic (Powell 1996, Werner and Soule 1976).

Competitive Ability (0–3) — 3

Sulphur cinquefoil is very competitive. It can displace native species in grasslands and forest habitats (Endress and Parks 2004) and has been shown to outcompete and displace invasive species such as yellow starthistle (*Centaurea solstitialis* L.), spotted knapweed (*Centaurea biebersteinii* DC), and leafy spurge (*Euphorbia esula* L.) on several sites in Montana, Nevada, Oregon, and British Columbia. Sulphur cinquefoil is not known to persist under a 100% canopy cover of other vegetation (Kadrmas and Johnson 2004, Powell 1996, Zouhar 2003).

Thicket-forming/Smothering growth form (0–2) — 0

Sulphur cinquefoil does not form dense thickets and does not have a climbing growth habit (Pojar 1999, Whitson et al. 2000).

Germination requirements (0–3) — 2

Sulphur cinquefoil germinates and establishes better in abandoned agricultural fields and other disturbed areas (Endress and Parks 2004, Kadrmas and Johnson 2004). Seedling mortality was high in sites with established vegetation in Montana grasslands (Peter 2002 cited in Zouhar 2003).

Other invasive species in the genus (0–3) — 0

There are a number of introduced *Potentilla* species in North America, but none are listed as weeds (USDA 2002).

Aquatic, wetland or riparian species (0–3) — 0

Sulphur cinquefoil is found in disturbed open ground, waste places, roadsides, pastures, and overgrazed grasslands (Endress and Parks 2004, Pojar 1999, Powell 1996) but it may also colonize undisturbed forest, shrub, and grassland communities (Endress and Parks 2004, Whitson et al. 2000). Soil moisture conditions where it grows range from dry to moist.

Total for Biological Characteristics and Dispersal — 13/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 2

Sulphur cinquefoil often impacts cultivated strawberry fields but is not a serious agricultural weed (Werner and Soule 1976, WS-NWCB 2005).

Known level of impact in natural areas (0–6)	4
Sulphur cinquefoil is known to invade and alter grasslands, shrublands, and open forest communities in Michigan, Minnesota, Montana, Idaho, Nevada, and eastern Oregon and Washington (Beckwith 1954, Gross and Werner 1982, Kadrmas and Johnson 2004). In British Columbia it is mainly found in early successional stages in lowland to steppe zones (Pojar 1999, Powell 1996).	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
Roadsides, abandoned agricultural fields, clearcuts, and other disturbed sites are particularly susceptible to invasion by sulphur cinquefoil (Endress and Parks 2004, Kadrmas and Johnson 2004). However, sulfur cinquefoil can also invade undisturbed natural grassland, shrubland, and open-canopy forests (Zouhar 2003).	
Current global distribution (0–5)	3
Sulphur cinquefoil is native to the eastern Mediterranean region of Eurasia and is also found in Central and Southern Europe, North America, and in the mountains of North Africa and Asia (Werner and Soule 1976). The northern latitudinal limit of sulphur cinquefoil is currently 53°N (Zouhar 2003).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Sulphur cinquefoil has spread throughout North America, and is reported in all states of the continental United States, except for Arizona, Utah, and New Mexico (USDA 2002, Werner and Soul 1976) and the 10 southernmost Canadian provinces. *Potentilla recta* is considered a weed in Colorado, Montana, Nevada, Oregon, and Washington (USDA 2002).	
Total for Ecological Amplitude and Distribution	17/25

Feasibility of Control	**Score**
Seed banks (0–3)	2
In laboratory experiment, viable seeds remained after 28 months of burial (Zouhar 2003). Baskin and Baskin (1990) suggest that seeds remain viable at least 2 years. In Montana sulphur cinquefoil seeds in the soil remain viable for at least 3–4 years (Rice 1991).	
Vegetative regeneration (0–3)	2
The plant is capable of resprouting after shoots are cut off (Powell 1996, Werner and Soule 1976).	
Level of effort required (0–4)	3
Sulphur cinquefoil is not a threat until it completely dominates an area. A combination of mechanical, chemical, and biological control methods may be necessary to eradicate or successfully contain large infestations. Chemical control is one of the most effective methods, however, the resistance of cinquefoil to some herbicides makes controlling more difficult (Endress and Parks 2004, Kadrmas and Johnson 2004, Powell 1996). Digging and tilling can be effective for small infestations; however, mowed or grazed sulphur cinquefoil can still flower and produce seeds.	
Total for Feasibility of Control	7/10
Total score for 4 sections	57/100

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Prunus padus L. common names: European bird cherry

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	31
Biological Characteristics and Dispersal	25	21
Amplitude and Distribution	25	17
Feasibility of Control	10	5
Relative Maximum		74

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	No

Prunus padus is documented from Fairbanks, Salcha River, (interior boreal ecoregion), and Baranof Island (south coastal ecoregion) (UAM 2003). It is widely planted as ornamental in Anchorage (I. Lapina pers. obs., M. Shephard pers. obs.). The range of the species includes Ust'Tsil'ma and Chirka-Kem' in Russia, and Røros, Norway (USDA, ARS 2004), which have relatively high climatic match with Nome (78%, 77%, and 76% respectively). However, it appears to reach its physiological limit around Fairbanks and Anchorage as it withstands winter temperatures to -33 °F and requires 110 frost-free days (USDA, NRCS 2006). Nome typically has 110 frost-free days, but winter temperatures reach -54 °F (WRCC 2001). It is unlikely to establish in the arctic alpine ecoregion of Alaska.

Ecological Impact — **Score**

Impact on Ecosystem Processes (0–10) — 7
European bird cherry likely reduces light, soil moisture, and nutrient availability for other species since becoming the dominant woody species in riparian habitats in Anchorage (J. Conn pers. com.). Very little is known about this species' impact on ecosystem processes.

Impact on Natural Community Structure (0–10) — 7
European bird cherry can create a tall shrub–small tree layer eliminating native willow–alder layers and all layers below (M. Shephard pers. obs.).

Impact on Natural Community Composition (0–10) — 10
European bird cherry replaces willows and other shrubs in riparian communities. It may also delay germination and growth of shade intolerant trees (M. Carlson, M. Shephard, and P. Spencer pers. obs.).

Impact on Higher Trophic Levels (0–10) — 7
European bird cherry can cause reduction of high quality willow-dominated foraging sites for moose (M. Carlson, M. Shephard pers. obs.). Six species of insect visit flowers of bird cherry (Leather 1996). Fruits are desirable to birds (Snow and Snow 1988, M. Carlson pers. obs.). Twenty-three species of phytophagous insect were found on European bird cherry in Britain (Leather 1985).

Total for Ecological Impact — 31/40

Biological Characteristics and Dispersal — **Score**

Mode of Reproduction (0–3) — 3
European bird cherry reproduces by seeds and bare roots. Also it is propagated by cuttings. This plant has very extensive seed production (USDA, NRCS 2006).

Long-distance dispersal (0–3) — 3
Fruits of European bird cherry are dispersed by birds (Snow and Snow 1988). Seeds also falls beneath the trees and may be dispersed by small mammals (Leather 1996).

Spread by humans (0–3) — 3
European bird cherry is widely planted as an ornamental in southern Alaska (Welsh 1974). Cultivars have been developed (USDA. NRCS 2006).

Allelopathic (0–2) — 0
European bird cherry is not listed as allelopathic (USDA, NRCS 2006).

Competitive Ability (0–3) — 3
In Anchorage, European bird cherry appears to be successfully competing in largely intact native habitats, with numerous seedlings being recruited (M. Shephard pers. obs.). Adult trees are drought and frost tolerant (Malyugin 1980).

Thicket-forming/Smothering growth form (0–2) — 1
This shrub or tree does not form dense thickets, but grows taller than most surrounding species (Welsh 1974).

Germination requirements (0–3) — 3
European bird cherry is found germinating well in mixed forests that were disturbed several decades ago (M. Shephard pers. com).

Other invasive species in the genus (0–3) — 3
Prunus virginiana L. and *P. serotina* Ehrh. are considered invasive in the Northeast (Rice 2006, USDA, NRCS 2006).

Aquatic, wetland or riparian species (0–3) — 2
In its native range European bird cherry inhabits wet woodland, meadows, riverbanks, and forest clearcuts (British Trees 2004, Gubanov et al. 1995). It is common along riparian areas of Anchorage.

Total for Biological Characteristics and Dispersal — 21/25

Ecological Amplitude and Distribution — **Score**

Highly domesticated or a weed of agriculture (0–4) — 4
European bird cherry has been grown for food and as an ornamental plant (USDA, ARS 2004, Welsh 1974).

Known level of impact in natural areas (0–6) — 3
There are observed impacts in riparian communities in Alaska that have been invaded by European bird cherry (M. Shephard pers. obs.). No information was found relating to impacts in habitats outside of Alaska.

Role of anthropogenic and natural disturbance in establishment (0–5) — 5
In south-central Alaska European bird cherry has established on sites that were disturbed in the last 50 years (M. Shephard pers. obs.). Grazing favors young saplings establishment (Leather 1996).

Current global distribution (0–5) — 3
European bird cherry is native to Europe, temperate Asia, and northern Africa. It is naturalized in North America (USDA, ARS 2004).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) — 2
European bird cherry occurs in Alaska, Illinois, New York, New Jersey, Pennsylvania, and Delaware (USDA, NRCS 2006). It is not considered a noxious weed in North America (Rice 2006).

Total for Ecological Amplitude and Distribution — 17/25

Feasibility of Control	Score
Seed banks (0–3)	0
The seeds of European bird cherry are viable for less than 1 year (Granström 1987).	
Vegetative regeneration (0–3)	2
European bird cherry readily resprouts after removal of aboveground growth (Heiligmann 2006). New shoots are commonly developed, especially during the early years of establishment (Leather 1996).	
Level of effort required (0–4)	3
Several control techniques can be used for control of undesirable shrubs and trees such as bird cherry. Cutting, frilling, or girdling can be used for control of bird cherry. Combination of mechanical treatments with herbicide applications is generally more effective (Heiligmann 2006).	
Total for Feasibility of Control	5/10
Total score for 4 sections	74/100

§

Ranunculus repens L. and *Ranunculus acris* L. — common names: creeping buttercup and tall buttercup

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	16
Biological Characteristics and Dispersal	23	13
Amplitude and Distribution	25	15
Feasibility of Control	10	9
Relative Maximum		54

Climatic Comparison	*Collected in Alaska regions?*	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Creeping buttercup has been reported from all ecogeographic region in Alaska (Hultén 1968). Tall buttercup has been collected in the south coastal and interior boreal ecogeographic regions in Alaska (Hultén 1968, University of Alaska Museum 2003)
The CLIMEX computer matching program indicates the climatic similarity between Nome and areas where *Ranunculus acris* is documented is moderately high. The species range includes Røros and Dombås, Norway (Lid and Lid 1994), which have a 76% and 63% climatic match with Nome, and 55% and 52% climatic match with Fairbanks, respectively. Thus establishment of *Ranunculus acris* in interior boreal and arctic alpine ecogeographic regions may be possible.

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	3
Both species of non-native buttercup readily occupy open areas and may hinder colonization by native species (Harper 1957, Lovett-Doust et al. 1990).	
Impact on Natural Community Structure (0–10)	3
Buttercup establishment may increase the density of the vegetation. In Lovett-Doust's study (1981) the density of creeping buttercup ramets was 264 per m^2 and 112 per m^2 in woodland and grassland, respectively. Sarukhan and Harper (1973) reported up to 385 ramets per m^2 in intensly grazed grassland. In Alaska creeping buttercup has been observed at covers near 100% (T. Heutte pers. obs.).	
Impact on Natural Community Composition (0–10)	3
Buttercup reduces the number of individual native plants in invaded communities (J. Heys pers. obs., C. McKee pers. obs.).	
Impact on Higher Trophic Levels (0–10)	7
The protoanemonin released in the sap of creeping and tall buttercups is poisonous and can cause death to grazing animals if consumed. Geese and other birds readily eat leaves and seeds of buttercup (Lovett-Doust et al. 1990). The flowers are visited by honeybees, butterflies, moths, bugs, and beetles for pollen or nectar (Steinbach and Gottsberger 1994). Buttercups host microorganisms and viruses, insects, and nematodes (Harper 1957, Lovett-Doust et al. 1990, Royer and Dickinson 1999). Apparently *Ranunculus acris* and *R. uncinatus* hybridize in Alaska (Welsh 1974). However, no hybrids have been recorded in Britain and Canada and experimental crosses between *Ranunculus* species have been unsuccessful (Harper 1957, Lovett-Doust et al. 1990).	
Total for Ecological Impact	16/30

Biological Characteristics and Dispersal	Score
Mode of Reproduction (0–3)	2
Creeping and tall buttercup are capable of producing up to 80 and 240 seeds per plant, respectively (Sarukhan 1974). Production of daughter ramets is the major mechanism of population increase for creeping buttercup (Lovett-Doust et al. 1990).	
Long-distance dispersal (0–3)	2
Although most seeds are dropped near the parent plant, some seeds are dispersed farther by wind, or in the dung of birds, farm animals, and small rodents (Harper 1957, Lovett-Doust et al. 1990).	
Spread by humans (0–3)	3
The seeds can be dispersed by attachment to clothes and tires. Creeping buttercup may have been introduced as an ornamental plant into North America (Lovett-Doust et al. 1990). Garden varieties have been grown and escaped from gardens in Alaska (J. Riley pers. obs.).	
Allelopathic (0–2)	U
There is an unconfirmed hypothesis that buttercups have toxic root secretions detrimental to neighboring plants (Lovett-Doust et al. 1990).	
Competitive Ability (0–3)	1
Creeping buttercup is capable of withstanding competition from tall-growing grasses (Harper 1957).	
Thicket-forming/Smothering growth form (0–2)	0
Buttercups do not form dense thickets nor are they characterized by climbing growth habit.	

Germination requirements (0–3)	0
Buttercup populations in established grasslands and woodlands are more likely to increase by vegetative spread than by germination and establishment of seedlings (Lovett-Douts 1981, Lovett-Doust et al. 1990).	
Other invasive species in the genus (0–3)	3
Ranunculus abortivus L., *R. arvensis* L., *R. bulbosus* L., and *R. sardous* Crantz are invasive in other areas of the United States (USDA 2002).	
Aquatic, wetland or riparian species (0–3)	2
Buttercups occur on disturbed soils including gardens and croplands, grasslands, woodlands, and semiaquatic communities, such as swamps, margins of ponds, rivers, and ditches. The plants are able to tolerate some salinity, therefore, are found on beaches, in salt marshes, and on the margins of tidal estuaries (Harper 1957, Lovett-Doust et al. 1990). In southeast Alaska it is a weed of wet, but not flooded sites along the road (T. Heutte pers. obs.).	
Total for Biological Characteristics and Dispersal	**13/23**

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
Creeping buttercup is a serious agricultural weed, especially in strawberry cultivation (Harper 1957, Lovett-Doust et al. 1990). It is considered a weed in 40 countries (NAPPO 2003).	
Known level of impact in natural areas (0–6)	1
Creeping and tall buttercup have become widespread in marshes, meadows, and woodlands of Montana, Ohio, and Minnesota (Ohio perennial and biennial weed guide 2005).	
Role of anthropogenic and natural disturbance in establishment (0–5)	0
Seedlings establish readily in open ground and rapidly colonize bare areas in the year following germination (Harper 1957). It is favored by regular mowing and thrives on lawn (T. Heutte pers. com.).	
Current global distribution (0–5)	5
Creeping buttercup originates in Europe and extends northward to 72°N in Norway. It is now naturalized in many temperate regions of the globe including North, Central, and South America, Asia, Africa, Australia, and New Zealand (Harper 1975, Hultén 1968, NAPPO 2003). Tall buttercup is generally distributed over Europe with its natural northern limit at 71°N in Norway. It has established in North America, South Africa, Asia, and New Zealand (Harper 1957, Hultén 1968).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Ranunculus repens and *R. acris* are very common throughout the United States (USDA 2002). Both species are considered weeds in the western United States (Whitson et al. 2000). *Ranunculus acris* is also designated as a weed in Manitoba and Quebec (Royer and Dickinson 1999).	
Total for Ecological Amplitude and Distribution	**15/25**

Feasibility of Control	**Score**
Seed banks (0–3)	3
Harper (1957) reports that creeping buttercup seeds remain viable for at least 3 years. Lewis (1973) documents a 16 year seed viability period. Viable seeds of creeping buttercup were also extracted from 68-year old soil samples (Chippindale and Milton 1934). A depression of germination rate was not observed for tall buttercup seeds stored for 4 years under laboratory conditions (Harper 1957).	
Vegetative regeneration (0–3)	3
Buttercups are able to regrow after cutting or heavy grazing (Harper 1957). Creeping buttercup readily regenerates from root fragments (Lovett-Doust et al. 1990).	
Level of effort required (0–4)	3
Herbicides are generally recommended to control buttercups. Plants may be weakened by cultivation, but parts of stolon may regenerate and cause population increase. Plowing provides ideal conditions for germination of seed, therefore, it is not recommended as an eradication technique (Harper 1957, Lovett-Doust et al. 1990). Experience of control of creeping buttercup in southeast Alaska shown that this weed is very resistant to herbicides (T. Heutte pers. com.).	
Total for Feasibility of Control	**9/10**
Total score for 4 sections	**53/98**

§

Rumex acetosella L. common names: sheep sorrel

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	12
Biological Characteristics and Dispersal	25	16
Amplitude and Distribution	25	16
Feasibility of Control	10	7
Relative Maximum		51

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Rumex acetosella is documented in all ecogeographic regions of Alaska (Hultén 1968, Welsh 1974, AKEPIC 2005, UAM 2004).

Ecological Impact **Score**

Impact on Ecosystem Processes (0–10) 3

Sheep sorrel may impede the colonization of the post-fire areas by native species. Sheep sorrel is documented as one of the common colonizer of burned areas (Hall 1955, Fonda 1974, Weaver et al. 1990).

Impact on Natural Community Structure (0–10) 3

Sheep sorrel has been observed establishing in existing layer of vegetation and increasing the density of the layer in Alaska National Parks and remote areas of the Chugach National Forest (M.L. Carlson pers. obs., I. Lapina pers. obs.).

Impact on Natural Community Composition (0–10) 3

Sheep sorrel is reported to form dense stands and displace native grasses and forbs in California (Cal-IPC 2005). However, this weed does not appear to cause a significant reduction in native species population size in Alaska.

Impact on Higher Trophic Levels (0–10) 3

Sheep sorrel contains oxalic acid, which can be poisonous to livestock; it is possible that it could be toxic to wildlife species (Cal-IPC 2005). Sheep sorrel is grazed by mule deer (Kruger and Donart 1974, Nixon et al. 1970). The seeds are rich source of food for birds (Schmidt 1936, Swenson 1985, Wilson et al. 1999).

Total for Ecological Impact 12/40

Biological Characteristics and Dispersal **Score**

Mode of Reproduction (0–3) 3

Sheep sorrel reproduces by seeds and from creeping roots and rhizomes (Kiltz 1930). Seed production per plant can vary from 250 to 1,622 seeds per season (Stevens 1932, Escarre and Thompson 1991) with estimated seed production up to 2,700 per m^2.

Long-distance dispersal (0–3) 2

The seeds are large and lack adaptation for long-distance dispersal. However, seeds can be dispersed by wind, water, and ants (Houssard and Escarre 1991).

Spread by humans (0–3) 3

The seeds of sheep sorrel can be transported on vehicles tires, agricultural equipment, with nursery stock or contaminated seeds, and hay (Gooch 1963). Seeds remain viable after passing through digestive tract of domestic birds and animals (Dorph-Peterson 1925, Evershed and Warburton 1918).

Allelopathic (0–2) 0

Sheep sorrel is not known to be allelopathic.

Competitive Ability (0–3) 1

Sheep sorrel is fairly competitive on nitrogen poor soils. Competition from other species on good soils may reduce its abundance and contain its spread (Putwain and Harper 1970). In Alaska parks units it persists only in areas where competition from other plants is reduced (Densmore et al. 2001).

Thicket-forming/Smothering growth form (0–2) 1

Seep sorrel sometimes forms dense colonies by shoots from roots and rhizomes on human-disturbed grounds. In Europe it commonly forms monocultures on post-fire sites. Dense stands in native communities have not been observed in Alaska (I. Lapina pers. obs., M.L. Carlson pers. obs.).

Germination requirements (0–3) 0

Sheep sorrel requires open soil for germination (Putwain et al. 1968). No establishment of sheep sorrel in a closed sward of vegetation was recorded in a study by Putwain et al. (1968). The number of seedlings emerged from buried seeds increased substantially on sites with open soil and removed vegetation in another experiment (Putwain and Harper 1970).

Other invasive species in the genus (0–3) 3

Rumex crispus L. is declared a noxious weed in Iowa (USDA, NRCS 2006).

Aquatic, wetland or riparian species (0–3) 3

Sheep sorrel can be found in variety of habitats including river bars, beaches (Fonda 974, Pojar and MacKinnon 1994), and fresh water and brine marshes (Fiedler and Leidy 1987).

Total for Biological Characteristics and Dispersal 16/25

Ecological Amplitude and Distribution **Score**

Highly domesticated or a weed of agriculture (0–4) 2

Sheep sorrel is a weed of fields, gardens, and pastures (Douglas and MacKinnon 1999, Welsh 1974).

Known level of impact in natural areas (0–6) 1

Sheep sorrel is known to have moderate impact on plant communities and higher trophic levels in California wildlands (Cal-IPC 2005). Sheep sorrel is found in areas disturbed in the last 10 years in Rocky Mountain National Park, Colorado, where it may inhibit the establishment of native species (Rutledge and McLendon 1996). Its impact on plant communities of Kenai Fjords National Park and Sitka National Historical Park in Alaska is considered to be low (Densmore et al. 2001).

Role of anthropogenic and natural disturbance in establishment (0–5) 3

Sheep sorrel rapidly colonizes clearcuts, burned, and flood-disturbed sites (Hall 1955, Fonda 1974, Weaver et al. 1990). Animal disturbances such as mole hills or cattle tracks can be sufficient for establishment of sheep sorrel in natural communities (Putwain et al. 1968).

Current global distribution (0–5) 5

Sheep sorrel is a forb of European origin. Today it has naturalized throughout temperate North America; it is introduced into South America, Africa, and Hawaii (Hultén 1968).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) 5

Sheep sorrel is found in nearly all American states. It is declared a noxious weed in Connecticut and Iowa (USDA, NRCS 2006).

Total for Ecological Amplitude and Distribution 16/25

Feasibility of Control	Score
Seed banks (0–3)	3
The seeds of sheep sorrel are long-lived. They remained viable for more than 6–7 years in the soil (Chippindale and Milton 1934, Steinbauer and Grigsby 1958). In a Massachusetts study sheep sorrel was not present in the ground cover of 80-year old pine stands, but viable seeds were found in soil samples. Presumably viable seeds remained buried in the soil since earlier successional stages (Livingston and Allessio 1968).	
Vegetative regeneration (0–3)	2
Sheep sorrel is able to survive severe fire and resprout from rhizomes and roots (Granström and Schimmel 1993).	
Level of effort required (0–4)	2
Control of sheep sorrel can be difficult because of its creeping rhizomes and long-lived seeds. Plants are too low to be affected by mowing or grazing. It usually survives prescribed burning. Repeated cultivation and frequent removal of resprouted plants will eventually exhaust the population. Several herbicides are available for be used in pastures and lawns; however, sheep sorrel is resistant to several herbicides (Putwain and Harper 1970). Liming the soil may help eradicate sheep sorrel (Rutledge and McLendon 1996). Densmore et al. (2001) suggested that eradication of sheep sorrel is not necessary, because it usually does not persist when shaded out by other vegetation.	
Total for Feasibility of Control	**7/10**
Total score for 4 sections	**51/100**

§

Rumex crispus L.
R. obtusifolius L.
R. longifolius DC.

common names: curly dock
bitter dock
dooryard dock

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	10
Biological Characteristics and Dispersal	25	16
Amplitude and Distribution	25	14
Feasibility of Control	10	8
Relative Maximum		**48**

Climatic Comparison

	Rumex crispus L. Collected	*Rumex obtusifolius L. Collected*	*Rumex longifolius DC. Collected*	*CLIMEX similarity?*
South Coastal	Yes	Yes	Yes	–
Interior Boreal	Yes	No	Yes	Yes
Arctic Alpine	Yes	No	Yes	Yes

Rumex crispus and *R. longifolius* are documented from all ecogeographic regions of Alaska. *Rumex obtusifolius* is known from the south coastal ecogeographic region (Hultén 1968, UAM 2004, AKEPIC 2005). *Rumex obtusifolius*: Using the CLIMEX matching program, the climatic similarity between Nome and other areas where the species is documented is fairly high. The range of the species includes Chirka-Kem' and Arkhangel'sk, Russia (Gubanov et al. 2003), which have a 77% and 76% climatic match with Nome respectively. The range of *R. obtusifolius* also includes Røros and Dombås, Norway (Lid and Lid 1994), which has 76% and 63% climatic matches with Nome and 55% and 52% climatic matches with Fairbanks, respectively. Thus establishment of *R. obtusifolius* in interior boreal and arctic alpine ecogeographic regions of Alaska may be possible.

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	1
The impact of exotic docks on ecosystem processes has not been documented. However, population densities of exotic docks in natural or seminatural habitats of Alaska are currently low enough that likely only minor ecosystem functions are affected (M.L. Carslon pers. obs.).	
Impact on Natural Community Structure (0–10)	3
Curly dock is capable of changing the density of the existing layer of vegetation (I. Lapina pers. obs.).	
Impact on Natural Community Composition (0–10)	3
Curly and bitter docks likely reduce the number of individuals in one or more native species in the community (Cal-IPC 2003).	
Impact on Higher Trophic Levels (0–10)	3
The seeds and vegetation of docks can be toxic to animals (Royer and Dickinson 1999). Bitter dock is avoided by rabbits, but it appears to be a favorite food of deer (Amphlett and Rea 1909, cited in Cavers and Harper 1964). Dock species are also an alternate host for number of viruses, fungi (Dal Bello and Carranza 1995), and nematodes (Edwards and Taylor 1963, Townshend and Davidson 1962). Hybrids between many species of the subgenus *Rumex* commonly occur. Although these hybrids are largely sterile, they can produce some viable seeds (Cavers and Harper 1964).	
Total for Ecological Impact	**10/40**

Biological Characteristics and Dispersal	Score
Mode of Reproduction (0–3)	3
Plants reproduce by seeds. The number of seeds per plant may vary from less than 100 to more than 40,000 for curly dock and more than 60,000 for bitter dock per season (Cavers and Harper 1964). Stevens (1932) reported 29,500 seeds per plant for curly dock and 23,000 seeds per plant for bitter dock. Damage plants can resprout from underground parts (Cavers and Harper 1964).	

Long-distance dispersal (0–3) 3

The seeds can be dispersed a long distance by wind and water. The spines on the seeds of bitter dock facilitate distribution on animal fur and bird feathers (DiTomaso and Healy 2003, Cavers and Harper 1967). Fruits are very lightweight and winged. The outer part of perianth may be enlarged into a tubercle which facilitates water dispersal (DiTomaso and Healy 2003). Fruits of curly dock float for 1–6 months in fresh water and for 15 months in salt water. Seeds of bitter dock remain floating in disturbed water for 24 hours (Cavers and Harper 1967).

Spread by humans (0–3) 3

Curly dock is a common contaminant of commercial seeds (Dorph-Petersen 1925, Singh 2001). The seeds can also be easily dispersed by attaching to clothing and fur of domestic animals. Seeds can also pass thought the digestive system of cattle (Cavers and Harper 1964).

Allelopathic (0–2) 0

Allelopathy has not been recorded for dock species.

Competitive Ability (0–3) 1

Seedlings of docks have low competitive ability and cannot establish in vegetated areas. However, once established, these species became difficult weeds (Cavers and Harper 1964). The results of greenhouse experiments showed that bitter dock was more competitive than *Poa trivialis* and *Lolium perenne* (Gibson and Courtney 1977).

Thicket-forming/Smothering growth form (0–2) 0

Curly dock, bitter dock, and dooryard dock have not been observed forming dense thickets in Alaska (M.L. Carlson pers. obs., I. Lapina pers. obs.).

Germination requirements (0–3) 0

Dock species require open soil and removed vegetation for successful germination and establishment (Cavers and Harper 1964). Establishment from seeds was observed only in open habitat, such as disturbed shingle beaches or on freshly cultivated field (Cavers and Harper 1964).

Other invasive species in the genus (0–3) 3

Rumex acetosella L. is invasive in Connecticut and Iowa (USDA, NRCS 2006).

Aquatic, wetland or riparian species (0–3) 3

Despite the fact that curly, bitter, and dooryard docks are common on disturbed ground, such as agricultural fields, roadsides, and waste grounds (DiTomaso and Healy 2003, Welsh 1974), these species may also invade riparian areas, including wet meadows, riverbanks, pond edges, and irrigation ditches (DiTomaso and Healy 2003, Royer and Dickinson 1999).

Total for Biological Characteristics and Dispersal 16/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) 2

Curly dock and bitter dock are serious agricultural weeds in many countries (Cavers and Harper 1964, Royer and Dickinson 1999). However, this weed is not a big agricultural problem in Alaska (J. Conn pers. com.).

Known level of impact in natural areas (0–6) 1

Curly dock is recorded invading California wetlands and causing low impact on plant communities and higher trophic levels (Cal-IPC 2003).

Role of anthropogenic and natural disturbance in establishment (0–5) 1

Curly, bitter, and dooryard dock generally colonize disturbed ground, however, it may occasionally establish in intact wetland communities (Cavers and Harper 1964, DiTomaso and Healy 2003). In Alaska these species are always associated with roadside disturbance (M.L. Carlson pers. obs.).

Current global distribution (0–5) 5

These species of docks are indigenous to Europe. They have been introduced into North and South Africa, North and South America, Asia, Australia, and New Zealand. Curly dock and bitter dock are found in arctic habitats in Norway and northern Russia (Cavers and Harper 1964, Hultén 1968).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) 5

Curly and bitter docks are distributed throughout most of the United States. Dooryard dock can be found in the northeast United States and in Alaska (USDA, NRCS 2006). *Rumex crispus* is declared noxious in Indiana, Iowa, Michigan, and Minnesota (USDA, NRCS 2006). *Rumex crispus* is a federal noxious weed in Canada (Royer and Dickinson 1999).

Total for Ecological Amplitude and Distribution 14/25

Feasibility of Control — Score

Seed banks (0–3) 3

Seeds of docks can remain viable in the soil for over 38 years (Toole 1946) and even over 80 years (Darlington and Steinbauer 1961).

Vegetative regeneration (0–3) 2

Adventitious buds on the roots and underground stems produce new shoots after aboveground damage. New shoots can produce autumn flowers very quickly (Monaco and Cumbo 1972).

Level of effort required (0–4) 3

Hand-cutting plants below the ground or herbicide application can control infestations of docks. Monitoring after treatment is required due to long-lived seed banks and the ability to regenerate from root fragments (Cavers and Harper 1964, DiTomaso and Healy 2003).

Total for Feasibility of Control 8/10

Total score for 4 sections 48/100

§

Rubus discolor Weihe & Nees common names: Himalayan blackberry

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		No
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	38
Biological Characteristics and Dispersal	25	18
Amplitude and Distribution	25	12
Feasibility of Control	10	9
Relative Maximum		77

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	No	No
Arctic Alpine	No	No

Rubus discolor has been collected in Sitka (AKEPIC 2004). The climatic similarity between Fairbanks and Nome and native and introduced locations of the species is low (CLIMEX 1999, USDA, ARS 2005). Additionally, one of the requirements for seeds germination is warm stratification at 68 ° to 86 °F for 90-days (Hoshovsky 2000); these conditions rarely occur in interior boreal and arctic alpine ecogeographic regions of Alaska (WRCC 2001). Thus establishment of *Rubus discolor* in interior boreal and arctic alpine ecogeographic regions is unlikely. Himalayan blackberry is known from the south coastal ecogeographic region of Alaska. (Additionally, the introduced range of Himalayan blackberry includes Thredbo, Australia [Australia's Virtual Herbarium 2005], which has 53% of climatic similarity with Juneau.)

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 8

Himalayan blackberry is a pioneer plant that colonizes intertidal zones in California and prevents establishment of native plants (Hoshovsky 2000, Tirmenstein 1989). Dense thickets of Himalayan blackberry are considered a fire hazard (Hoshovsky 1989, Hoshovsky 2000). Grasslands, meadows, and savannas are lost after Himalayan blackberry has invaded in the Pacific Northwest (M.L. Carlson pers. obs.).

Impact on Natural Community Structure (0–10) — 10

Himalayan blackberry forms impenetrable thickets of prickly stems, eliminating all layers below. Density of canes can reach of 525 canes per square meter. Mature thickets have large amounts of litter and standing dead canes (Hoshovsky 2000, Tirmenstein 1989).

Impact on Natural Community Composition (0–10) — 10

This species forms a dense canopy, shading out native vegetation and reducing plant species diversity (Hoshovsky 2000, Tirmenstein 1989).

Impact on Higher Trophic Levels (0–10) — 10

Himalayan blackberry can hybridizes with a number of other *Rubus* species. It provides food and cover for many wildlife species. Fruits are eaten by numerous species of birds. A large diversity of mammals feed on the berries, stems, and leaves (Tirmenstein 1989). Dense thickets can hinder large mammal movement (Hoshovsky 2000).

Total for Ecological Impact — 38/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3

Himalayan blackberry reproduces by seed and aggressive vegetative growth (rooting at cane apices, suckering of roots, and from root and shoot fragments). Up to 7,000–13,000 seeds can be produced per square meter (Hoshovsky 2000, Richardson 1975).

Long-distance dispersal (0–3) — 3

The seeds are readily dispersed by mammals and birds. Passing through digestive tracts scarifies seeds and may enhance germination (Brunner et al. 1975, Tirmenstein 1989). It can also be spread long distances by streams and rivers (Hoshovsky 2000).

Spread by humans (0–3) — 2

Himalayan blackberry is widely cultivated; it has escaped and become established (Hitchcock and Cronquist 1961).

Allelopathic (0–2) — 0

There is no record concerning allelopathy.

Competitive Ability (0–3) — 3

Himalayan blackberry is a very strong competitor. Thickets grow quickly and produce a dense canopy that shades and limits the growth of other plants (Hoshovsky 2000).

Thicket-forming/Smothering growth form (0–2) — 2

Himalayan blackberry forms very large impenetrable thickets (Hoshovsky 2000, Tirmenstein 1989).

Germination requirements (0–3) — 0

Seedlings require open habitats or eroded soils for establishment (Hoshovsky 2000). Seedlings are intolerant of shading and are easily surpassed by the rapidly growing vegetative daughter plants (Hoshovsky 2000).

Other invasive species in the genus (0–3) — 3

Rubus argutus Link, *R. ellipticus* Sm., *R. glaucus* Benth., and *R. niveus* Thunb. are considered invasive species in Hawaii (Plans of Hawaii 2003).

Aquatic, wetland or riparian species (0–3) — 2

Himalayan blackberry is common in wastelands, pastures, and clearcuts. It grows along roadsides, creek gullies, river flats, and fence lines. It is common in riparian areas, where it withstands periodic inundation by fresh or brackish water (Ertter 1993, Hoshovsky 2000).

Total for Biological Characteristics and Dispersal — 18/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 4

Himalayan blackberry is widely cultivated. It was probably introduced to North America in 1885 as a cultivated crop (Hoshovsky 2000, Tirmenstein 1989).

Known level of impact in natural areas (0–6) — 1

Himalayan blackberry is known to impact riparian woodlands and intertidal zones of central California (Hoshovsky 2000, Tirmenstein 1989). This species invades pastures and forest plantations in Victoria, Australia (Amor 1973). It can become dominant in clearcut coniferous forests in the Pacific Northwest (M.L. Carlson pers. obs.)

Role of anthropogenic and natural disturbance in establishment (0–5) — 0

Himalayan blackberry colonizes disturbed areas. The seedlings require open habitats or eroded soils for establishment (Hoshovsky 2000). Seeds from the seed bank can germinate in large numbers after disturbance (Tirmenstein 1989).

Current global distribution (0–5)	3
Himalayan blackberry is native to Western Europe and Northern Africa. It was naturalized in Southwestern Asia, Australia, Polynesia, North and South America, South Africa, and New Zealand (USDA, ARS 2005).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	4
Himalayan blackberry has become widely naturalized in the Northeast from Delaware to Virginia, and in the Pacific Northwest from northern California through southern British Columbia, and east to Idaho (Starr and Loope 2003, USDA 2002). *Rubus discolor* is considered a noxious weed in Oregon (Invaders Database System 2003, USDA 2002).	
Total for Ecological Amplitude and Distribution	**12/25**
Feasibility of Control	**Score**
Seed banks (0–3)	2
The seeds remain viable in the soil for several years (Hoshovsky 2000).	
Vegetative regeneration (0–3)	3
This shrub resprouts from roots and canes (Richardson 1975, Tirmenstein 1989).	
Level of effort required (0–4)	4
Himalayan blackberry is a difficult species to control because of its extensive vegetative reproduction and because it often grows in very sensitive wetland habitats. Mechanical removal or burning may by the most effective ways of removing mature plants. Additional treatments with some herbicides can promote vegetative growth from lateral roots. This species is shade-intolerant, so reestablishment may be prevented by planting fast-growing shrubs or trees. Resprouting is problematic, and many years of follow-up efforts are necessary for control. The introduction of herbivorous insects and fungi to control Himalayan blackberry is not supported by USDA because of the risk posed to commercially important *Rubus* species (Hoshovsky 1989, Hoshovsky 2000, Starr 2003).	
Total for Feasibility of Control	**9/10**
Total score for 4 sections	**77/100**

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Saponaria officinalis L. common names: bouncingbet, soapwort, sweet betty

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	30	5
Biological Characteristics and Dispersal	22	8
Amplitude and Distribution	25	12
Feasibility of Control	3	2
Relative Maximum		34

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	No	Yes
Interior Boreal	Yes	–
Arctic Alpine	No	No

Saponaria officinalis was collected in Wasilla, interior boreal ecoregion (AKNHP 2003). *Saponaria officinalis* is common along the southern coast of Norway, including Bergen (Lid and Lid 1994), which has a 73% climatic match (CLIMEX 1999) with Juneau, south coastal ecoregion. It likely is able to establish in this ecoregion. This species is documented from the mountainous high elevation Norwegian provinces of Oppland and Hedmark, adjacent to Røros, which has a 76% similarity with Nome (Faarlund and Sunding 1992, Lid and Lid 1994). However, according to the USDA (2002), 130 frost-free days are required and plants can withstand a minimum temperature of -18 °F. It is unlikely to establish in the arctic alpine ecoregion and much of the interior boreal ecoregion.

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	U
No information was found identifying impacts to ecosystem processes.	
Impact on Natural Community Structure (0–10)	1
Bouncingbet establishes in an existing layer without significant changes to the density of other species. It is capable of creating a new layer on recently disturbed soil (I. Lapina pers. obs.).	
Impact on Natural Community Composition (0–10)	1
The plants can form large populations and completely dominate on disturbed sites (OPBWG 2004). However, in south-central Alaska it occurs in sparse populations in natural communities (I. Lapina pers. obs.).	
Impact on Higher Trophic Levels (0–10)	3
The roots and seeds are slightly poisonous to human and animals (Russell 1997). Animals typically avoid eating this plant. There is a potential for drawing pollinating insects from native species to visit *S. officinalis* (OPBWG 2004, Whitson et al. 2000).	
Total for Ecological Impact	**5/30**
Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	3
Bouncingbet reproduces by seeds and by spreading underground stems (OPBWG 2004). The average number of ovules per fruit is 75, and seeds produced per fruit are 50, for a potential of 1,500 seeds/plant (I. Lapina and M.L. Carlson unpubl. data).	
Long-distance dispersal (0–3)	0
Saponaria officinalis does not have any apparent adaptations for long-distance dispersal. Its seeds are not winged or plumed for wind dispersal and the fruits do not appear adapted to frugivory (M.L. Carlson pers. obs.), but it does disperse from gardens.	
Spread by humans (0–3)	3
Hay and other feeds can be contaminated by seeds or other plants parts. It also appears for sale in nurseries and escapement is well documented from gardens in northern Europe (Lid and Lid 1994).	
Allelopathic (0–2)	0
This species is not allelopathic.	

Competitive Ability (0–3)	1
It spreads rapidly and replaces plants of other species (Whitson et al. 2000). Its competitive ability in Alaska is questionable as it is primarily restricted to a single highly disturbed site (I. Lapina pers. obs.).	
Thicket-forming/Smothering growth form (0–2)	1
The plant has tendency to form large and dense patches (OPBWG 2004), but does not climb or produce a smothering growth-form.	
Germination requirements (0–3)	U
No information was found identifying germination requirements.	
Other invasive species in the genus (0–3)	0
No other weedy *Saponaria* species are present	
Aquatic, wetland or riparian species (0–3)	0
Saponaria officinalis typically grows along roadsides, railroads, waste places, fields, and pastures.	
Total for Biological Characteristics and Dispersal	**8/22**

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
It was introduced for ornamental and soap-like properties (OPBWG 2004). A few cultivars have been developed (Gubanov et al. 1995).	
Known level of impact in natural areas (0–6)	1
It appears to grow in nearly all states (USDA 2002), but impacts tend to be of highly disturbed areas unlike most natural areas in Alaska.	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
This species typically establishes in disturbed sites.	
Current global distribution (0–5)	0
Native to Central and Southern Europe, but has spread throughout Western and Northern Europe (Faarlund and Sunding 1992). This species has become naturalized in Northern Europe, originating from ballast and escaped ornamentals (Lid and Lid 1994).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	4
The species occurs in nearly all states of the United States (USDA 2002). Listed as a noxious weed in Colorado (Invaders Database System 2003), "exotic pest" in California, and "weed" in Kentucky (USDA 2002).	
Total for Ecological Amplitude and Distribution	**12/25**

Feasibility of Control	**Score**
Seed banks (0–3)	U
No information was found identifying seed longevity	
Vegetative regeneration (0–3)	2
Bouncingbet has the ability to resprout and can be propagated by sprigs (USDA 2002).	
Level of effort required (0–4)	U
Control options have not been investigated. One population in south-central Alaska was seeded for erosion control after road construction, the following spring no seedlings were observed (I. Lapina pers. obs., J. Riley pers. com.). It is possible that this species will not persists in Alaska	
Total for Feasibility of Control	**2/3**
Total score for 4 sections	**27/80**

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Senecio jacobaea L. common names: ragwort, stinking willie, tansy ragwort

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	20
Biological Characteristics and Dispersal	25	15
Amplitude and Distribution	25	20
Feasibility of Control	10	8
Relative Maximum		**63**

Climatic Comparison		
	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Tansy ragwort has been collected in Anchorage and Ketchikan (AKEPIC 2004), and Prince of Wales Island (M. Shephard pers. com.). The range of the species includes Kirov and Perm in Russia, which have 66% and 63% climatic match with Nome, respectively. It is likely to establish in the arctic alpine ecoregion.

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	3
As a pioneer of disturbed sites it is likely to hinder the colonization by native species. Additionally, as a strong competitor (Harris 2000) it likely reduces the availability of resources for co-occurring native species.	
Impact on Natural Community Structure (0–10)	5
In southeast Alaska tansy ragwort establishes in the existing herbaceous layer, increasing its density and outcompeting other species (J. Conn pers. com., T. Heutte pers. com.).	
Impact on Natural Community Composition (0–10)	5
Tansy ragwort may outcompete native plants, reducing number of individuals of native species in communities (Harris 2000).	
Impact on Higher Trophic Levels (0–10)	7
Tansy ragwort is highly toxic to animals, including humans (CUPPID 2004, Harris 2000). Large numbers of pollinating insects visit its flowers. More than 60 different consumers of tansy ragwort are recorded (Cameron 1935). Hybridization with other species of *Senecio* is known from Britain (Harper and Wood 1957).	
Total for Ecological Impact	**20/40**

Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	3
Ragwort can regenerate by both seed and vegetatively. Cameron (1935) reported 4,760–174,230 seeds per plant from a range of habitats. Chancellor (Harper and Wood 1957) found a range of 7,000–20,000. In a study by van der Meijden and van der Waals-kooi (1979) production varied between 1,000 and 30,000 achenes per plant. Plants are also capable of regeneration from pieces of rootstock (Harris 2000, Macdonald and Russo 1989).	

Long-distance dispersal (0–3) 3
Ragwort achenes are tipped by hair-like plumes and able to travel by wind long distances (Harris 2000, Meijden van der and van der Waals-kooi 1979). However, studies have found that 60% of the total seed shed landed within 4.6 m of the base of the plants, an additional 39% landed between 4.6 and 9 m from the plant (Harris 2000, Macdonald and Russo 1989). Dispersal is also by water, animals, and birds. Achenes eaten by sheep pass through the digestive system undamaged (Green 1937, Harper and Wood 1957).

Spread by humans (0–3) 3
Tansy ragwort is often spread as a contaminant in hay, grain seeds, and top soil (Harris 2000, USDA, ARS 2004). The plant can be also transported in mud or soil adhering to vehicles (Harris 2000).

Allelopathic (0–2) 0
Judging from the amount of literature, this species is not allelopathic.

Competitive Ability (0–3) 2
This plant easily outcompetes native grasses and forbs (Harris 2000)

Thicket-forming//Smothering growth form (0–2) 0
Tansy ragwort can grow up to 6 feet tall, but it does not have a smothering growth habit (Whitson 2000).

Germination requirements (0–3) 1
Germination and establishment is much higher on bare soils. Light is required for germination (Cameron 1935, Harper and Wood 1957, Meijden van der and van der Waals-kooi 1979). In southeast Alaska it has been observed germinating and established in vegetated stands (T. Heutte pers. obs.).

Other invasive species in the genus (0–3) 3
Senecio madagascariensis Poir., *S. riddellii* Torr. & Gray, *S. squalidus* L., and *S. vulgaris* L. (USDA 2002, Whitson et al. 2000).

Aquatic, wetland or riparian species (0–3) 0
Tansy ragwort is commonly found in pastures, forest clearcuts, overgrazed pastures, and along roadsides. The species occupies natural communities such as sand dunes and beech woodlands (Harris 2000, Harper and Wood 1957).

Total for Biological Characteristics and Dispersal 15/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) 4
Tansy ragwort is a weed of pastures and grasslands (Cameron 1935, Harper and Wood 1957).

Known level of impact in natural areas (0–6) 3
Tansy ragwort is known to reduce the number of individuals in native species on sand dunes and beech woodlands (Harris 2000).

Role of anthropogenic and natural disturbance in establishment (0–5) 3
Ragwort needs disturbance to become established. Disturbance of turf by moles, gophers, ants, or rabbits may allow it to enter a previously closed community. Disturbances such as plowing, mowing, or trampling stimulate regeneration from the root buds and can intensify infestations (Cameron 1935, Harris 2000, Harper and Wood 1957, van der Meijden and van der Waals-kooi 1979). Sand drift is also a process creating favorable conditions for ragwort (van der Meijden and van der Waals-kooi 1979).

Current global distribution (0–5) 5
Tansy ragwort is native to Europe (including northern Scandinavia) and Western Asia and has become a serious rangeland pest in New Zealand, Tasmania, Australia, South Africa, and North and South America (Harris 2000).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) 5
Tansy ragwort infests millions of acres of range and pasture land in the Pacific Northwest (Harris 2000). It is listed as a noxious weed in Arizona, California, Colorado, Idaho, Montana, Oregon, Washington, British Columbia, and Nova Scotia (Invaders Database System 2003).

Total for Ecological Amplitude and Distribution 20/25

Feasibility of Control — Score

Seed banks (0–3) 2
Seeds stored at the field temperature more than 3 years maintained a high capacity for germination. In another study, the large-scale germination was obtained from achenes 4 years old or more (Meijden van der and van der Waals-kooi 1979).

Vegetative regeneration (0–3) 2
Plants regenerate readily from root fragment after cutting or plowing (Cameron 1935, Harris 2000, Harper and Wood 1957, Macdonald and Russo 1989).

Level of effort required (0–4) 4
Hand pulling has been the most common method of control in the early stages of infestation. Plowing, mowing, and burning might intensify local infestation. Sodium chlorate has been used in New Zealand but may seriously damage other plants in the community. High cost of this chemical prevents its widespread use. Other herbicides have not been effective in controlling this plant. Biological controls have proven to be effective for long-term control in California (Harris 2000, Harper and Wood 1957, Macdonald and Russo 1989).

Total for Feasibility of Control 8/10

Total score for 4 sections 63/100

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Senecio vulgaris L. — common names: common groundsel, old-man-in-the-spring

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	4
Biological Characteristics and Dispersal	25	12
Amplitude and Distribution	25	15
Feasibility of Control	10	5
Relative Maximum		46

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Senecio vulgaris is documented in all ecogeographic regions in Alaska (Hultén 1968, AKEPIC 2005, UAM 2004).

Ecological Impact — **Score**

Impact on Ecosystem Processes (0–10) — 0
Common groundsel has been documented only on disturbed areas in Alaska (Hultén 1968, Welsh 1974, Weeds of Alaska Database 2006). It is unlikely that measurable impacts to ecosystem processes occur due to its presence.

Impact on Natural Community Structure (0–10) — 1
Common groundsel establishes in a sparsely vegetated herbaceous layer in disturbed areas, increasing the density of the layer (I. Lapina pers obs.). No significant impact on the natural community structure has been documented or observed.

Impact on Natural Community Composition (0–10) — 0
Common groundsel has been documented in undisturbed areas in Alaska (AKEPIC 2006); no perceived impact on native populations is known.

Impact on Higher Trophic Levels (0–10) — 3
Common groundsel is poisonous to livestock (Royer and Dickinson 1999) and may be poisonous to wild animals. Also, it is an alternate host for a number of viruses, nematodes, and aphids (Townshend and Davidson 1962, Heathcote and Byford 1975, Royer and Dickinson 1999).

Total for Ecological Impact — 4/40

Biological Characteristics and Dispersal — **Score**

Mode of Reproduction (0–3) — 3
Common groundsel is an annual and reproduces only by seed (Alex and Switzer 1976). Each common groundsel plant is capable of producing an average of 830 seeds (Kadereit 1984) and over 1,700 seeds per plant are possible (Royer and Dickinson 1999).

Long-distance dispersal (0–3) — 2
The seeds have a pappus of hairs and can be dispersed by wind for short distances (Bergelson et al. 1993). Additionally, its seeds are sticky when wet and can attached to fur (Royer and Dickinson 1999).

Spread by humans (0–3) — 3
The seeds of common groundsel contaminate commercial seeds and horticultural stock. Wet seeds can attach to vehicles and clothing (Hodkinson and Thompson 1997, USDA, ARS 2006).

Allelopathic (0–2) — 0
Common groundsel is not allelopathic (Qasem and Hill 1989, USDA, NRCS 2006). Possible allelopathic effects of common groundsel were studied in a greenhouse experiment, but did not show a significant effect on the growth of other plants (Qasem and Hill 1989).

Competitive Ability (0–3) — 1
Common groundsel competes with cultivated crops (MAFRI 2001).

Thicket-forming/Smothering growth form (0–2) — 0
Common groundsel can form stands up to 18 inches tall (Alex and Switzer 1976, Douglas et al. 1998, Whitson et al. 2000). In Alaska it usually does not form dense stands and does not shade other species (I. Lapina pers. obs.).

Germination requirements (0–3) — 0
Common groundsel requires open soil and no vegetation for germination and successful establishment (Popay and Roberts 1970, Bergelson et al. 1993).

Other invasive species in the genus (0–3) — 3
Senecio jacobaea L., *S. madagascariensis* Poir., and *S. squalidus* L. are listed as noxious weed in several American states (USDA, NRCS 2006).

Aquatic, wetland or riparian species (0–3) — 0
Common groundsel inhabits open disturbed sites such as fields, gardens, lawns, roadsides, and waste places (Douglas et al. 1998).

Total for Biological Characteristics and Dispersal — 12/25

Ecological Amplitude and Distribution — **Score**

Highly domesticated or a weed of agriculture (0–4) — 4
Common groundsel is a weed of agricultural fields and gardens (Royer and Dickinson 1999).

Known level of impact in natural areas (0–6) — 0
Common groundsel is not known to cause any impacts in natural areas.

Role of anthropogenic and natural disturbance in establishment (0–5) — 1
Common groundsel is distributed mainly in anthropogenic habitats, such as ruderal and agricultural lands (Douglas et al. 1998). In its native range, common groundsel can be found on naturally disturbed habitats such as sand dunes (Ashton and Abbott 1992, Hoffmann 2001).

Current global distribution (0–5) — 5
Common groundsel is native to Europe and North Africa. It has been introduced into South Africa, North and South America, Hawaii, Australia, and New Zealand (Hultén 1968). It now has a nearly worldwide distribution, with introductions into arctic and subarctic regions in Europe (Lid and Lid 1994).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) — 5
Common groundsel is found throughout the United States and Canada (Royer and Dickinson 1999, USDA, NRCS 2006). *Senecio vulgaris* is declared a weed in Washington, Tennessee, and Manitoba (Royer and Dickinson 1999, Rice 2006).

Total for Ecological Amplitude and Distribution — 15/25

Feasibility of Control	Score
Seed banks (0–3)	3
The seeds of common groundsel can remain viable in undisturbed soils for more than 6 years (Roberts and Feast 1973).	
Vegetative regeneration (0–3)	0
Common groundsel has no resprouting potential.	
Level of effort required (0–4)	2
Common groundsel can be controlled by tillage in fall and early spring. Mowing or grazing before seed set will prevent the infestation from spreading. Herbicides are available for common groundsel control (SAF 2000).	
Total for Feasibility of Control	**5/10**
Total score for 4 sections	**36/100**

§

Silene noctiflora L / *S. latifolia* ssp. *alba* L. / *S. vulgaris* (Moench) Garcke / *S. dioica* (L.) Clairville

common names: night-flowering catchfly, white cockle, bladder campion, red catchfly

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	13
Biological Characteristics and Dispersal	25	9
Amplitude and Distribution	25	13
Feasibility of Control	10	7
Relative Maximum		**42**

Climatic Comparison	*Collected in Alaska regions?*	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Silene noctiflora has been collected from Fairbanks, Anchorage, Healy, and the Kenai Peninsula (Hultén 1968, UAM 2004). Although this species is reported by Hultén (1968) from Nome and Juneau, these specimens appear to be misidentified (McNeill 1980). *Silene vulgaris* has been documented from the Yukon Territory in the vicinity of Dawson (Cody 1996, UAM 2004). *Silene latifolia* ssp. *alba* has been documented from Eklutna Valley and the Matanuska and Susitna Valleys in Alaska (AKEPIC 2004, UAM 2004). *Silene dioica* has been collected from Palmer (AKEPIC 2004). The CLIMEX matching program indicates the climatic similarity between Alaska and areas where *Silene noctiflora*, *S. latifolis* ssp. *alba*, *S. vulgaris*, and *S. dioica* are documented as moderately high. The ranges for these species include Røros and Dombås, Norway (Lid and Lid 1994), which have a 76% and 63% climatic match with Nome; and from Bergen, Norway which has a 73% climatic match with Juneau. *Silene latifolia* ssp. *alba* and *S. dioica* also have been documented from arctic and subarctic Norway and Finland (Lid and Lid 1994, Thompson 1975). Thus establishment of these non-native *Silene* species in arctic alpine and south coastal ecogeographic regions is likely.

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	3
Silene species occupy disturbed ground and likely hinder colonization by native species. These weeds can decrease soil moisture and nutrient availability (Royer and Dickinson 1999).	
Impact on Natural Community Structure (0–10)	3
These species have been observed in the existing layer of vegetation in disturbed areas (I. Lapina pers. obs.). Red catchfly is capable of forming almost complete monocultures on bare soil (Matlack and Harper 1986).	
Impact on Natural Community Composition (0–10)	2
These species compete for moisture, nutrients, and sunlight in pastures and crowd native plants (Royer and Dickinson 1999).	
Impact on Higher Trophic Levels (0–10)	5
Grazing animals find *Silene* species unpalatable. These plants are alternate hosts for numerous viruses (Royer and Dickinson 1999). Hybrids of *S. dioica* and *S. latifolia* ssp. *alba* have been collected in Canada (Douglas and MacKinnon 1998). The flowers of most *Silene* species open in the evening and are moth-pollinated. Red catchfly flowers open during the day and are typically pollinated by bees or butterflies (McNeill 1978).	
Total for Ecological Impact	**13/40**

Biological Characteristics and Dispersal	Score
Mode of Reproduction (0–3)	3
Silene species reproduce primarily by seed. Each plant of night-flowering catchfly is capable of producing up to 2,600 seeds. White cockle plants produce over 24,000 seeds (Royer and Dickinson 1999) and red catchfly plants produced more than 4,500 seeds in an experimental garden in Britain (Kay et al. 1984). White campion and bladder campion are able to reproduce vegetatively by root and stem fragments (Whitson et al. 2000).	
Long-distance dispersal (0–3)	0
Most seeds fall from the parent plant to the ground (Guide to Weeds in British Columbia 2002).	
Spread by humans (0–3)	2
The seeds are very similar to those of crop clovers and are difficult to separate. Consequently, seed impurities have been a major source of dispersal. Seeds also are capable of germination after passing through the digestive tract of domestic animals (McNeill 1980, Royer and Dickinson 1999, Whitson et al. 2000).	
Allelopathic (0–2)	0
There are no records of allelopathy.	

Competitive Ability (0–3)	1
Silene species can rapidly colonize disturbed sites and compete with other vegetation (Royer and Dickinson 1999). However; cultivated field experiments demonstrated that bladder campion did not compete well with alfalfa and barley (Wall and Morrison 1990). Bladder campion and red catchfly tolerate high concentrations of copper, nickel, zinc, lead, and air pollution; and are highly adapted to water and nutrient deficient conditions (Brooks and Crooks 1980, Leopold et al. 1999, Wierzbicka and Paufnik 1998).	
Thicket-forming/Smothering growth form (0–2)	0
Silene species can grow up to 3 feet tall, but are not characterized by a climbing or smothering growth habit (Douglas and MacKinnon 1998, Royer and Dickinson 1999, Whitson et al. 2000).	
Germination requirements (0–3)	0
Buried seeds germinate readily after soil disturbance (Guide to Weeds in British Columbia 2002). Some populations may require light for germination.	
Other invasive species in the genus (0–3)	3
The genus *Silene* consists of a number of serious agricultural weeds (Royer and Dickinson 1999, Whitson et al. 2000).	
Aquatic, wetland or riparian species (0–3)	0
These plants are important weeds of pastures, grain fields, and gardens. They are also found along highways, railroad tracks, and in waste places (Gubanov et al. 2003, McNeill 1980, Royer and Dickinson 1999).	
Total for Biological Characteristics and Dispersal	**9/25**

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	3
Silene species are found in most agricultural areas of United States and Canada, they are important weeds particularly of grain and leguminous crops (Royer and Dickinson 1999, McNeill 1980, Whitson et al. 2000).	
Known level of impact in natural areas (0–6)	0
Silene species are known as agricultural weeds, but have not been reported to impact natural habitats (Royer and Dickinson 1999, Whitson et al. 2000).	
Role of anthropogenic and natural disturbance in establishment (0–5)	0
Silene species can colonize open ground. Buried seeds remain viable and germinate and establish easily after soil disturbance (Guide to Weeds in British Columbia 2002, Matlack and Harper 1986).	
Current global distribution (0–5)	5
The native range of *Silene* species extends across Europe and Southwest Asia. They are now found throughout Canada and the United States with the exception of Alabama, Arkansas, Hawaii, Nevada, Arizona, South Carolina, Tennessee, and Texas (USDA 2002). *Silene noctiflora* has been recorded from Australia and Greenland (McNeill 1980). *Silene noctiflora* and *S. dioica* have been recorded from arctic Norway and Finland (Lid and Lid 1994, Thompson 1975).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Night-flowering catchfly, white cockle, and bladder campion are declared federal noxious weeds in Canada. These species are also listed as weeds in Connecticut, Wisconsin, and Washington (Royer and Dickinson 1999).	
Total for Ecological Amplitude and Distribution	**13/25**

Feasibility of Control	**Score**
Seed banks (0–3)	3
The seeds of night-flowering catchfly and bladder campion can remain viable in the soil for at least 5 years (Chepil 1946). Seeds of red catchfly older than 2 years normally do not germinate (Carlsson-Graner et al. 1998).	
Vegetative regeneration (0–3)	1
White campion and bladder campion can resprout from root and stem fragments (Whitson et al. 2000).	
Level of effort required (0–4)	3
Mowing or burning is unlikely to control *Silene* species because of its large seed bank. Cultivation usually increases the infestation by facilitating the spread of *Silene*. Herbicides provide limited control, as these species are resistant or somewhat resistant to many common herbicides. No biological control agent is available (Guide to weeds in British Columbia 2002, McNeill 1980).	
Total for Feasibility of Control	**7/10**
Total score for 4 sections	**42/100**

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Sonchus arvensis L. [including ssp. *arvensis* and *uliginosus* (Bieb.) Nyman] common names: field sowthistle, moist sowthistle, perennial sowthistle

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	22
Biological Characteristics and Dispersal	25	21
Amplitude and Distribution	25	21
Feasibility of Control	10	9
Relative Maximum		73

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	No

Sonchus arvensis has been collected in south coastal (Hyder and Hoonah) and interior boreal (Fairbanks, Anchorage, Delta Junction, and Palmer) ecogeographic regions (AKEPIC 2004, UAM 2004). Climatic similarity between Nome and areas where the species is documented is relatively high. The introduced range of the species includes Anchorage and Fairbanks (AKEPIC 2004) that have a 61% and 56% climatic match with Nome, respectively using CLIMEX. However, winter temperatures in Nome are too low for *Sonchus arvensis* according to the Washington Noxious Weed Control Board (2003). This suggests that establishment of this species in arctic alpine Alaska may not be possible.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 5

Perennial sowthistle may modify or retard the successional establishment of native species (Butterfield et al. 1996). This species can form very thick, nearly monospecific stands along the upper beach strands in southeast Alaska and likely has a moderate influence on nutrient, moisture, and light availability (B. Krieckhaus and T. Heutte, pers. com.).

Impact on Natural Community Structure (0–10) — 7

Perennial sowthistle has recently been observed at a number of sites forming large stands in the upper beach strand and in estuaries in southeastern Alaska, where it forms a tall herbaceous layer over the dominant grass, *Elymus mollis*, intertidal sedges, and other species (B. Krieckhaus and T. Heutte, pers. com.).

Impact on Natural Community Composition (0–10) — 7

At high densities perennial sowthistle has drastically reduced water resources (Zollinger and Kells 1993) and possibly decreased the number of plants in communities. Such densities have been observed in natural communities in Alaska (B. Krieckhaus and T. Heutte, pers. com.). Perennial sowthistle reduced soil moisture by 33–47% in field experiments (Zollinger and Kells 1993).

Impact on Higher Trophic Levels (0–10) — 3

Perennial sowthistle is host to a number of plant pests. This plant is acceptable forage for rabbits and other animals (Noxious Weed Control Board 2003).

Total for Ecological Impact — 22/30

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3

Perennial sowthistle reproduces by seeds and horizontal roots. Each plant can produce 4,000–13,000 seeds (Royer and Dickinson 1999, Rutledge and McLendon 1996, Stevens 1957).

Long-distance dispersal (0–3) — 3

Seeds of perennial sowthistle possess long hairs and are spread by the wind (Royer and Dickinson 1999, Rutledge and McLendon 1996). Seeds may also become attached to animals (Butterfield et al. 1996).

Spread by humans (0–3) — 3

Seeds of perennial sowthistle can be transported by vehicles and farm equipment. The seeds often contaminate commercial seeds and hay (Butterfield et al. 1996, Noxious Weed Control Board 2003).

Allelopathic (0–2) — 2

Perennial sowthistle inhibits seed germination of native species (Weeds BC 2004).

Competitive Ability (0–3) — 2

Perennial sowthistle is competitive for soil and water (Zollinger and Kells 1993). It also is considered a vigorous competitor for removing minerals from soil (Lemna and Messersmith 1990).

Thicket-forming/Smothering growth form (0–2) — 1

Perennial sowthistle can grow 2–4 feet tall (Whitson et al. 2000). In Alaska it can form dense stands (Krieckhaus and Heutte, pers. com.).

Germination requirements (0–3) — 3

Seedlings emerge and survival is best in areas with plant cover or litter. Achenes require a continual water supply for germination. Seedlings emerged from less than 1-inch seeding depth have higher rate of survival and establishment (Hakansson and Wallgren 1972).

Other invasive species in the genus (0–3) — 3

Sonchus asper (L.) Hill, and *S. oleraceus* L. (Whitson et al. 2000).

Aquatic, wetland or riparian species (0–3) — 1

Perennial sowthistle is common in gardens, cultivated crops, roadsides, and fertile waste areas (Rutledge and McLendon 1996, Whitson et al. 2000). It may occur on disturbed sites of meadows, beaches, ditches, and river and lakeshores (Butterfield et al. 1996, Gubanov et al. 1995, Noxious Weed Control Board 2003).

Total for Biological Characteristics and Dispersal — 21/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 4

Perennial sowthistle is a common weed of gardens and cultivated fields (Gubanov et al. 1995, Rutledge and McLendon 1996, Whitson et al. 2000).

Known level of impact in natural areas (0–6) — 4

Perennial sowthistle is ranked as an exotic plant with a moderate impact on natural communities in Pipestone National Monument in Minnesota. It is found in mid-succesional sites that have been disturbed in the last 11–50 years (Butterfield et al. 1996). It is found in the Rocky Mountain National Park of Colorado (Rutledge and McLendon 1996).

Role of anthropogenic and natural disturbance in establishment (0–5)	3
Perennial sowthistle requires disturbances to establish (Butterfield et al. 1996). This species will likely invade steep slopes, riparian banks, and loess slopes (J. Conn and M. Shephard pers. com.). Additionally, it is known to invade the upper beach strand and estuaries that are only moderately disturbed by natural means (Krieckhaus and Heutte pers. com.).	
Current global distribution (0–5)	5
Perennial sowthistle is native to Europe, Western Asia, and Iceland. It has spread widely throughout the northern United States and southern Canada. The plant has also established in South America, Australia, and New Zealand (Noxious Weed Control Board 2003).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Perennial sowthistle has spread widely throughout the northern United States and southern Canada (USDA 2002). It is a noxious weed in 20 American states and 5 Canadian provinces; declared a federal noxious weed in U.S. and Canada (Invader Database System 2003, Royer and Dickinson 1999). It is a prohibited noxious weed in Alaska (Alaska Administrative Code 1987).	
Total for Ecological Amplitude and Distribution	21/25

Feasibility of Control	**Score**
Seed banks (0–3)	3
Seeds of perennial sowthistle may remain dormant in the soil for up to 5 years. Most of seeds germinate the first year. Viability in subsequent years is commonly low (Roberts and Neilson 1981).	
Vegetative regeneration (0–3)	2
Perennial sowthistle is capable of producing new plants from rhizomes (Royer and Dickinson 1999, Rutledge and McLendon 1996).	
Level of effort required (0–4)	4
Biological, chemical, and mechanical control methods have been used on perennial sowthistle. Mechanical treatment for several years should be done a few times a season to reduce seed production and root reserves. This weed is relatively resistant to many common broadleaf herbicides (Butterfield et al. 1996, Rutledge and McLendon 1996).	
Total for Feasibility of Control	8/10
Total score for 4 sections	72/100

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Sorbus aucuparia L. common names: European mountain ash

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		No
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	22
Biological Characteristics and Dispersal	25	14
Amplitude and Distribution	25	16
Feasibility of Control	10	7
Relative Maximum		59

Climatic Comparison		
	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Adjacent	No
Arctic Alpine	No	No

European mountain ash has been collected in Juneau, Ketchikan, Craig, Petersburg, and Sitka (Hultén 1968, UAM 2004, Welsh 1974). It is widely planted ornamental in Anchorage and towns in southeast Alaska. The range of the species includes Kirov and Kazan in Russia, and Anchorage, which have 60%, 59%, and 58% climatic match with Fairbanks, respectively. However, it appears to reach its physiological limit around Anchorage, it withstands winter temperatures to -33 °F and requires 110 frost-free days (USDA 2002). Fairbanks typically has 140 frost-free days, but winter temperatures commonly reach -60 °F. It is unlikely to establish in the interior ecogeographic region. In the arctic alpine ecoregion, there is a high climatic match between Nome and areas where the species is documented such as Arkhangel'sk (76%) and Kirov (66%), Russia, (Hultén 1968). However, minimum temperatures are far too low and the number of frost-free days is at the physiological limit of *Sorbus aucuparia*.

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	5
Stands of European mountain ash likely alter light and nutrient availability for other species (Conn pers. obs.).	
Impact on Natural Community Structure (0–10)	5
European mountain ash is able to integrate into largely undisturbed coastal rainforest communities and dominate, creating moderately dense crown canopy. When established at high densities it likely reduces structural complexity below it in Sitka Historical Park (M. Shephard pers. obs.).	
Impact on Natural Community Composition (0–10)	5
European mountain ash appears to outcompete red alder along shorelines (M. Shephard pers. obs.). It causes significant reduction in the population size of one or more native species in the community (J. Conn pers. obs.). Hybridizes with native *Sorbus scopulina* and *S. sitchensis* (Pojar and MacKinnon 1994).	
Impact on Higher Trophic Levels (0–10)	7
The fruits of European mountain ash are highly desirable to birds, so there is a potential for alterations in abundance and composition of avian fauna (Gilman and Watson 1994, Carlson and Lapina pers. obs.). There is also the possibility for competition with native plants for fruit dispersal.	
Total for Ecological Impact	22/40

Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	3
The seeds of European mountain ash are numerous and small (125,000/lbs), with many thousands of seeds produced per plant per year (Granström 1987, USDA, NRCS 2002).	
Long-distance dispersal (0–3)	3
The fruits of European mountain ash are spread by birds, especially waxwings and thrushes (Gilman and Watson 1994, Dickinson and Campbell 1991).	

Spread by humans (0–3) European mountain ash is widely planted as an ornamental in southern and southeastern Alaska, where it has escaped (Hultén 1968, Welsh 1974). It has been reported to spread as contaminant of horticultural stock (Hodkinson and Thompson 1997).	3
Allelopathic (0–2) This species is not listed as an allelopathic (USDA, NRCS 2002).	0
Competitive Ability (0–3) European mountain ash is able to compete with native species in undisturbed forest communities (Wisconsin DNR 2003).	1
Thicket-forming/Smothering growth form (0–2) European mountain ash can grow 25–40 feet high and form a rounded open crown, shading out other vegetation (USDA, NRCS 2002, Gilman and Watson 1994, Welsh 1974).	2
Germination requirements (0–3) The seeds of European mountain ash germinated well in experimental conditions of multiple years in moist soil (2 cm in soil, under moss/litter layer) in central Sweden then full light and 20 °C (Granström 1987). Cold-stratification is necessary for germination (USDA 2002).	2
Other invasive species in the genus (0–3) No other weedy *Sorbus* species are present.	0
Aquatic, wetland or riparian species (0–3) European mountain ash is a species of forests and suburban habitats.	0
Total for Biological Characteristics and Dispersal	**14/25**

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4) European mountain ash is planted as an ornamental and tree of residential areas. Flowers, fruits, and fall leaves are showy. It is successfully grown in urban areas where air pollution, poor drainage, compacted soil, and drought are common.	4
Known level of impact in natural areas (0–6) European mountain ash invades forest communities in Wisconsin (Wisconsin Department of Natural Resources 2003). It has spread from Wrangell Island to Kadin Island and invades undisturbed coastal rainforest in Sitka Natural Historical Park, Alaska (R. Lipkin, M. Shephard pers obs.).	3
Role of anthropogenic and natural disturbance in establishment (0–5) European mountain ash may occasionally establish in undisturbed areas. Cutting promotes resprouting and establishment. This species has intermediate shade tolerance (USDA 2002), so it is unlikely to establish in late successional coastal rainforest communities without disturbance.	2
Current global distribution (0–5) European mountain ash is native of Europe (Spain to Balkans, north to British Isles/Nordic countries, and east to Ural Mountains), Northern Africa, and Western Asia. It has naturalized in 27 northern states, in many climatic areas, throughout moist cool regions of North America.	3
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) European mountain ash has naturalized in 27 northern states, in many climatic areas, throughout moist cool regions of North America. This species is not considered noxious in North America (Invaders Database System 2003, USDA, NRCS 2002).	4
Total for Ecological Amplitude and Distribution	**16/25**

Feasibility of Control	**Score**
Seed banks (0–3) The seeds remain viable in the soil for 5 years or more (Granström 1987).	3
Vegetative regeneration (0–3) European mountain ash resprouts after cutting (USDA, NRCS 2002).	2
Level of effort required (0–4) Control measures for European mountain ash are largely untested. Management requires a major short-term investment, or moderate long-term investment (J. Conn pers. obs.).	2
Total for Feasibility of Control	**7/10**
Total score for 4 sections	**59/100**

§

Spartina alterniflora Loisel., *Spartina anglica* C.E. Hubbard, *S. densilfora* Brongn., and *S. patens* (Ait.) Muhl.

common names: Atlantic cordgrass, saltmarsh cordgrass, smooth cordgrass

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		No
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	40
Biological Characteristics and Dispersal	25	17
Amplitude and Distribution	25	23
Feasibility of Control	10	6
Relative Maximum		86

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	No	Yes
Interior Boreal	No	No
Arctic Alpine	No	No

No species of *Spartina* has been collected in Alaska (AKEPIC 2004, UAM 2004). *Spartina alterniflora* is native to the Atlantic and Gulf coasts of North America, occurring from Newfoundland south to Florida and Texas (USDA 2002, WAPMS 2004). Using the CLIMEX matching program, climatic similarity between Juneau and Grand Banks and St. Johns, Newfoundland is high (55% and 54% respectively). There is a 45% similarity between Juneau and Eastport, Maine. Further, aquatic species are generally less impacted by variation in terrestrial climates. It is likely to establish in the south coastal region of Alaska.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 10

The dense stands of smooth cordgrass trap and holds sediments, decrease waterflow and circulation and lead to flooding. Invertebrate communities associated with unvegetated mudflats are replaced by saltmarsh species due to *Spartina* invasion (Daehler 2000, Jacono 1998, WAPMS 2004).

Impact on Natural Community Structure (0–10) — 10

Spartina colonizes bare sites, creating a new vegetative layer (Daehler 2000, Walkup 2004, WAPMS 2004).

Impact on Natural Community Composition (0–10) — 10

Spartina displaces native plants, such as *Zostera marina*, *Salicornia virginica*, and *Triglochin maritinum* (WAPMS 2004). It also results in decreases in benthic invertebrates and algae populations. Studies indicate that populations of invertebrates in the sediments of *Spartina alterniflora* clones are smaller than in mudflats (WAPMS 2004, Jacono 1998).

Impact on Higher Trophic Levels (0–10) — 10

Spartina stands lower light levels and cause decreases in algae production (Walkup 2004). Subsequently, it causes a reduction in refuge and food sources for clams, fish, crabs, waterfowl, and other marine life (Daehler 2000, WAPMS 2004). In Alaska, chum salmon (*Oncorhynchus keta*), English sole (*Pleuronectes vetulus*), and Dungeness crab (*Cancer magister*) depend on mudflat habitats; they would likely be affected by cordgrass invasion (Jacono 1998). Large populations of *Spartina* can also cause loss of important foraging and refuge habitat for shorebirds and waterfowl (WAPMS 2004). In its native range, it is a favorite of muskrats, nutria, and other grazing animals (Materne 2000, Waklup 2004).

Total for Ecological Impact — 40/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3

Smooth cordgrass reproduces both by seed and rhizomes. While seeds are important for colonizing new areas, the expansion of established stands is primarily due to vegetative growth. Clones spread laterally by vegetative shoots often more than 3-feet per year, producing a characteristic circular growth pattern (Daehler 2000, WAPMS 2004).

Long-distance dispersal (0–3) — 2

The seed can be dispersed by water. Waterfowl can potentially transport seeds to new areas. Dispersal by floating wracks of vegetation is probably the most important long-distance dispersal mechanism (Sytsma et al. 2003). Vegetative fragments may be spread to sites prone to erosion (Daehler 2000).

Spread by humans (0–3) — 3

It was intentionally introduced on the west coast for erosion control. Additional pathways of introduction include shipping, commercial shellfish operations, ballast water, boats, and other equipment (Sytsma et al. 2003, WAPMS 2004).

Allelopathic (0–2) — 0

This species has no known allelopathic effects (USDA 2002).

Competitive Ability (0–3) — 1

Once it is established, smooth cordgrass outcompetes native vegetation (Jacono 1998). It does not compete well with mature established plants (Walkup 2004).

Thicket-forming/Smothering growth form (0–2) — 2

Smooth cord grass forms dense, monospecific stands in salt and brackish marshes (Jacono 1998).

Germination requirements (0–3) — 0

Seedlings are unable to survive under the vegetative canopy, maximum establishment is recorded on bare patches (Waklup 2004, WAPMS 2004).

Other invasive species in the genus (0–3) — 3

Spartina anglica C.E. Hubbard, *S. densilfora* Brongn., and *S. patens* (Ait.) Muhl. are considered invasive on the west coast (Daehler 2000, Sytsma et al. 2003).

Aquatic, wetland or riparian species (0–3) — 3

Spartina alterniflora is a plant of the intertidal zone, colonizing, bays, lagoons, ponds, and ditches (Walkup 2004, WAPMS 2004).

Total for Biological Characteristics and Dispersal — 17/25

Ecological Amplitude and Distribution	Score
Highly domesticated or a weed of agriculture (0–4)	4
A few cultivars have been developed, and they are commercially sold. They are used for erosion control and oil spill mediation along shorelines (Materne 2000, USDA 2002, Walkup 2004).	
Known level of impact in natural areas (0–6)	6
In Willapa Bay, Washington, *Spartina alterniflora* has displaced approximately 20% of critical habitat for wintering and breeding aquatic birds (WAPMS 2004). In California, it has invaded San Francisco and Humboldt Bays, threatening to transform open mudflats into a single-species tall grass community (Daehler 2000, Daehler and Strong 1994). A population established in the Siuslaw estuary in Oregon, and numerous sites are known from Washington (Jacono 1998).	
Role of anthropogenic and natural disturbance in establishment (0–5)	5
Spartina has been recorded as established on sites with no anthropogenic disturbances (Daehler 2000, Jacono 1998, WAPMS 2004).	
Current global distribution (0–5)	3
Smooth cordgrass is native to the Atlantic and Gulf Coast marshes of North America. Its introduced range includes the west coast of North America, Europe, and New Zealand (Baird and Thieret 1993, Daehler 2000, WAPMS 2004).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Spartina alterniflora occurs in all coastal states from Newfoundland to Florida and Texas (USDA 2002, WAPMS 2004). It is declared noxious in Oregon and Washington (Invader Database System 2003).	
Total for Ecological Amplitude and Distribution	**23/25**

Feasibility of Control	Score
Seed banks (0–3)	0
The seeds remain viable for only 8–12 months, and they do not withstand desiccation. The species does not have a persistent seed bank (Daehler 2000, Mooring et al. 1971, WAPMS 2004).	
Vegetative regeneration (0–3)	2
After removal of aboveground growth plant can resprout (WAPMS 2004).	
Level of effort required (0–4)	4
Smooth cordgrass can grow on very soft, deep mud, making infestations nearly inaccessible by foot or boat. Hand pulling or digging seedlings is suggested for small infestations (less than 5 acres). Special care should be taken to remove both shoots and roots. Shading small *Spartina* clones with woven geotextile fabric was successful in Oregon. Mowing and herbicide treatment can limit growth and seed set (Daehler 2000, Sytsma et al. 2003).	
Total for Feasibility of Control	**6/10**
Total score for 4 sections	**86/100**

§

Spergula arvensis L. — common names: corn spurry

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	2
Biological Characteristics and Dispersal	25	11
Amplitude and Distribution	25	14
Feasibility of Control	10	5
Relative Maximum		**42**

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Spergula arvensis is documented in the south coastal and interior boreal ecogeographic regions of Alaska (Hultén 1968, Welsh 1974, AKEPIC 2005, UAM 2004). The CLIMEX matching program indicates the climatic similarity between the arctic alpine ecogeographic region of Alaska and areas where *Spergula arvensis* has been documented is moderately high. This species range include Røros and Dombås, Norway (Lid and Lid 1994), which have a 76% and 63% climatic match with Nome. *Spergula arvensis* is known to occur in arctic regions of Norway and Greenland (Lid and Lid 1994, Natur Historiska Riksmuseet Database 2005). Thus establishment of corn spurry in the arctic alpine ecogeographic region is likely.

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	0
Corn spurry has not been observed in undisturbed areas in Alaska (UAM 2006, AKEPIC 2006). It is unlikely that measurable impacts to ecosystem processes occur due to its presence.	
Impact on Natural Community Structure (0–10)	0
Corn spurry establishes in an existing layer and very likely increases the density of the layer (Mann 1934) in ruderal or roadside plant communities. No impact on the natural community structure has been documented.	
Impact on Natural Community Composition (0–10)	0
Corn spurry has not been observed in undisturbed areas in Alaska (UAM 2006, AKEPIC 2006); no perceived impacts on native populations have been documented.	
Impact on Higher Trophic Levels (0–10)	2
Corn spurry is readily eaten by livestock and poultry and likely can be used by wildlife species as a food. Corn spurry is an alternate host for a number of viruses (Royer and Dickinson 1999). Flowers of corn spurry are self-pollinating, nevertheless bees, solitary wasps, and syrphids are occasionally seen visiting the flowers (New 1961).	
Total for Ecological Impact	**2/40**

Biological Characteristics and Dispersal	Score
Mode of Reproduction (0–3)	3
Corn spurry reproduces by seed. An average plant can produce 2,000 to 7,000 seeds (New 1961, Trivedi and Tripathi 1982a, b).	
Long-distance dispersal (0–3)	1
The seeds do not tend to spread long-distances, naturally. Occasionally they can be carried in digestive tracts of deer or on animal fur (New 1961, Guide to Weeds in British Columbia 2002).	
Spread by humans (0–3)	3
This species' seeds can contaminate soil and crop seed (Volkart 1924, Board 1952, Guide to Weeds in British Columbia 2002). The seeds can also be spread by vehicles or in mud on agricultural equipment (New 1961).	
Allelopathic (0–2)	2
Corn spurry causes strong inhibition of germination and growth of crops (Harrison and Peterson 1997, Peterson et al. 1998).	
Competitive Ability (0–3)	0
Corn spurry has not been observed in closed plant communities. It is very susceptible to shade and is a less effective competitor than perennial species (Fenner 1978a, b). In an experiment by Fenner (1978b) the growth rate of corn spurry was higher in bare soil when compared to short and tall turf.	
Thicket-forming/Smothering growth form (0–2)	0
Although corn spurry is capable of forming a dense stand, up to 7,000 seedlings per sq. yard (Mann 1939) it is a short plant and does not have a climbing or smothering growth habit (Welsh 1974, Royer and Dickinson 1999, Whitson et al. 2000).	
Germination requirements (0–3)	2
Germination of corn spurry is markedly higher in bare soil compared to turf (Fenner 1978b). About 43% of seeds germinated in bare soil, 35% in short turf, and 10% in tall turf of *Festuca rubra* in experiment (Fenner 1978b).	
Other invasive species in the genus (0–3)	0
Other species of *Spergula* have been introduced into North America but none of them appears to be particularly weedy (USDA, NRCS 2006).	
Aquatic, wetland or riparian species (0–3)	0
Corn spurry is a plant of disturbed open habitats. It typically occurs on cultivated fields (Royer and Dickinson 1999, Guide to Weeds in British Columbia 2002), roadsides, and sometimes the seashore (New 1961).	
Total for Biological Characteristics and Dispersal	**11/25**

Ecological Amplitude and Distribution	Score
Highly domesticated or a weed of agriculture (0–4)	4
Corn spurry is found as a weed in cultivated wheat, oats, and flax (New 1961). Records of fossils seeds suggest that corn spurry has been a common weed of flax from the Iron Age (Jessen and Helbaek 1944 cited in New 1961).	
Known level of impact in natural areas (0–6)	0
Corn spurry has been recorded only in disturbed habitats (New 1961). It is not known to cause an impact in any natural areas.	
Role of anthropogenic and natural disturbance in establishment (0–5)	0
Corn spurry requires bare soil for successful establishment (Fenner 1978a, b).	
Current global distribution (0–5)	5
Corn spurry originated from Eurasia. It occurs throughout Europe and also in Asia, North and South Africa, North and South America, Australia, and New Zealand (Hultén 1968). It has been recorded above the Arctic Circle (Natur Historiska Riksmuseet Database 2005).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Corn spurry is found in most American states, and nearly all Canadian provinces (Royer and Dickinson 1999, USDA, NRCS 2006). *Spergula arvensis* is declared noxious in Alberta and Quebec (Rice 2006).	
Total for Ecological Amplitude and Distribution	**14/25**

Feasibility of Control	Score
Seed banks (0–3)	3
The seeds of corn spurry have been reported to remain viable for 6–8 years in formerly cultivated soil (Chippindale and Milton 1934, Roberts and Feast 1973).Viability of seeds was 18% after 6.7 years, and less than 1% after 9.7 years in a seed viability experiment conducted in Fairbanks (Conn and Deck 1995). Seeds of corn spurry were found viable after 22 years in soil beneath pastures (Chippindale and Milton 1934).	
Vegetative regeneration (0–3)	2
Corn spurry is able to produce new branches and often bear flowers and seeds when plants are cut off 2–3 nodes from the ground (New 1961).	
Level of effort required (0–4)	0
Mechanical methods (hand pulling, hoeing, or grazing) before seeds set can be successful in the control of corn spurry. Control actions must be repeated as soil disturbance induces germination of dormant seeds. Chemicals can be used, but corn spurry is resistant to several herbicides. Biocontrol methods are not developed (New 1961, Guide to Weeds in British Columbia 2002). Liming significantly reduces the density of corn spurry in field (Mann 1939).	
Total for Feasibility of Control	**5/10**
Total score for 4 sections	**32/100**

§

Stellaria media (L.) Vill. common names: common chickweed

Ranking Summary

Ecoregion known or expected to occur in			
South Coastal			Yes
Interior Boreal			Yes
Arctic Alpine			Yes

	Potential Max	*Score: All other habitats*	*Score: Maritime bird nesting habitats*
Ecological Impact	40	10	14
Biological Characteristics and Dispersal	25	12	12
Amplitude and Distribution	25	15	20
Feasibility of Control	10	5	8
Relative Maximum		42	54

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Special Note: *Stellaria media* appears to be restricted to anthropogenically disturbed sites in Alaska. There are no thoughts that this weed poses a threat to native plant communities. However, on several arctic and subarctic islands, introduced populations of *Stellaria media* represent an important component of the flora on sea bird colonies sites. These populations on naturally disturbed, high nutrient sites might impact native plant and animal communities. The ecological and community impacts are believed to be different in nutrient rich sea bird colonies and human-disturbed areas; therefore, we assess this impact separately to each type of communities. The ranking values for each question are presented in two columns. The first column represents all nonmaritime nesting bird habitats and the second column represents values specific to maritime nesting bird habitats.

Stellaria media is documented in all ecogeographical regions of Alaska (Hultén 1968, Welsh 1974, AKEPIC 2005UAM 2004,). It is more successful in the cooler and more humid coastal regions of the world (Sobey 1981).

Ecological Impact **Score**

Impact on Ecosystem Processes (0–10) 1-3

Common chickweed is usually found on human disturbed sites. It is unlikely that measurable impacts to ecosystem processes occur due to its presence. It is likely to have some impact on ecosystem processes in sea bird colonies. Common chickweed can form high densities in sea bird colony habitats (Mochalova and Yakubov 2004).

Impact on Natural Community Structure (0–10) 3-3

Common chickweed is able to create dense mats of shoots up to 12 inches long, shading young seedlings of other plants (Lawson 1972, Whitson et al. 2000, Welsh 1974).

Impact on Natural Community Composition (0–10) 1-3

Common chickweed can colonize naturally disturbed, nutrient rich soils and dominate the area (Gillham 1956, Sobey and Kenworthy 1979).

Impact on Higher Trophic Levels (0–10) 5-5

The shoots and seeds of common chickweed are eaten by many animals and birds, both domesticated and wild. Many insect species feed on the plant (Batra 1979, Firbank and Smart 2002, Watson et al. 2003). A large number of nematode species have been reported to attack chickweed (Taylor 1967, Townshend and Davidson 1962, Murant 1970). This plant is also an important host for a number of viruses and fungal species. The flowers of common chickweed are usually self-pollinated; however, cross-pollinating by insects has been recorded. Common chickweed is reported to be potentially toxic to some animals (Case 1957, Sobey 1981). However, in Alaska common chickweed represents a small part of plant community, it is unlikely for common chickweed to have high trophic effects.

Total for Ecological Impact 10-14/40

Biological Characteristics and Dispersal **Score**

Mode of Reproduction (0–3) 3-3

Common chickweed reproduces mainly by seeds. Seed output per plant can vary from 600 to 15 000 (Lutman 2000, Mertens and Jansen 2002, Stevens 1932, Stevens 1957). Vegetative reproduction by fragmentation of stems also can occur (Sobey 1981).

Long-distance dispersal (0–3) 3-3

The seeds can be transported by horses, cattle, deer, pigs, sparrows, quail, and gulls (Gillham 1956, Sobey and Kenworthy 1979). It also is known to be dispersed by ants and earthworms. The seeds are also capable of surviving immersion in sea water (Sobey 1981).

Spread by humans (0–3) 3-3

The seeds can be transported in mud and dust on boots, animal hooves, and machinery. Seeds of chickweed also contaminate some commercial seeds, horticultural stock, and topsoil (Hodkinson and Thompson 1997, Sobey 1981, Turkington et al. 1980, Walton 1975).

Allelopathic (0–2) 2-2

Results of studies indicate that chickweed can be allelopathic to wheat. Both young and mature growth stages of chickweed contribute water-soluble phenolics to the soil and reduce growth of wheat seedlings (Inderjit and Dakshini 1998).

Competitive Ability (0–3) 1-1

Common chickweed is a powerful competitor with annual crop plants, especially in cool wet conditions (Gibson and Courtney 1977, Lawson 1972, Mann and Barnes 1950). However, it has been observed that chickweed can be outcompeted by perennial herbs (Sobey 1981). Welbank (1963) in a comparative study of competitive effects of some weed species found chickweed to have a relatively small effect. Common chickweeds success as a competitor apparently resulted from a rapid root growth, and thus a more efficient exploitation of soil nutrients (Menn and Barnes 1950). The ability to develop adventitious roots on prostrate stem fragments partially covered by soil greatly increases the plants competition potential (Roberts and Stokes 1966). Under favorable conditions, three to five generations may be produced during a year (Johnson et al. 1995, Sobey 1981).

Thicket-forming/Smothering growth form (0–2) 0-0

Common chickweed does not form dense thickets and does not possess a climbing or smothering growth habit (Douglas and MacKinnon 1998, Hultén 1968, Welsh 1974).

Germination requirements (0–3)	0-0
Disturbance is important for chickweed germination and establishment (Sobey and Kenworthy 1979). Removal of vegetation in an experiment in Scotland revealed the importance of disturbance. Common chickweed became established on areas formerly occupied by perennial species (Sobey and Kenworthy 1979).	
Other invasive species in the genus (0–3)	0-0
A number of *Stellaria* species has been introduced to the United States; however, none of them are listed as a noxious weed (USDA, NRCS. 2006).	
Aquatic, wetland or riparian species (0–3)	0-0
In its native range common chickweed is a plant of coastal banks and cliffs, especially in and around the breeding colonies of sea birds and seals. However, it is more often found on cultivated ground and waste places (Douglas and MacKinnon 1998, Sobey 1981, Welsh 1974, Whitson et al. 2000).).	
Total for Biological Characteristics and Dispersal	12-12/25

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4-4
Common chickweed is a weed of crops, vegetable gardens, pastures, and lawns (Alex and Switzer 1976, Sobey 1981, Turkington et al. 1980).	
Known level of impact in natural areas (0–6)	1-3
Common chickweed is well naturalized in breeding colonies of sea birds and seals on the Commander Islands (Mochalova and Yakubov 2004). It is widespread and common on sand dunes and in maritime habitats in Falkland Islands and a number of islands around Antarctica (Broughton and McAdam 2002, Walton 1975). Common chickweed seems to have visible impact on vegetation of sea bird islands. Common chickweed has also been documented under deciduous forests in Ontario, but its impact on ecosystem functions is negligible (Alex and Switzer 1976).	
Role of anthropogenic and natural disturbance in establishment (0–5)	0-3
Common chickweed establishes readily on human-disturbed ground. Additionally, it is known to invade habitats around breeding colonies of sea birds or seals, where the habitat is disturbed by physical suppression, collecting of nest material, and defecation (Sobey and Kenworthy 1979, Walton 1975).	
Current global distribution (0–5)	5-5
Chickweed is native to Europe. It has been spread throughout the world and became one of the most completely cosmopolitan species. It extends from the tropical regions of Africa, South America, and Asia to Arctic and sub-Antarctic islands (Hultén 1968, Mochalova and Yakubov 2004, Polunin 1957, Walton 1975).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5-5
Common chickweed is common throughout the United States and Canada. This species is listed as a noxious weed in Alberta, Manitoba, and Quebec (Rice 2006).	
Total for Ecological Amplitude and Distribution	15-20/25

Feasibility of Control	**Score**
Seed banks (0–3)	3-3
Seeds have been reported to live for at least 20 years (McCloskey et al. 1996). Other authors suggested survival of seeds for 30–35 years (Darlington and Steinbauer 1961, Kivilaan and Bandurski 1981). A dramatic decrease in viability was noted after burial for 6–10 years in studies of Conn and Deck (1995) and Roberts and Feast (1973).	
Vegetative regeneration (0–3)	2-2
Plant fragments have the ability to reroot if partially covered by soil (Guide to weeds in British Columbia 2002, Sobey 1981).	
Level of effort required (0–4)	0-3
Mechanical methods can manage chickweed effectively, but all plant fragments should be removed or deeply buried in the soil since plants shoots have the ability to reroot. Common chickweed can be controlled by a variety of chemicals; however, it is resistant to a number of commonly used herbicides. Strong perennials can be used to prevent chickweed reestablishment (Guide to weeds in British Columbia 2002, Sobey 1981). This weed can be very difficult to control on nutrient rich sites such as vegetable crops fields or sea bird colonies (J. Conn pers. obs.).	
Total for Feasibility of Control	5-8/10
Total score for 4 sections	42-52/100

§

Taraxacum officinale ssp. *officinale* G.H. Weber ex Wiggers

common names: common dandelion

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	18
Biological Characteristics and Dispersal	25	14
Amplitude and Distribution	25	18
Feasibility of Control	10	8
Relative Maximum		58

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Taraxacum officinale has been collected in the south coastal, interior boreal, and arctic alpine ecogeographic regions of Alaska (Hultén 1968, UAM 2004).

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 5

Common dandelion can cause modest impacts on community succession. It likely delays establishment of native species, since it is an early colonizer of recently disturbed areas (Auchmoody and Walters 1988, Densmore et al. 2001, Rutledge and McLendon 1996). Common dandelion reduces the availability of moisture and nutrients for native plants.

Impact on Natural Community Structure (0–10) — 3

In Alaska common dandelion often establishes in an existing herbaceous layer, changing the density of the layer (I. Lapina pers. obs.). It also can form a new herbaceous layer on nearly mineral soil along banks and roadsides (M.L. Carlson & I. Lapina pers. obs.)

Impact on Natural Community Composition (0–10) — 5

Common dandelion is highly competitive. It may reduce the number of individuals of other species in early-successional communities (Royer and Dickinson 1999).

Impact on Higher Trophic Levels (0–10) — 5

Common dandelion is quite palatable and is commonly eaten by moose and bears (J. Snyder pers. obs., P. Spencer pers. obs.), grouse, gophers, deer, elk, and sheep (Esser 1993). Populations of sage grouse and deer benefit from high amounts of dandelion. Common dandelion is important source of nectar and pollen for bees in Alaska (Esser 1993). Its presence may alter pollination ecologies of co-occurring plants. It also is an alternate host for number of viruses (Royer and Dickinson 1999).

Total for Ecological Impact — 18/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3

Common dandelion reproduces entirely by seeds (Densmore et al. 2001, Whitson et al. 2000). Each plant is capable of producing up to 5,000 seeds (Royer and Dickinson 1999). Reproduction from cut pieces is possible (Rutledge and McLendon 1996).

Long-distance dispersal (0–3) — 3

The seeds are wind dispersed; pappus and light seed weight enable seeds to travel long distances. In tall grass prairie communities in Iowa, seeds were blown several hundred meters from the nearest source population (Platt 1975).

Spread by humans (0–3) — 3

Common dandelion is spread by vehicles and horticultural material (Hodkinson and Thompson 1997). It is a common contaminant in crop and forage seeds (Rutledge and McLendon 1996).

Allelopathic (0–2) — 0

Common dandelion is not listed as allelopathic (USDA 2002).

Competitive Ability (0–3) — 1

Common dandelion is very competitive with crops for moisture and nutrients; however, it is a much less aggressive competitor in tall herbaceous communities (Royer and Dickinson 1999, Rutledge and McLendon 1996).

Thicket-forming/Smothering growth form (0–2) — 0

Common dandelion does not grow in very dense stands and does not overtop surrounding vegetation. The stem is very short, leafless flowering stalks grow to 2 feet tall (Welsh 1974).

Germination requirements (0–3) — 0

Common dandelion requires open disturbed soil for germination (Densmore et al. 2001).

Other invasive species in the genus (0–3) — 3

Taraxacum scanicum Dahlstedt (Hultén 1968).

Aquatic, wetland or riparian species (0–3) — 1

Common dandelion grows in moist sites, including lawns, meadows, pastures, and overgrazed areas. It also occurs along highway and railroad rights-of-ways, waste places, and old fields (Royer and Dickinson 1999, Rutledge and McLendon 1996). It is found along riverbanks and terraces in south-central Alaska near anthropogenic disturbance (M.L. Carlson pers. obs.)

Total for Biological Characteristics and Dispersal — 14/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 2

Common dandelion is a weed of lawns, pastures, and cultivated fields (Royer and Dickinson 1999). It also is grown commercially as a salad green in California.

Known level of impact in natural areas (0–6) — 3

Common dandelion has invaded partially disturbed and undisturbed montane forest and alpine communities in Montana (Esser 1993). In Alaska it is observed invading forb meadows in Glacier Bay National Park and Preserve, colonizing burned areas on the Kenai Peninsula, and is reported from Nenana and Stikine Rivers bars (M. Shephard pers. obs., P. Spencer pers. obs.).

Role of anthropogenic and natural disturbance in establishment (0–5) — 3

Common dandelion is reported to not establish where the organic layer is undisturbed. Additionally, it does not persist after it is shaded out by taller native species in natural succession (Densmore et al. 2001). In south-central Alaska, it has established along riverbanks downstream from anthropogenic disturbances, such as boat launches and pull outs (M.L. Carlson pers. obs.)

Current global distribution (0–5) — 5

Common dandelion is of Eurasian origin. It is now introduced into southern Africa, South and North America, New Zealand, Australia, and India (Esser 1993, Hultén 1968).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Common dandelion occurs in all 50 states and almost all Canadian provinces (USDA 2002). It is a noxious weed in Alberta, Manitoba, Quebec, and Saskatchewan (Invaders Database System 2003). It has been reported from all three primary ecogeographic regions of Alaska (Hultén 1968, University of Alaska Museum 2003).	
Total for Ecological Amplitude and Distribution	**18/25**
Feasibility of Control	**Score**
Seed banks (0–3)	3
Common dandelion creates a long-lived seed bank (Esser 1993, Pratt 1984). The seeds of common dandelion were viable up to 5 years in soil samples from Montana (Bard 1952), and up to 9 years in experiments in Nebraska (Burnside et al. 1996).	
Vegetative regeneration (0–3)	2
Common dandelion sprouts from caudex and root crowns (Densmore et al. 2001, Staniforth and Scott 1991, Whitson et al. 2000). Reproduction from cut pieces is possible (Rutledge and McLendon 1996).	
Level of effort required (0–4)	3
Common dandelion can be controlled with repeated chemical and mechanical control measures. Seeding a mixture of native species after treatment is recommended (Densmore et al. 2001, MAFRI 2004).	
Total for Feasibility of Control	**8/10**
Total score for 4 sections	**58/100**

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Tanacetum vulgare L. common names: common tansy, garden tansy

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	20
Biological Characteristics and Dispersal	23	15
Amplitude and Distribution	25	15
Feasibility of Control	10	8
Relative Maximum		**57**

Climatic Comparison		
	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Tanacetum vulgare has been collected in the south coastal and interior boreal ecogeographic regions (Welsh 1974, AKEPIC 2004, UAM 2004). It is widely planted as ornamental in Anchorage and Matanuska–Susitna Valleys. The range of common tansy includes lowlands and mountain valleys north of 70°N (the provinces of Finnmark and Troms in Norway) (Lid and Lid 1994). These regions are north of the Arctic Circle, and include tundra habitats. It is possible for tansy to establish in Alaska's arctic alpine ecogeographic regions.

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	5
Common tansy often grows along streams, watercourses, and ditches where it can restrict waterflow (CWMA 2004).	
Impact on Natural Community Structure (0–10)	5
Common tansy is not known to cause major impacts on natural community structure (U.S. Department of the Interior 2004). In Alaska, it can establish in the existing herbaceous layer and alter the density of the layer (I. Lapina pers. obs.).	
Impact on Natural Community Composition (0–10)	5
Common tansy is likely to affect the availability of water and soil nutrients, therefore, may cause a reduction in the number of individuals of other species (U.S. Department of the Interior 2004).	
Impact on Higher Trophic Levels (0–10)	5
Common tansy has been reported as unpalatable to moderately poisonous; therefore, infestations can alter the quantity of foraging sites (CWMA 2004, Royer and Dickinson 1999, Plants for a Future 2002). It is an alternate host for viruses (Royer and Dickinson 1999).	
Total for Ecological Impact	**20/40**

Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	3
Common tansy reproduces by both seed and stoloniferous rhizomes. Each plant is capable of producing over 50,000 seeds (Royer and Dickinson 1999, Whitson et al. 2000). It is quite aggressive in its vegetative spread (Plants for a Future 2002).	
Long-distance dispersal (0–3)	0
The seeds of common tansy have no adaptation for long-distance dispersal (Royer and Dickinson 1999).	
Spread by humans (0–3)	3
Common tansy has been used as ornamental and medicinal remedy. It has escaped and become widely established. It also is a potential contaminant in commercial seed (CWMA 2004, USDA, ARS 2004).	
Allelopathic (0–2)	U
Unknown	
Competitive Ability (0–3)	1
Common tansy is a moderately successful competitor (U.S. Department of the Interior 2004).	
Thicket-forming/Smothering growth form (0–2)	2
The plant can grow up to 6 feet tall and it is usually taller than surrounding herbaceous vegetation (Royer and Dickinson 1999, Whitson et al. 2000). Its extensive rhizomatous growth can create dense stands.	
Germination requirements (0–3)	2
Common tansy is known to germinate in vegetated areas (U.S. Department of the Interior 2004).	
Other invasive species in the genus (0–3)	3
Tanacetum corymbosum (L.,) Schultz-Bip. and *Tanacetum parthenium* (L.) Schultz-Bip. (ITIS 2002).	

Aquatic, wetland or riparian species (0–3)	1
Common tansy is generally found along roadsides and waste areas. However, it can establish and spread along streambanks and lakeshores (CWMA 2004, Gubanov et al. 1995, Whitson et al. 2000).	
Total for Biological Characteristics and Dispersal	**15/23**

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	2
Common tansy was originally introduced to North America from Europe as an ornamental and for medicinal purposes (CWMA 2004, Whitson et al. 2000). Cultivars have been developed and are widely sold in nurseries (Plants for a Future 2002).	
Known level of impact in natural areas (0–6)	2
In Colorado common tansy is known to cause low impacts in mid-successional sites that were disturbed 11–50 years before (U.S. Department of the Interior 2004). Common tansy invades disturbed prairies in Wisconsin (Wisconsin DNR 2003). It has been observed invading beach meadows in Haines (M. Shephard pers. obs.).	
Role of anthropogenic and natural disturbance in establishment (0–5)	1
Common tansy is generally restricted to disturbed sites (Royer and Dickinson 1999, U.S. Department of the Interior 2004). However, it is growing in undisturbed meadows in Haines (M. Shephard pers. obs.).	
Current global distribution (0–5)	3
Common tansy is a native of Europe and Western Asia and has become established in the United States and Canada (USDA, ARS 2004).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
The introduced range of common tansy includes nearly all states of the United States (USDA 2002). This plant is listed as a noxious weed in Colorado, Minnesota, Montana, Washington, Wyoming, Alberta, British Columbia, and Manitoba (Invaders Database System 2003, USDA 2002).	
Total for Ecological Amplitude and Distribution	**13/25**

Feasibility of Control	**Score**
Seed banks (0–3)	2
The seeds of common tansy remain viable in the soil for 1–5 years (U.S. Department of the Interior 2004).	
Vegetative regeneration (0–3)	2
Plants can sprout from roots or stumps (U.S. Department of the Interior 2004).	
Level of effort required (0–4)	4
Common tansy is an aggressive weed and is difficult to control (CWMA 2004, Plants for a future 2002).	
Total for Feasibility of Control	**8/10**
Total score for 4 sections	**56/98**

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Tragopogon dubius Scop. common names: yellow salsify, goat's beard

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	20
Biological Characteristics and Dispersal	25	11
Amplitude and Distribution	25	16
Feasibility of Control	10	3
Relative Maximum		**50**

Climatic Comparison		
	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	No	Yes
Interior Boreal	Yes	–
Arctic Alpine	No	No

Tragopogon dubius has been collected along Turnagain Arm in the interior boreal ecogeographic region (AKEPIC 2004, UAM 2004). The range of the species includes Portland, Oregon and Vancouver, British Columbia (Pojar and MacKinnon 1994), which have 41% and 40% climatic match with Juneau, respectively (CLIMEX 1999). It withstands winter temperatures to -28 °F and requires 160 frost-free days (USDA 2002). Juneau typically has 165 frost-free days, and winter extreme temperatures reach -22 °F (WRCC 2001). *Tragopogon dubius* is likely to establish in the south coastal region of Alaska. Climatic similarity between Nome and areas where the species is documented is relatively low. This suggests that establishment in the arctic alpine region of Alaska may be not possible.

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	3
Yellow salsify has been observed only along disturbed and partially modified habitats in south-central Alaska. It likely competes with native species for moisture and nutrients. However, it does not appear to cause measurable impacts to ecosystem processes (Rutledge and McLendon 1996). New stabilized hybrid species have been formed in western North America from *T. dubius*, *T. pratensis*, and *T. porrifolius* (Owenby 1950) and become widespread.	
Impact on Natural Community Structure (0–10)	7
Yellow salsify creates a new layer in herbaceous communities (M. Shephard pers. obs.).	
Impact on Natural Community Composition (0–10)	3
Yellow salsify has increased in abundance along the slopes in Turnagain Arm. High densities of plants likely inhibit growth and recruitment of native forbs and grasses (M. Shephard pers. obs.).	
Impact on Higher Trophic Levels (0–10)	7
Yellow salsify is unpalatable to grazing animals. It is attractive to native pollinators in the continental U.S., therefore, may alter pollination ecology of native species in Alaska (M.L. Carlson pers. obs.)	
Total for Ecological Impact	**20/40**

Biological Characteristics and Dispersal	Score
Mode of Reproduction (0–3) Yellow salsify reproduces by seed only. Plants may produce as many as 500 seeds (Royer and Dickinson 1999).	1
Long-distance dispersal (0–3) The seeds are wind dispersed with a pappus of hairs that promote long-distance dispersal (Royer and Dickinson 1999).	3
Spread by humans (0–3) Yellow salsify is a potential seed contaminant (USDA, ARS 2004).	2
Allelopathic (0–2) It is not listed as allelophathic (USDA 2002).	0
Competitive Ability (0–3) Yellow salsify is not an aggressive weed (Rutledge and McLendon 1996); however, it likely competes moderately with native species for moisture and nutrient.	1
Thicket-forming/Smothering growth form (0–2) Although yellow salsify can grow to 3 feet tall (Royer and Dickinson 1999, Whitson et al. 2000), it does not form dense stands or thickets (I. Lapina pers. obs.).	0
Germination requirements (0–3) Seedlings of yellow salsify emerge and survive in different types of vegetative cover, including thick stands (Gross and Werner 1982).	3
Other invasive species in the genus (0–3) A number of *Tragopogon* species has been introduced to North America. *Tragopogon porrifolius* and *T. pratensis* are considered to be weedy (Stebbins 1993). *T. pratensis* hybridizes with other species creating aggressive weedy hybrids *T. ×crantzii* Dichlt. [*dubius* × *pratensis*] and *T. ×neohybridus* Farw. [*porrifolius* × *pratensis*] (USDA, NRCS 2006, Owenby 1950).	1
Aquatic, wetland or riparian species (0–3) Yellow salsify is a common weed of cultivated crops, roadsides, and waste areas (Royer and Dickinson 1999, Rutledge and McLendon 1996) and not of riparian areas or wetlands.	0
Total for Biological Characteristics and Dispersal	11/25

Ecological Amplitude and Distribution	Score
Highly domesticated or a weed of agriculture (0–4) Yellow salsify is a weed of cultivated crop (Rutledge and McLendon 1999).	2
Known level of impact in natural areas (0–6) Yellow salsify has been found in areas disturbed in the last decade. It does not appear to have a perceivable impact on natural plant communities (Rutledge and McLendon 1996). It can establish in relatively high population densities in intact to moderately grazed prairies in Oregon (M.L. Carlson pers. obs.).	3
Role of anthropogenic and natural disturbance in establishment (0–5) Yellow salsify generally occurs on disturbed sites (Rutledge and McLendon 1996). It readily established in grazed prairies. Steep slopes and slides are also susceptible to invasion (M.L. Carlson pers. obs.).	3
Current global distribution (0–5) Native range of yellow saslify includes mid and southern Europe and temperate Asia. It is now established over much of temperate North America (USDA, ARS 2004).	3
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) Yellow salsify occurs in nearly all states of the United States (USDA 2002). This species is considered an invasive weed in Tennessee, Manitoba, and Ontario (Royer and Dickinson 1999).	5
Total for Ecological Amplitude and Distribution	16/25

Feasibility of Control	Score
Seed banks (0–3) Seed longevity for yellow salsify is very short. Generally seeds germinate the next year after dispersal (Chepil 1946).	0
Vegetative regeneration (0–3) Yellow salsify does not resprout after removal of aboveground growth (USDA 2002).	0
Level of effort required (0–4) Multiple years of management (hand pulling) of infestation along Turnagain Arm have been unsuccessful (M. Shephard pers. obs., J. Snyder pers. obs.).	3
Total for Feasibility of Control	3/10
Total score for 4 sections	50/100

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Trifolium hybridum L. common names: alsike clover

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	22
Biological Characteristics and Dispersal	25	12
Amplitude and Distribution	25	18
Feasibility of Control	10	5
Relative Maximum		57

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Alsike clover has been collected in the south coastal, interior boreal, and arctic alpine ecogeographic regions of Alaska (Hultén 1968, UAM 2004).

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 7
Alsike clover alters edaphic conditions due to nitrogen fixation (USDA 2002) and may retard natural succession (Rutledge and McLendon 1996).

Impact on Natural Community Structure (0–10) — 7
Alsike clover establishes in an existing layer, increases the density of the layer, and reduces the cover of graminoids and low forbs (I. Lapina pers obs.).

Impact on Natural Community Composition (0–10) — 5
Alsike clover forms dominant stands and may delay establishment of native species (Rutledge and McLendon 1996).

Impact on Higher Trophic Levels (0–10) — 3
Alsike clover is highly palatable to grazing animals (USDA 2002). This species serves as a host for multiple crop diseases (USDA, ARS 2004).

Total for Ecological Impact — 22/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 1
Alsike clover reproduces only by abundant seed (USDA, NRCS 2001).

Long-distance dispersal (0–3) — 2
Alsike clover has no innate adaptations for long-distance dispersal; however, it does appear to move long distances occasionally (I. Lapina pers. obs.).

Spread by humans (0–3) — 3
It is a widely cultivated forage and cover crop. Additionally, it is seeded along roadsides and banks for erosion control in Alaska (Densmore et al. 2001, Kubanis 1982).

Allelopathic (0–2) — 0
This species is not allelopathic (USDA 2002)

Competitive Ability (0–3) — 1
Alsike clover is moderately competitive for limiting factors. It persists in disturbed areas even when overtopped and shaded by native species (Densmore et al. 2001).

Thicket-forming/Smothering growth form (0–2) — 0
The plant is 6–20 inches tall and usually does not shade other vegetation (Welsh 1974).

Germination requirements (0–3) — 2
The seeds of alsike clover do not germinate until the seed coat is sufficiently scarified. They germinate readily when temperature rises to 25 °C (Rutledge and McLendon 1996). Alsike clover can germinate in vegetated areas (Densmore et al. 2001).

Other invasive species in the genus (0–3) — 3
Trifolium repens L. *T. angustifolium* L., *T. arvense* L., *T. aureum* L., *T. campestre* Schreb., *T. dubium* Sibth., *T. hirtum* All., *T. incarnatum* L., *T. pratense* L., and *T. subterraneum*.

Aquatic, wetland or riparian species (0–3) — 0
Alsike clover is a weed of lawns, roadsides, and disturbed sites (Hultén 1968).

Total for Biological Characteristics and Dispersal — 12/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 4
Alsike clover has been planted for lawns and revegetation on disturbed areas (Kubanis 1982). It has often escaped from cultivation (Hultén 1968, Welsh 1974).

Known level of impact in natural areas (0–6) — 1
Alsike clover is found only on disturbed sites in Alaska (Densmore et al. 2001). In Colorado it is found in degraded native habitats, disturbed in the last 11–50 years (Rutledge and McLendon 1996).

Role of anthropogenic and natural disturbance in establishment (0–5) — 3
In Alaska alsike clover is observed only in disturbed sites (Densmore et al. 2001). It has been found in areas with natural disturbances, such as terraces and banks along glacial rivers and streams (M. Shephard pers. obs.).

Current global distribution (0–5) — 5
Alsike clover is native to Europe, Western Asia, and northern Africa. It has been introduced and naturalized throughout the temperate and subarctic regions of both hemispheres (Hultén 1968).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) — 5
Alsike clover is known from all continental states, except Texas (USDA 2002).

Total for Ecological Amplitude and Distribution — 18/23

Feasibility of Control — Score

Seed banks (0–3) — 2
Some seeds of alsike clover are viable after 3 years of burial in the soil (Rutledge and McLendon 1996).

Vegetative regeneration (0–3) — 0
Alsike clover has no resprouting ability (USDA 2002).

Level of effort required (0–4) — 3
Eradication of alsike clover is nearly impossible from sites (Densmore et al. 2002). However, it is quite sensitive to herbicides and seed viability is not particularly long (J. Conn pers. obs.).

Total for Feasibility of Control — 5/10

Total score for 4 sections — 57/100

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Trifolium pratense L. common names: red clover

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	16
Biological Characteristics and Dispersal	25	12
Amplitude and Distribution	25	16
Feasibility of Control	10	7
Relative Maximum		53

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Trifolium pratense is documented in the south coastal and interior boreal ecogeographic regions of Alaska (Hultén 1968, Welsh 1974, AKEPIC 2005, UAM 2004). The CLIMEX matching program indicates the climatic similarity between the arctic alpine ecogeographic region of Alaska and areas of native range of *Trifolium pratense* are moderately high. The range of red clover includes Røros and Dombås, Norway (Markenschlager 1934, Lid and Lid 1994), which have a 76% and 63% climatic match with Nome. Thus establishment of red clover in the arctic alpine ecogeographic region is likely.

Ecological Impact **Score**

Impact on Ecosystem Processes (0–10) 5

Red clover increases soil nitrogen levels by fixing atmospheric nitrogen (USDA, NRCS 2006). The alteration of soil conditions may delay establishment of native species (Rutledge and McLendon 1996) and facilitate colonization by other exotic plant species.

Impact on Natural Community Structure (0–10) 3

Red clover is capable of creating very dense stands (Gettle et al. 1996a). It produces a large biomass (Gettle et al. 1996b, Hofmann and Isselstein 2004), which influences the structure of the layer. Density of up to 632 stems per m^2 was recorded in field study (Gettle et al. 1996a).

Impact on Natural Community Composition (0–10) 3

Red clover reduces the number of individuals of native species in the community (Gettle et al. 1996a). Density of grasses decreased as density of established red clover increased in switchgrass communities (Gettle et al. 1996a).

Impact on Higher Trophic Levels (0–10) 5

Moose and mule deer graze on red clover in California. The leaves of red clover are also eaten by beaver, woodchuck, muskrat, meadow mice, and sharp-tailed grouse. Seeds are eaten by crow, horned lark, and ruffed and sharp-tailed grouse. Red clover is visited by bumblebees and sometimes by introduced honeybees (Graham 1941).

Total for Ecological Impact 16/40

Biological Characteristics and Dispersal **Score**

Mode of Reproduction (0–3) 1

Red clover reproduces by seeds. It can produce moderate amount of seeds (11–1,000) (Densomore et al. 2001).

Long-distance dispersal (0–3) U

Seeds of red clover are large and do not have a specific adaptation for long-distance dispersal.

Spread by humans (0–3) 2

Red clover escaped cultivation (Rutledge and McLendon 1996, Welsh 1974). The seeds of red clover are commercially available. It has been planted for trials in Alaska (Panciera et al. 1990, Sparrow et al. 1993).

Allelopathic (0–2) 0

Red clover is not allelopathic (USDA, NRCS 2006).

Competitive Ability (0–3) 3

Red clover is capable of outcompeting exotic and native grasses (Gettle et al. 1996a, Hofmann and Isselstein 2004). Red clover has the ability to fix nitrogen (USDA, NRCS 2006). The high establishment success of red clover seedlings in existing swards was obtained in field experiments (see Gettle et al. 1996a). Resources of the large seeds apparently allow seedlings to survive periods of establishment in deep shade of existing vegetation (Hofmann and Isselstein 2004). Once red clover has established it competes with neighboring grasses (Gettle et al. 1996a).

Thicket-forming/Smothering growth form (0–2) 0

In seeded fields red clover can reach a density of 632 plants per m^2 (Gettle et al. 1996a). Red clover has not been observed at high densities in noncultivated sites in Alaska (I. Lapina pers. obs.).

Germination requirements (0–3) 3

Red clover can germinate and establish in existing swards (Gettle et al. 1996b, Hofmann and Isselstein 2004); however, mechanical disturbances that provide gaps in existing vegetation create favorable conditions for the establishment of red clover (Hofmann and Isselstein 2004).

Other invasive species in the genus (0–3) 3

Trifolium arvense L., *T. campestre* Schreb., *T. incarnatum* L., and *T. repens* L. (USDA, NRCS 2006).

Aquatic, wetland or riparian species (0–3) 0

Red clover is often planted as a forage crop, it escapes and establishes on roadsides, clearcuts, lawns, gardens, and meadows (Rutledge and McLendon 1996, Welsh 1974).

Total for Biological Characteristics and Dispersal 12/23

Ecological Amplitude and Distribution **Score**

Highly domesticated or a weed of agriculture (0–4) 4

Red clover is widely planted as a component of pasture and forage mixes. It is recommended for soil improvement. Several varieties have been developed (USDA, NRCS 2006). It was first cultivated in northern Europe around 1650 (Merkenschlager 1934).

Known level of impact in natural areas (0–6) 1

Red clover does not appear to have a perceivable impact on habitats within Rocky Mountain National Park (Rutledge and McLendon 1996).

Role of anthropogenic and natural disturbance in establishment (0–5) 3

If seeded, red clover can successfully establish in pastures (Gettle et al. 1996a, b). Soil disturbances, cutting or grazing of competitive vegetation increases the rate of establishment (Guretzky et al. 2004, Hofmann and Isselstein 2004). It has been found in sites disturbed in the last 11–50 years in Rocky Mountain National Park (Rutledge and McLendon 1996). It is found in Wrangell–St. Elias National Park in sites disturbed within the last 10 years (Densmore et al. 2001).

Current global distribution (0–5)	3
Red clover is native to Southeastern Europe and Asia Minor. Today its distribution includes Europe, Southwest Asia, Africa, and North America (Hultén 1968). Red clover has not been documented in the Arctic (Markenschlager 1934, Lid and Lid 1994, Gubanov et al. 2003).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Red clover can be found throughout the United States and Canada (USDA, NRCS 2006). This species is not considered invasive in North America (Rice 2006).	
Total for Ecological Amplitude and Distribution	**16/25**

Feasibility of Control	Score
Seed banks (0–3)	3
The seeds of red clover remain viable in the soil for 3–5 years (Duvel 1904, Dorph-Petersen 1925). A low survival rate was recorded for seeds stored in undisturbed soil for a period of 20 (Lewis 1973) and even 30 years (Toole 1946).	
Vegetative regeneration (0–3)	2
Varieties of red clover are adapted to be grazed or cut for hay and able to resprout (Densmore et al. 2001, USDA, NRCS 2006).	
Level of effort required (0–4)	2
Red clover can be controlled by mechanical methods (Densmore et al. 2001). It appears to be resistant to some chemicals (Rutledge and McLendon 1996).	
Total for Feasibility of Control	**7/10**
Total score for 4 sections	**51/97**

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Trifolium repens L. common names: white clover, ladino clover, Dutch clover

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	22
Biological Characteristics and Dispersal	25	15
Amplitude and Distribution	25	14
Feasibility of Control	10	8
Relative Maximum		59

Climatic Comparison		
	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Trifolium repens has been collected in the south coastal, interior boreal, and arctic alpine ecogeographic regions of Alaska (Hultén 1968, AKEPIC 2004, UAM 2004).

Ecological Impact	Score
Impact on Ecosystem Processes (0–10)	7
White clover alters edaphic conditions due to nitrogen fixation (USDA 2002). This plant may alter succession by delaying the establishment of native species (Rutledge and McLendon 1996). However, it is primarily associated with anthropogenically altered communities in Alaska (M.L. Carlson pers. obs.).	
Impact on Natural Community Structure (0–10)	7
White clover creates a nearly monospecific low herbaceous forb layer, eliminating graminoids and other low herbaceous species (I. Lapina pers. obs.). *Trifolium repens* occupies the same fundamental niche space as many grasses and dicotyledonous herbs and is in direct competition with these species (Turkington et al. 1979)	
Impact on Natural Community Composition (0–10)	3
White clover may delay the establishment of native species (Rutledge and McLendon 1996). It appears to reduce diversity of native species along roadsides and trail edges in Alaska (M.L. Carlson pers. obs.)	
Impact on Higher Trophic Levels (0–10)	5
White clover produces cyanogenic glycosides that are poisonous to cattle and other herbivores (Ennos 1981). It is an alternate host for alfalfa mosaic and pea mottle viruses (Royer and Dickinson 1999). White clover potentially alters the pollination ecology of ecological communities (M. Carlson pers. obs., J. Snyder prs. obs.).	
Total for Ecological Impact	**22/40**

Biological Characteristics and Dispersal	Score
Mode of Reproduction (0–3)	3
White clover reproduces by seeds and creeping stems that root at nodes (Royer and Dickinson 1999). It is an extremely mobile species by spreading rhizomes (Thórhallsdóttir 1999). It has high seeds abundance (Rutledge and McLendon 1996).	
Long-distance dispersal (0–3)	2
Most seed likely is spread incidentally by the movement of animals and humans (Rutledge and McLendon 1996). However, the plant does not have any adaptations for long-distance dispersal.	
Spread by humans (0–3)	3
White clover is seeded for revegetation on roadsides and other disturbed areas (Densmore et al. 2001). It has been found carried on motor vehicles (Hodkinson and Thompson 1997).	
Allelopathic (0–2)	0
There are no records for allelopathic effects for this species, despite a large volume of literature.	
Competitive Ability (0–3)	2
Its establishment by seed and rhizome fragments is significantly reduced by the presence of graminoid and forb competitors (Turkington et al. 1979), but it is able to invade particular graminoid stands (Thórhallsdóttir 1999). The species has an intermediate level of nitrogen-fixing ability (USDA 2002).	
Thicket-forming/Smothering growth form (0–2)	1
White clover forms dense, low stands due to its rhizomatous growth, but does not overtop taller vegetation (I. Lapina pers. obs.).	

Germination requirements (0–3)	0
Seedlings are rare and only established in disturbed areas, including molehills (Turkington et al. 1979). Soil temperatures of at least 50 °F are required for germination (Royer and Dickinson 1999). The seeds do not germinate until the seed coat is sufficiently broken down (by decay or abrasion) to admit water (Densmore et al. 2001).	
Other invasive species in the genus (0–3)	3
Trifolium angustifolium L., *T. arvense* L., *T. aureum* L., *T. campestre* Schreb., *T. dubium* Sibth., *T. hirtum* All., *T. hybridum* L., *T. incarnatum* L., *T. pratense* L., and *T. subterraneum* L.	
Aquatic, wetland or riparian species (0–3)	1
White clover is a serious weed of lawns, roadsides, and disturbed areas (Hultén 1968; Royer and Dickinson 1999).	
Total for Biological Characteristics and Dispersal	**15/25**
Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
White clover was common as a forage crop in Canada (Royer and Dickinson 1999) It has been widely planted for lawns and revegetation on roadsides and other disturbed areas in Alaska (Densmore et al. 2001).	
Known level of impact in natural areas (0–6)	1
White clover invades prairies in Wisconsin (WDNR 2004).	
Role of anthropogenic and natural disturbance in establishment (0–5)	0
In Alaska white clover is found in sites disturbed in recent years and readily invades open habitats (Densmore et al. 2001). It is relatively shade intolerant (USDA 2002). Frequent, intense grazing encourages growth of white clover (Rutledge and McLendon 1996).	
Current global distribution (0–5)	5
White clover is native to Europe and Asia. It has been introduced to North and southern Africa, North and South America, New Zealand, Australia, Tasmania, and India (Hultén 1968). It is often found north of the Arctic Circle (Royer and Dickinson 1999).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	4
White clover occurs in nearly all states of the United States. It is listed as a weed in Kentucky (USDA 2002).	
Total for Ecological Amplitude and Distribution	**14/25**
Feasibility of Control	**Score**
Seed banks (0–3)	3
Seeds of white clover remain viable in the soil over 30 years (Rutledge and McLendon 1996).	
Vegetative regeneration (0–3)	2
Grazing promotes resprouting of white clover (Rutledge and McLendon 1996).	
Level of effort required (0–4)	3
It is virtually impossible to eradicate white clover from invaded sites (Densmore et al. 2001). Herbicides can be used to control white clover (Rutledge and McLendon 1996).	
Total for Feasibility of Control	**8/10**
Total score for 4 sections	**59/100**

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Tripleurospermum perforata (Merat) M. Lainz — common names: scentless false mayweed, scentless chamomile

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	*Score*
Ecological Impact	40	13
Biological Characteristics and Dispersal	23	13
Amplitude and Distribution	25	15
Feasibility of Control	10	6
Relative Maximum		**48**

Climatic Comparison		
	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	Yes	–

Scentless false mayweed has been collected in the south coastal, interior boreal, and arctic alpine ecogeographic regions of Alaska (AKEPIC 2004, UAM 2004).

Ecological Impact	**Score**
Impact on Ecosystem Processes (0–10)	3
Scentless false mayweed reduces soil moisture and nutrients for other species. It likely causes retardation of successional establishment of native species (NAPPO 2003).	
Impact on Natural Community Structure (0–10)	3
Dense stands of scentless false mayweed in prairies have been reported (CWMA 2000, NAPPO 2003, Parchoma 2004). This plant has not been observed in dense stands in Alaska, but it does increase the density of the early successional herbaceous layer (I. Lapina pers. obs.).	
Impact on Natural Community Composition (0–10)	3
Spring-emergent seedlings can form very dense stands, reducing the growth of seedlings of other species (NAPPO 2003).	
Impact on Higher Trophic Levels (0–10)	4
Scentless false mayweed is unpalatable to animals and can form dense stands in pastures and hayfields, thus altering the quantity of foraging sites (CWMA 2000, Parchoma 2004). The flowers attract bees and flies (Harris and McClay 2003) and may alter the pollination ecology of native communities.	
Total for Ecological Impact	**13/40**
Biological Characteristics and Dispersal	**Score**
Mode of Reproduction (0–3)	3
Scentless false mayweed reproduces entirely by copious amounts of seed. A single plant can produce up to a million seeds, with dense stands capable of producing 1,800,000 seeds per square meter (Harris and McClay 2003, Juras et al. 2004, NAPPO 2003, Parchoma 2004).	

Long-distance dispersal (0–3)	2
The seeds are dispersed by flowing water, wind, and drifting snow (Juras et al. 2004, Parchoma 2004). Up to 26% of seeds remained viable in dung (NAPPO 2003, Rutledge and McLendon 1996). However, the species lacks morphological adaptations for long-distance dispersal. There is no pappus on achenes.	
Spread by humans (0–3)	3
The seeds are easily dispersed by vehicles and as a contaminant in crop seed and hay (Juras et al. 2004, Parchoma 2004).	
Allelopathic (0–2)	U
Unknown	
Competitive Ability (0–3)	0
Scentless false mayweed readily establishes on disturbed sites, but cannot compete with later successional forbs and grasses (Harris and McClay 2003).	
Thicket-forming/Smothering growth form (0–2)	0
Densities of 40 plants per square meter are common on crop fields in Canada (Harris and McClay 2003). It is not observed creating dense thickets in Alaska (I. Lapina pers. obs.).	
Germination requirements (0–3)	3
The seeds are able to germinate under a wide range of temperature and moisture conditions. Germination is better under the canopy than on open, barren soil (Juras et al. 2004).	
Other invasive species in the genus (0–3)	0
None.	
Aquatic, wetland or riparian species (0–3)	2
Scentless false mayweed is found along irrigation ditches, shorelines, streams, and pond edges, as well as roadsides, perennial forage crops, pastures, lawns, gardens, and waste areas (Gubanov et al. 1995, Juras et al. 2004, Parchoma 2004).	
Total for Biological Characteristics and Dispersal	13/23

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
Scentless false mayweed is a one of the major weeds in wheat, lentil, mustard, and flax agriculture (Juras et al. 2004, Royer and Dickinson 1999, Parchoma 2004).	
Known level of impact in natural areas (0–6)	0
Scentless false mayweed does not appear to have a perceivable impact on natural plant communities (Rutledge and McLendon 1996).	
Role of anthropogenic and natural disturbance in establishment (0–5)	1
Scentless false mayweed is often associated with disturbed habitats where there is little competition from established vegetation. Periodic disturbance by cultivation, livestock trampling, or flooding promote establishment (Juras et al. 2004). In Russia it is often associated with natural erosion along streambanks (I. Lapina pers. obs.)	
Current global distribution (0–5)	5
Scentless false mayweed is native to northern and central Europe. It is introduced into North America and Asia. (Juras et al. 2004, NAPPO 2003).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Scentless false mayweed is present in 26 northern states of the United States and in all Canadian provinces (Juras et al. 2004, NAPPO 2003, USDA 2002). It is listed as noxious in Washington and Saskatchewan (Invader Database System 2003). It is considered a weed in Alberta, British Columbia, Manitoba, and Quebec (Royer and Dickinson 1999).	
Total for Ecological Amplitude and Distribution	15/25

Feasibility of Control	**Score**
Seed banks (0–3)	3
The seeds remain viable in the soil for 10–15 years (Harris and McClay 2003, Juras et al. 2004, Rutledge and McLendon 1996).	
Vegetative regeneration (0–3)	1
Scentless false mayweed is reported to survive after removal aboveground growth (Juras et al. 2004).	
Level of effort required (0–4)	2
Scentless false mayweed tends to occupy recently disturbed sites and it does not persist without continued disturbance, thus control is seldom necessary (Harris and McClay 2003). However, multiple weeding treatments across years may be necessary to eliminate plants germinating from buried seeds. A combination of mowing, tillage, and hand weeding can be used for prevent introduction to new areas. This species tolerates many common herbicides. Biological agents have been released in British Columbia to control this species (Juras et al. 2004, Parchoma 2004).	
Total for Feasibility of Control	6/10
Total score for 4 sections	47/98

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Verbascum thapsus L. common names: common mullein, big taper, flannel mullein, flannel plant, great mullein, velvet dock, velvet plant, woolly mullein

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	20
Biological Characteristics and Dispersal	25	9
Amplitude and Distribution	25	16
Feasibility of Control	10	7
Relative Maximum		52

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	No	Yes
Interior Boreal	Yes	–
Arctic Alpine	No	No

Verbascum thapsus is grown in Anchorage for horticultural purposes. There have been reports of mullein growing along the Seward Highway west of Girdwood but this population apparently has not persisted (M. Rasy pers. com., J. Riley pers. com.). *Verbascum thapsus* is known from southern Norway, including Bergen (Lid and Lid 1994), which has a 73% climatic match (CLIMEX 1999) with Juneau (south coastal ecogeographic region). It is likely to be able to establish in this region. According to Lid and Lid (1994), however, this species is rare in the coastal region of Norway. Common mullein is documented from high elevations in the Nord-Trøndelag province in Norway; this area has high similarity of climate with arctic alpine areas in Alaska (Lid and Lid 1994, WRCC 2001). However, according to the Gross and Werner (1978), this species requires a growing season at least 140 days. It is unlikely to establish in the arctic alpine ecoregion.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 5
Common mullein likely alters normal successional pathways. At high densities common mullein appears to prevent the establishment of native herbs and grasses in burned or disturbed areas (Pitcairn 2000).

Impact on Natural Community Structure (0–10) — 5
Common mullein is likely to create a new sparse herbaceous layer (Hoshovsky 2000).

Impact on Natural Community Composition (0–10) — 5
Common mullein is not often a problematic weed of natural areas; however, it can displace native species in sparsely vegetated meadows (Pitcairn 2000).

Impact on Higher Trophic Levels (0–10) — 5
Grazing animals avoid eating mullein (Rutledge and McLendon 1996). Its flowers are visited by a number of insects. Common mullein is also a host for numerous diseases and insect pests. Hybridization is known within the genus (Gross and Werner 1978).

Total for Ecological Impact — 20/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 3
Common mullein reproduces solely by seed. Seed production can be 100,000–180,000 seeds per plant (Gross 1980, Gross and Werner 1982).

Long-distance dispersal (0–3) — 0
Seeds are not adapted to long-distance dispersal. Movement of the stalk by wind or large animals can dispersed seeds as far as 11 m (Gross and Werner 1978, Hoshovsky 1986).

Spread by humans (0–3) — 2
Common mullein was introduced into North America as a medicinal herb. It is often grown as an ornamental (Hoshovsky 1986, Gross and Werner 1978).

Allelopathic (0–2) — 0
This species is not known to be allelopathic (Gross and Werner 1978).

Competitive Ability (0–3) — 0
Common mullein is easily outcompeted by native plants (Hoshovsky 1986, Pitcairn 2000).

Thicket-forming/Smothering growth form (0–2) — 1
Common mullein has been observed at densities of 5.2 flowering plants/m^2 in woodlands 2 years after timber harvest. Gross and Werner (1978) report densities of 1 plant/m^2 and 0.17 plant/m^2 in the 3 and 12 years old fields respectively. The stout flowering stem in the second year of growth can be up to 6 feet tall (Whitson et al. 2000).

Germination requirements (0–3) — 0
Common mullein requires bare soil for successful establishment and growth. In experiments in Ohio and Michigan, 50% emergence of seedlings took 9 days on bare soil, but 30 days on vegetated plots. Seedling growth rates were 4–7 times faster on bare soils, producing 2,000 times more biomass within the same time period (Gross 1984).

Other invasive species in the genus (0–3) — 3
Verbascum blattaria L. is considered a noxious weed in Colorado (USDA 2002).

Aquatic, wetland or riparian species (0–3) — 0
Common mullein is a weed of pastures, abandoned fields, and roadsides (Gross and Werner 1978). It also is can be found in meadows and river bottoms (Rutledge and McLendon 1996).

Total for Biological Characteristics and Dispersal — 9/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 2
Common mullein is not a weed of agricultural crops, as it cannot tolerate tilling (Gross and Werner 1978, Patcairn 2000). It is often grown as an ornamental (Hoshovsky 1986, Gross and Werner 1978).

Known level of impact in natural areas (0–6) — 3
Common mullein can invade undisturbed meadows, displacing native herbs and grasses in California. It also is been observed establishing in burns in the Sierra Nevada Mountains. High densities of rosettes prevent colonization by native species (Pitcairn 2000). Common mullein was reported as not being a problem species in natural areas in Canada (White et al. 1993). Common mullein invades riverbanks in open coniferous forest at British Colombia and Idaho border (J. Snyder pers. com.).

Role of anthropogenic and natural disturbance in establishment (0–5) 3
Common mullein is an initial colonist in newly disturbed sites (Gross and Werner 1978, Pitcairn 2000). Seedling growth rates were faster, producing more biomass within the same time period on bare soils relative to vegetated soils (Gross 1984). Seedlings did not establish in small experimentally created openings, but they did colonize larger openings such as those created by animal digging. Only in the open plots did plants survive and produce seeds (Gross 1980).

Current global distribution (0–5) 3
Common mullein occurs throughout Europe to 64°N in Norway, east into Russia, and south to the Caucasus Mountains and to the western Himalayas. It also is occurs in Asia Minor and China (Lid and Lid 1994, Gross and Werner 1978, Gubanov et al. 1995).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) 5
Common mullein occurs in nearly all of the United States (USDA 2002). In Canada it occurs mainly in Ontario, Quebec, the eastern provinces, and British Columbia (Gross and Werner 1978). *Verbascum tapsus* is a noxious weed in Colorado, Hawaii, and Manitoba (Royer and Dickinson 1999, USDA 2002).

Total for Ecological Amplitude and Distribution 16/25

Feasibility of Control **Score**

Seed banks (0–3) 3
The seeds may remain viable for over 100 years (Kivilaan and Bandurski 1981), and viable seeds have been found in soil samples archaeologically dated from A.D. 1300 (Ødum 1965, cited in Gross and Werner 1978).

Vegetative regeneration (0–3) 1
Plants will not die if cut above the root crown. This will cause increased growth of lateral branches, which will produce flowers later (Gross and Werner 1978).

Level of effort required (0–4) 3
Common mullein is difficult to control because of the large number of seed and long lived seed bank. Hairs on the leaves prevent herbicides from penetrating the leaf surface. Mechanical, chemical and biological control methods can be used for common mullein. Sowing sites with native grasses and forbs may decrease seed germination and the chance of successful establishment. A weevil specific to common mullein was introduced to North America from Europe. The larvae destroy up to 50% of the seeds (Gross and Werner 1978, Hoshovsky 1986, Pitcairn 2000, Rutledge and McLendon 1996).

Total for Feasibility of Control 7/10

Total score for 4 sections 52/100

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Vicia cracca L. common names: bird vetch, cow vetch

Ranking Summary

Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		Yes
	Potential Max.	***Score***
Ecological Impact	40	27
Biological Characteristics and Dispersal	25	16
Amplitude and Distribution	25	21
Feasibility of Control	10	9
Relative Maximum		73

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	Yes	–
Interior Boreal	Yes	–
Arctic Alpine	No	Yes

Vicia cracca has been collected in the south coastal [Seward, Ketchikan, and Unalaska] (UAM 2004) and interior boreal [Anchorage, Wasilla, Fairbanks, Rampart, and Minto] (AKNHP 2003, Hultén 1968, UAM 2004), ecogeographic regions of Alaska. The climatic similarity between Nome and areas where the species is documented has a moderate match (CLIMEX 1999). There is a 77% similarity between Nome and city Chirka-Kem', Russia, where the species occurs (Hultén 1968). Additionally, the range of bird vetch includes Røros, Norway and Arkhangel'sk, Russia (Hultén 1968), which have 76% of climatic matches with Nome respectively. This suggests that establishment of bird vetch in arctic and alpine regions of Alaska may be possible.

Ecological Impact **Score**

Impact on Ecosystem Processes (0–10) 7
Bird vetch alters edaphic conditions due to fixation of atmospheric nitrogen (USDA 2002).

Impact on Natural Community Structure (0–10) 7
Vicia cracca can form dense stands in Alaska. It can overgrow herbaceous vegetation and climb over shrubs, such as alder, willow, and spruce up to 2 m in height, forming a new herbaceous layer (Lapina pers. obs.).

Impact on Natural Community Composition (0–10) 8
Bird vetch quickly overtops herbaceous and low-woody species at boreal forest edges in Alaska. No data is present, but native plant species certainly suffer from its presence (M.L. Carlson pers obs.)

Impact on Higher Trophic Levels (0–10) 5
Bird vetch is highly palatable to grazing and browsing animals (USDA 2002). The seeds of bird vetch are toxic (Cornel University: PPID). Flowers are visited by native bees and may alter pollination ecology of the surrounding area (Aarssen et al. 1986, Klebesadel 1980, M.L. Carlson pers. obs.).

Total for Ecological Impact 27/40

Biological Characteristics and Dispersal **Score**

Mode of Reproduction (0–3) 2
Bird vetch reproduces by seeds and also spreads vegetatively by growth of rhizomes (Aarssen et al. 1986, Klebesadel 1980, Nolen 2002).

Long-distance dispersal (0–3) 2
The seeds of bird vetch are large and not easily dispersed. The pods explosively split open when it dries. Plant can spread when tendrils and vine branches with seed pods cling to vectors, are broken off the plant, and carried to a new location (Densmore et al. 2001).

Spread by humans (0–3)	3
Bird vetch was first planted in Alaska in 1909. Later it was planted at the Fairbanks and Matanuska experiment stations where it was evaluated for forage (Klebesadel 1980). It can be introduced with topsoil (Densmore et al. 2001). Additionally, it can spread along roads on cars and heavy equipment (J. Conn pers. obs., M. Shephard pers. obs.).	
Allelopathic (0–2)	0
This species is not allelopathic (USDA 2002).	
Competitive Ability (0–3)	2
Bird vetch has the ability to fix nitrogen (USDA 2002) and competes for resources with other species.	
Thicket-forming/Smothering growth form (0–2)	2
Bird vetch overgrows herbaceous vegetation and climbs "kudzu-style" up and over shrubs such as alder and willow as well as small spruce trees (Densmore et al. 2001).	
Germination requirements (0–3)	2
Vicia cracca usually establishes in disturbed areas, including those with well-developed vegetation (Densmore et al. 2001). The seeds can easy germinate in wide range of conditions without scarification (J. Snyder unpubl. data).	
Other invasive species in the genus (0–3)	3
Vicia benghalensis L. *V. disperma* DC., *V. hirsuta* (l.) S.F. Gray, *V. lathyroides* L., *V. pannonica* Crantz, *V. sativa* L., *V. tetrasperma* (L.) Schreber, and *V. villosa* Roth.	
Aquatic, wetland or riparian species (0–3)	0
Bird vetch is a weed of roadsides and disturbed areas.	
Total for Biological Characteristics and Dispersal	16/25

Ecological Amplitude and Distribution	**Score**
Highly domesticated or a weed of agriculture (0–4)	4
In Alaska, *Vicia cracca* was introduced as a forage crop in Fairbanks and Palmer (Densmore et al. 2001, Klebesadel 1980).	
Known level of impact in natural areas (0–6)	4
Bird vetch has ability to invade natural areas. The species has been observed growing in open mature deciduous forest near Fairbanks (Densmore et al. 2001), and it penetrates well beyond boreal forest edges in the Susitna Valley (I. Lapina, M.L. Carlson pers. obs.). It is a significant component of grassland in northern Ontario and Quebec (Aarssen et al. 1986).	
Role of anthropogenic and natural disturbance in establishment (0–5)	3
It establishes in disturbed grassy areas and along roadsides (Nolen 2002). From these areas of disturbance bird vetch can invade habitats with moderate amounts of light penetration (M.L. Carlson pers. obs.).	
Current global distribution (0–5)	5
Originally native to Europe, it now occurs in North America, South Africa, temperate Asia, and New Zealand (Hultén 1968).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	5
Bird vetch now ranges from Alaska and British Columbia south and east across Canada to Newfoundland, south to Georgia and Alabama; a total of 36 states (USDA 2002). *Vicia cracca* listed as a noxious weed seed in Alaska (Group B) (Alaska Administrative Code).	
Total for Ecological Amplitude and Distribution	21/25

Feasibility of Control	**Score**
Seed banks (0–3)	3
The seeds do not germinate until the seed coat is sufficiently broken down (by decay or abrasion) to admit water (Densmore et al. 2001). Most hard-seeded legumes have seed dormancy lasting 5 years or more (M.L. Carlson pers. obs.). J. Snyder (unpubl. data) observed vetch seeds germinating without period of dormancy.	
Vegetative regeneration (0–3)	2
There is strong vegetative growth from dormant buds of belowground roots (Aarssen et al. 1986).	
Level of effort required (0–4)	4
This species is very difficult to eradicate once established	
Total for Feasibility of Control	9/10
Total score for 4 sections	73/100

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Vicia villosa Roth common names: winter vetch, hairy vetch

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	22
Biological Characteristics and Dispersal	22	11
Amplitude and Distribution	19	12
Feasibility of Control	10	3
Relative Maximum		53

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	No	Yes
Interior Boreal	Yes	–
Arctic Alpine	No	No

Vicia villosa is reported from interior boreal ecogeographic region of Alaska (Hultén 1968). The climatic similarity between Nome and areas where the species is documented is relatively low (CLIMEX 1999). This species withstands winter temperatures to -30 °F (some cultivars to 7 °F), and requires 100 frost-free days (USDA 2002). Winter temperature in Nome can reach -54 °F (WRCC 2001) and the number of frost-free days is at the physiological limit of *Vicia villosa*. It is unlikely to establish in the arctic alpine ecogeographic region of Alaska. V*icia villosa* has been reported from Bergen, Norway (Lid and Lid 1994), which has 76% climatic similarity with Juneau. Thus establishment in south coastal ecogeographic region of Alaska is possible.

Ecological Impact — **Score**

Impact on Ecosystem Processes (0–10) — 7
Hairy vetch alters edaphic conditions due to fixation of atmospheric nitrogen (USDA 2002). It can significantly reduce available soil water (Nielson and Vigil 2005).

Impact on Natural Community Structure (0–10) — 7
Hairy vetch often overgrows herbaceous vegetation and forms a dense herbaceous layer (Whitson et al. 2000).

Impact on Natural Community Composition (0–10) — 3
Hairy vetch overtops herbaceous and low-woody species and can cause reductions in the number of individual native species in the community (M. Shephard pers. obs.).

Impact on Higher Trophic Levels (0–10) — 5
Hairy vetch is reported to be both slightly toxic and highly palatable to grazing animals (USDA 2002). The foliage of hairy vetch is eaten by deer (Graham 1941). *Vicia* species host several insect pests and disease organisms. The flowers are visited by native bees and may alter pollination ecology of the surrounding area (Aarssen et al. 1986).

Total for Ecological Impact — 22/40

Biological Characteristics and Dispersal — **Score**

Mode of Reproduction (0–3) — 1
Winter vetch reproduces by seed only (Aarssen et al. 1986). This plant produces moderate amounts of seed (USDA 2002).

Long-distance dispersal (0–3) — 0
The seeds are large and are not easily dispersed (M. Shephard pers. obs.).

Spread by humans (0–3) — 2
Hairy vetch is a forage plant that sometimes escapes cultivation (Welsh 1974). It is a crop seed contaminant (USDA, ARS 2004).

Allelopathic (0–2) — 0
None (USDA 2002).

Competitive Ability (0–3) — 3
Winter vetch has the ability to fix nitrogen (USDA 2002) and it competes for resources with other species. Winter vetch is a very hardy species. It demonstrates high frost, drought, and flood tolerance (Brandsæter et al. 2002, Walsh and Skujins 1981, Hoveland and Donnelly 1966).

Thicket-forming/Smothering growth form (0–2) — 2
Winter vetch has a climbing growth habit with stems up to 6 feet long (Hultén 1968).

Germination requirements (0–3) — U
Unknown

Other invasive species in the genus (0–3) — 3
Vicia cracca L., *V. sativa* ssp. *nigra* (L.) Ehrh, *V. benghalensis* L., *V. disperma* DC., *V. hirsuta* (L.) S.F. Gray, *V. lathyroides* L., *V. pannonica* Crantz, and *V. tetrasperma* (L.) Schreber (Hultén 1968, USDA 2002, Whitson et al. 2000).

Aquatic, wetland or riparian species (0–3) — 0
Winter vetch has escaped cultivation and is common along roadsides and disturbed areas (Whitson et al. 2000).

Total for Biological Characteristics and Dispersal — 11/22

Ecological Amplitude and Distribution — **Score**

Highly domesticated or a weed of agriculture (0–4) — 4
Winter vetch has been used as a both a forage and rotation crop (Welsh 1974, Whitson et al. 2000).

Known level of impact in natural areas (0–6) — U
Unknown.

Role of anthropogenic and natural disturbance in establishment (0–5) — 0
Winter vetch establishes in areas with anthropogenic soil disturbance (Pojar and MacKinnon 1994, Whitson et al. 2000).

Current global distribution (0–5) — 3
Native range of winter vetch includes northern Africa, temperate Asia, and Europe (USDA, ARS 2004).

Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5) — 5
Winter vetch occurs in nearly all American states (USDA 2002). It is not considered noxious in North America (Invaders Database System 2003).

Total for Ecological Amplitude and Distribution — 12/19

Feasibility of Control — **Score**

Seed banks (0–3) — 0
The seeds of winter vetch can remain viable for less than 2 years (McKee and Musil 1984).

Vegetative regeneration (0–3) — 1
Some of the winter vetch cultivars have good regrowth ability (Brandsæter et al. 2002).

Level of effort required (0–4) — 2
Control of winter vetch can be achieved relatively easily by mechanical methods or herbicides applications (Aarssen et al. 1986).

Total for Feasibility of Control — 3/10

Total score for 4 sections — 48/91

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Zostera japonica Aschers. & Graebn.

common names: dwarf eelgrass

Ranking Summary		
Ecoregion known or expected to occur in		
South Coastal		Yes
Interior Boreal		Yes
Arctic Alpine		No
	Potential Max.	*Score*
Ecological Impact	40	30
Biological Characteristics and Dispersal	25	10
Amplitude and Distribution	25	8
Feasibility of Control	3	1
Relative Maximum		53

Climatic Comparison

	Collected in Alaska regions?	*CLIMEX similarity?*
South Coastal	No	Yes
Interior Boreal	No	Yes
Arctic Alpine	No	No

Zostera japonica has not been collected in Alaska (Hultén 1968, Welsh 1974, AKEPIC 2004, UAM 2004). *Zostera japonica* is a native of subtropical to cool seacoasts ranging from Vietnam, East Asia, mainland Russia, and the Sakhalin Islands (Miki 1933, Shin and Choi 1998). The CLIMEX matching program indicates the climatic similarity between Juneau and Akita, Japan is 55%. The native range of this species also includes Vladivostok and Nevel'sk, Russia which have a 60% and 57% climatic match with Anchorage, respectively. Aquatic species are generally less susceptible to variation in terrestrial climates. Climatic matches between the species' native range and Nome are low however. Dwarf eelgrass is likely to establish in the south coastal and the coastal portions of the interior boreal regions of Alaska.

Ecological Impact — Score

Impact on Ecosystem Processes (0–10) — 8

The colonization of sparsely vegetated or bare intertidal flats by dwarf eelgrass represents a drastic modification of habitat. Increased eelgrass coverage slows waterflow which increases sedimentation and reduces mean sediment grain size. Eventually eelgrass patches may raise the elevation of mudflats and disrupt ocean currents (Harrison and Bigley 1982, Posey 1988). Significant changes in the ecology of intertidal sediments are predicted as the exotic eelgrass spreads to potential habitat in North America (Harrison and Bigley 1982).

Impact on Natural Community Structure (0–10) — 7

Dwarf eelgrass can form dense mats on previously bare intertidal flats (Harrison and Bigley 1982). Faunal richness and abundance can be higher in patches of introduced eelgrass compared to adjacent unvegetated areas (Posey 1988).

Impact on Natural Community Composition (0–10) — 8

Dwarf eelgrass is not likely to displace native co-occurring eelgrasses (Harrison 1982). Although the introduction of dwarf eelgrass can decrease shrimp and tubeworm populations (Harrison 1987). The richness and number of other species may be increased by the vegetative cover (Posey 1988).

Impact on Higher Trophic Levels (0–10) — 7

Dwarf eelgrass provides habitat and food for invertebrates, fish, and birds, but degrades the quality of habitat for shrimp and tubeworms (Harrison 1987).

Total for Ecological Impact — 30/40

Biological Characteristics and Dispersal — Score

Mode of Reproduction (0–3) — 2

Dwarf eelgrass produces an abundance of seeds (Harrison 1979, Harrison and Bigley 1982).

Long-distance dispersal (0–3) — 1

Vegetative and flowering plants have been seen uprooted and floating, but it is not known if they can become established. Birds grazing on seeds may act as dispersal vectors (Harrison and Bigley 1982).

Spread by humans (0–3) — 2

Dwarf eelgrass was apparently introduced to North America with shipments of oysters (Carlton 1989). This plant may be transported inadvertently when entangled with boating or fishing gear (Harrison and Bigley 1982).

Allelopathic (0–2) — 0

No records concerning allelopathy were found.

Competitive Ability (0–3) — 0

Zostera japonica grows in the intertidal zone with *Z. marina* in both Japan and North America. Competition from *Zostera marina* may limit the growth of *Z. japonica* (Harrison 1982). *Zostera marina* usually has well developed rhizomes and roots which penetrate deeper into the sediment than those of *Z. japonica* (Harrison 1982).

Thicket-forming/Smothering growth form (0–2) — 0

Dwarf eelgrass is not characterized by climbing or smothering growth habit, and is not taller than the surrounding vegetation (Flora of North America 1993, Hitchcock et al. 1969, Shin and Choi 1998).

Germination requirements (0–3) — 2

Dwarf eelgrass requires bare sand or mud for germination and establishment (Harrison and Bigley 1982), but usually does not establish in disturbed areas (Harrison 1987).

Other invasive species in the genus (0–3) — 0

No other *Zostera* species are known as weeds (USDA 2002).

Aquatic, wetland or riparian species (0–3) — 3

Dwarf eelgrass inhabits the intertidal zone of sandy or muddy coasts (Harrison and Bigley 1982, Hitchcock 1969, Shin and Choi 1998).

Total for Biological Characteristics and Dispersal — 10/25

Ecological Amplitude and Distribution — Score

Highly domesticated or a weed of agriculture (0–4) — 0

Dwarf eelgrass is not an agricultural weed nor is it grown deliberately.

Known level of impact in natural areas (0–6) — 3

Colonization of sand flats by native and exotic eelgrasses has reduced the population range of the burrowing shrimp in British Columbia (Harrison 1987). Dense populations of dwarf eelgrass infest approximately 17,000 ha of intertidal flats in Washington (Harrison and Bigley 1982).

Role of anthropogenic and natural disturbance in establishment (0–5) — 5

Dwarf eelgrass may establish on undisturbed bare sand or mud. Dredging, filling, and erosion associated with dike or port construction are known to inhibit the establishment and expansion of infestations (Harrison 1987).

Current global distribution (0–5)	0
Dwarf eelgrass is distributed on sandy and muddy shores of sheltered bays from subtropical Vietnam to East Asia, mainland Russia, and the Sakhalin Islands (Shin and Choi 1998). It has been recently introduced to British Columbia, Oregon, and Washington (Harrison and Bigley 1982, Hitchcock 1969).	
Extent of the species U.S. range and/or occurrence of formal state or provincial listing (0–5)	0
Dwarf eelgrass has been recently introduced to British Columbia, Oregon, and Washington (Harrison and Bigley 1982, Hitchcock 1969). This plant is not listed in any state as noxious weed (Invaders Database System 2003, USDA 2002).	
Total for Ecological Amplitude and Distribution	8/25

Feasibility of Control	**Score**
Seed banks (0–3)	U
No records are found concerning seed viability.	
Vegetative regeneration (0–3)	1
Although dwarf eelgrass is capable of resprouting from rhizomes when storms remove the aboveground biomass, resprouting is usually not very vigorous (Harrison 1979).	
Level of effort required (0–4)	U
Control methods for dwarf eelgrass have not been investigated.	
Total for Feasibility of Control	1/3
Total score for 4 sections	49/93

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Appendix C. Blank Invasiveness Form

Alaska non-native plant invasiveness ranking form

Botanical name: ______________________________

Common name: ______________________________

Assessors: ______________ | ______________

Reviewers: ______________ | ______________

______________ | ______________

Date: ______________ ***Date of previous ranking, if any:*** ______________

Outcome score:

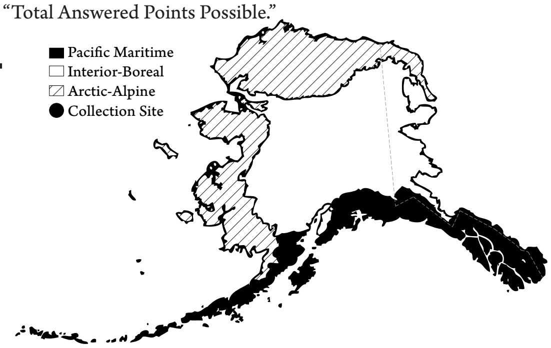
A. Climatic Comparison

This species is present or may potentially establish in the following eco-geographic regions:

1	South Coastal		
2	Interior-Boreal		
3	Arctic-Alpine		

B.	**Invasiveness Ranking**	**Total (Total Answered[1] Points Possible)**	**Total**
1	Ecological impact	40 (__)	
2	Biological characteristic and dispersal ability	25 (__)	
3	Ecological amplitude and distribution	25 (__)	
4	Feasibility of control	10 (__)	
	Outcome score	100 (__)[b]	[a]
	Relative maximum score[2]		

[1] For questions answered "unknown" do not include point value for the question in parentheses for "Total Answered Points Possible."
[2] Calculated as a/b × 100.



A. Climatic Comparison:

1.1. ***Has this species ever been collected or documented in Alaska?***

- [ ] Yes – continue to 1.2
- [ ] No – continue to 2.1

1.2. ***Which ecogeographic region has it been collected or documented (see inset map)? Proceed to Section B. Invasiveness Ranking.***

- [ ] South Coastal
- [ ] Interior-Boreal
- [ ] Arctic-Alpine

Documentation:
Sources of information:

2.1. ***Is there a 40 percent or higher similarity (based on CLIMEX climate matching) between climates any where the species currently occurs and***

a. Juneau (South Coastal Region)?
- [ ] Yes – record locations and similarity; proceed to Section B. Invasiveness Ranking
- [ ] No

b. Fairbanks (Interior-Boreal)?
- [ ] Yes – record locations and similarity; proceed to Section B. Invasiveness Ranking
- [ ] No

c. Nome (Arctic-Alpine)?
- [ ] Yes – record locations and similarity; proceed to Section B. Invasiveness Ranking
- [ ] No

–If "No" is answered for all regions, reject species from consideration

Documentation:
Sources of information:

B. Invasiveness Ranking

1. Ecological Impact

1.1. Impact on Natural Ecosystem Processes

A.	No perceivable impact on ecosystem processes	0
B.	Has the potential to influences ecosystem processes to a minor degree (e.g., has a perceivable but mild influence on soil nutrient availability)	3
C.	Has the potential to cause significant alteration of ecosystem processes (e.g., increases sedimentation rates along streams or coastlines, reduces open water that are important to waterfowl)	7
D.	May cause major, possibly irreversible, alteration or disruption of ecosystem processes (e.g., the species alters geomorphology; hydrology; or affects fire frequency, altering community composition; species fixes substantial levels of nitrogen in the soil making soil unlikely to support certain native plants or more likely to favor non-native species)	10
U.	Unknown	

Score

Documentation:
Identify ecosystem processes impacted:
Rational:
Sources of information:

1.2. Impact on Natural Community Structure

A.	No perceived impact; establishes in an existing layer without influencing its structure	0
B.	Has the potential to influences structure in one layer (e.g., changes the density of one layer)	3
C.	Has the potential to cause significant impact in at least one layer (e.g., creation of a new layer or elimination of an existing layer)	7
D.	Likely to cause major alteration of structure (e.g., covers canopy, eradicating most or all layers below)	10
U.	Unknown	

Score

Documentation:
Identify type of impact or alteration:
Rational:
Sources of information:

1.3. Impact on Natural Community Composition

A.	No perceived impact; causes no apparent change in native populations	0
B.	Has the potential to influences community composition (e.g., reduces the number of individuals in one or more native species in the community)	3
C.	Has the potential to significantly alters community composition (e.g., produces a significant reduction in the population size of one or more native species in the community)	7
D.	Likely to cause major alteration in community composition (e.g., results in the extirpation of one or several native species, reducing biodiversity or change the community composition towards species exotic to the natural community)	10
U.	Unknown	

Score

Documentation:
Identify type of impact or alteration:
Rational:
Sources of information:

1.4. Impact on higher trophic levels (cumulative impact of this species on the animals, fungi, microbes, and other organisms in the community it invades)

A.	Negligible perceived impact	0
B.	Has the potential to cause minor alteration	3
C.	Has the potential to cause moderate alteration (minor reduction in nesting/foraging sites, reduction in habitat connectivity, interference with native pollinators, injurious components such as spines, toxins)	7
D.	Likely to cause severe alteration of higher trophic populations (extirpation or endangerment of an existing native species/population, or significant reduction in nesting or foraging sites)	10
U.	Unknown	

Score

Documentation:
Identify type of impact or alteration:
Rational:
Sources of information:

Total Possible [ ]
Total [ ]

2. Biological Characteristics and Dispersal Ability

2.1. Mode of reproduction

A.	Not aggressive reproduction (few [0-10] seeds per plant and no vegetative reproduction)	0
B.	Somewhat aggressive (reproduces only by seeds (11-1,000/m²)	1
C.	Moderately aggressive (reproduces vegetatively and/or by a moderate amount of seed, <1,000/m²)	2
D.	Highly aggressive reproduction (extensive vegetative spread and/or many seeded, >1,000/m²)	3
U.	Unknown	

Score [ ]

Documentation:
Describe key reproductive characteristics (including seeds per plant):
Rational:
Sources of information:

2.2. Innate potential for long-distance dispersal (bird dispersal, sticks to animal hair, buoyant fruits, wind-dispersal)

A.	Does not occur (no long-distance dispersal mechanisms)	0
B.	Infrequent or inefficient long-distance dispersal (occurs occasionally despite lack of adaptations)	2
C.	Numerous opportunities for long-distance dispersal (species has adaptations such as pappus, hooked fruit-coats, etc.)	3
U.	Unknown	

Score [ ]

Documentation:
Identify dispersal mechanisms:
Rational:
Sources of information:

2.3. Potential to be spread by human activities (both directly and indirectly—possible mechanisms include: commercial sales, use as forage/revegetation, spread along highways, transport on boats, contamination, etc.)

A.	Does not occur	0
B.	Low (human dispersal is infrequent or inefficient)	1
C.	Moderate (human dispersal occurs)	2
D.	High (there are numerous opportunities for dispersal to new areas)	3
U.	Unknown	

Score [ ]

Documentation:
Identify dispersal mechanisms:
Rational:
Sources of information:

2.4. Allelopathic

A.	No	0
B.	Yes	2
U.	Unknown	

Score [ ]

Documentation:
Describe effect on adjacent plants:
Rational:
Sources of information:

2.5. Competitive ability

A.	Poor competitor for limiting factors	0
B.	Moderately competitive for limiting factors	1
C.	Highly competitive for limiting factors and/or nitrogen fixing ability	3
U.	Unknown	

Score [ ]

Documentation:
Evidence of competitive ability:
Rational:
Sources of information:

2.6. Forms dense thickets, climbing or smothering growth habit, or otherwise taller than the surrounding vegetation

A.	No	0
B.	Forms dense thickets	1
C.	Has climbing or smothering growth habit, or otherwise taller than the surrounding vegetation	2
U.	Unknown	

Score [ ]

Documentation:
Describe grow form:
Rational:
Sources of information:

2.7. Germination requirements

A.	Requires open soil and disturbance to germinate	0
B.	Can germinate in vegetated areas but in a narrow range or in special conditions	2
C.	Can germinate in existing vegetation in a wide range of conditions	3
U.	Unknown	

Score [ ]

Documentation:
Describe germination requirements:
Rational:
Sources of information:

2.8. Other species in the genus invasive in Alaska or elsewhere

A.	No	0
B.	Yes	3
U.	Unknown	

Score [ ]

Documentation:
Species:
Sources of information:

2.9. Aquatic, wetland, or riparian species

A.	Not invasive in wetland communities	0
B.	Invasive in riparian communities	1
C.	Invasive in wetland communities	3
U.	Unknown	

Score [ ]

Documentation:
Describe type of habitat:
Rational:
Sources of information:

Total Possible [ ]
Total [ ]

3. Distribution

3.1. Is the species highly domesticated or a weed of agriculture

A.	No	0
B.	Is occasionally an agricultural pest	2
C.	Has been grown deliberately, bred, or is known as a significant agricultural pest	4
U.	Unknown	
	Score	

Documentation:
Identify reason for selection, or evidence of weedy history:
Rational:
Sources of information:

3.2. Known level of ecological impact in natural areas

A.	Not known to cause impact in any other natural area	0
B.	Known to cause impacts in natural areas, but in dissimilar habitats and climate zones than exist in regions of Alaska	1
C.	Known to cause low impact in natural areas in similar habitats and climate zones to those present in Alaska	3
D.	Known to cause moderate impact in natural areas in similar habitat and climate zones	4
E.	Known to cause high impact in natural areas in similar habitat and climate zones	6
U.	Unknown	
	Score	

Documentation:
Identify type of habitat and states or provinces where it occurs:
Sources of information:

3.3. Role of anthropogenic and natural disturbance in establishment

A.	Requires anthropogenic disturbances to establish	0
B.	May occasionally establish in undisturbed areas but can readily establish in areas with natural disturbances	3
C.	Can establish independent of any known natural or anthropogenic disturbances	5
U.	Unknown	
	Score	

Documentation:
Identify type of disturbance:
Rational:
Sources of information:

3.4. Current global distribution

A.	Occurs in one or two continents or regions (e.g., Mediterranean region)	0
B.	Extends over three or more continents	3
C.	Extends over three or more continents, including successful introductions in arctic or subarctic regions	5
U.	Unknown	
	Score	

Documentation:
Describe distribution:
Rational:
Sources of information:

3.5. Extent of the species U.S. range and/or occurrence of formal state or provincial listing

A.	0-5 percent of the states	0
B.	6-20 percent of the states	2
C.	21-50 percent, and/or state listed as a problem weed (e.g., "Noxious," or "Invasive") in 1 state or Canadian province	4
D.	Greater than 50 percent, and/or identified as "Noxious" in 2 or more states or Canadian provinces	5
U.	Unknown	
	Score	

Documentation:
Identify states invaded:
Rational:
Sources of information:

Total Possible
Total

4. Feasibility of Control

4.1. Seed banks

A.	Seeds remain viable in the soil for less than 3 years	0
B.	Seeds remain viable in the soil for between 3 and 5 years	2
C.	Seeds remain viable in the soil for 5 years and more	3
U.	Unknown	
	Score	

Documentation:

Identify longevity of seed bank:
Rational:
Sources of information:

4.2. Vegetative regeneration

A.	No resprouting following removal of aboveground growth	0
B.	Resprouting from ground-level meristems	1
C.	Resprouting from extensive underground system	2
D.	Any plant part is a viable propagule	3
U.	Unknown	
	Score	

Documentation:

Describe vegetative response:
Rational:
Sources of information:

4.3. Level of effort required

A.	Management is not required (e.g., species does not persist without repeated anthropogenic disturbance)	0
B.	Management is relatively easy and inexpensive; requires a minor investment in human and financial resources	2
C.	Management requires a major short-term investment of human and financial resources, or a moderate long-term investment	3
D.	Management requires a major, long-term investment of human and financial resources	4
U.	Unknown	
	Score	

Documentation:

Identify types of control methods and time-term required:
Rational:
Sources of information:

Total Possible	
Total	
Total for 4 sections Possible	
Total for 4 sections	

References: