ALASKA NON-NATIVE PLANT INVASIVENESS RANKING FORM

Botanical name: *Lotus corniculatus* L.
Common name: birdsfoot trefoil
Assessors:

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Date: 3/7/2011
Date of previous ranking, if any: 4T

OUTCOME SCORE:

CLIMATIC COMPARISON
This species is present or may potentially establish in the following eco-geographic regions:

Pacific Maritime	Yes
Interior-Boreal	Yes
Arctic-Alpine	Yes

INVASIVENESS RANKING	**Total** (total answered points possible[1])	**Total**
Ecological impact	40 (40)	22
Biological characteristics and dispersal ability	25 (25)	16
Ecological amplitude and distribution	25 (25)	18
Feasibility of control	10 (10)	9
Outcome score	100 (100)[b]	65[a]
Relative maximum score[2]		**65**

[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

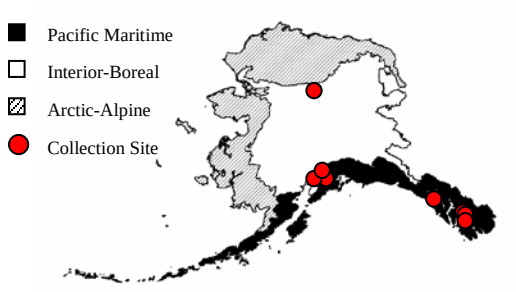
A. CLIMATIC COMPARISON

1.1. Has this species ever been collected or documented in Alaska?

☒ Yes - continue to 1.2
☐ No - continue to 2.1

1.2. From which eco-geographic region has it been collected or documented (see inset map)? Proceed to Section B. INVASIVNESS RANKING

☒ Pacific Maritime
☒ Interior-Boreal
☐ Arctic-Alpine



Documentation: *Lotus corniculatus* has been documented from the Pacific Maritime and Interior-Boreal ecogeographic regions of Alaska (AKEPIC 2011, UAM 2011).

2.1. Is there a 40 percent or higher similarity (based on CLIMEX climate matching, see references) between climates where this species currently occurs and:

a. Juneau (Pacific Maritime region)?
☐ Yes – record locations and percent similarity; proceed to Section B.
☐ No

b. Fairbanks (Interior-Boreal region)?
☐ Yes – record locations and percent similarity; proceed to Section B.
☐ No

c. Nome (Arctic-Alpine region)?
☒ Yes – record locations and percent similarity; proceed to Section B.
☐ No

If "No" is answered for all regions; reject species from consideration

Documentation: *Lotus corniculatus* has been documented from sites near Lærdalsøyri, Lillehammer, and Dombås, Norway, which have 45%, 49%, and 63% climatic similarities with Nome, respectively (CLIMEX 1999, Norwegian Species Observation Service 2011). It is known to grow in areas in Finland, Estonia, Latvia, Lithuania, Belarus, and Russia that have 40% or greater climatic similarities with Nome (CLIMEX 1999, Dzyubenko et al. 2003, NatureGate 2011).

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 influence 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, degrades habitat important to waterfowl)	7
d.	Has the potential to cause major, possibly irreversible, alteration or disruption	10

of ecosystem processes (e.g., the species alters geomorphology, hydrology, or affects fire frequency thereby 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)

e. Unknown U

Score **7**

Documentation: The roots of *Lotus corniculatus* are associated with bacteria that fix atmospheric nitrogen; thus, populations increase the availability of nitrogen in the soil. This species often forms dense, fibrous root networks (Jones and Turkington 1986) that reduce soil erosion (DiTomaso and Healy 2007).

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 influence 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, eliminating most or all lower layers) 10

e. Unknown U

Score **5**

Documentation: *Lotus corniculatus* can form dense mats (Turkington and Franko 1980) and likely increases the density of vegetation in disturbed areas. In Alaska, 25% of infestations have occurred at or above 20% ground cover (AKEPIC 2011).

1.3. Impact on Natural Community Composition

a. No perceived impact; causes no apparent change in native populations 0

b. Has the potential to influence community composition (e.g., reduces the population size of one or more native species in the community) 3

c. Has the potential to significantly alter community composition (e.g., significantly reduces 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 more native species, thereby reducing local biodiversity and/or shifting the community composition towards exotic species) 10

e. Unknown U

Score **5**

Documentation: *Lotus corniculatus* can form dense mats that outshade surrounding vegetation (Winter and Yalch 1996).

1.4. Impact on associated 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 (e.g., causes a minor reduction in nesting or foraging sites) 3

c. Has the potential to cause moderate alteration (e.g., causes a moderate reduction in habitat connectivity, interferes with native pollinators, or introduces injurious components such as spines, toxins) 7

d. Likely to cause severe alteration of associated trophic populations (e.g., extirpation or endangerment of an existing native species or population, or significant reduction in nesting or foraging sites) 10

e. Unknown U

Score **5**

Documentation: *Lotus corniculatus* is a highly nutritious forage that, unlike many legumes, does not cause bloating (Turkington and Franko 1980). This species sometimes produces cyanogenic glucosides that discourage herbivory by mollusks and insects but rarely cause symptoms in livestock (Turkington and Franko 1980, Jones and Turkington 1986, DiTomaso and Healy 2007). Flowers are pollinated by bees (Turkington and Franko 1980); therefore, the presence of *Lotus corniculatus* may alter native plant-pollinator interactions.

Total Possible 40

Total **22**

2. Biological Characteristics and Dispersal Ability

2.1. Mode of reproduction

a. Not aggressive (produces few seeds per plant [0-10/m^2] and not able to reproduce vegetatively). 0

b. Somewhat aggressive (reproduces by seed only [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 (extensive vegetative spread and/or many seeded [>1,000/m^2]) 3

e. Unknown U

Score **3**

Documentation: *Lotus corniculatus* reproduces sexually by seeds and vegetatively under certain conditions. Most cultivars do not produce rhizomes; however, rhizomatous cultivars have been developed (Beuselinck et al. 2005). Roots can produce new shoots in spring, when the crown is damaged, or when roots are fragmented (DiTomaso and Healy 2007, Dzyubenko and Dzyubenko 2009). Older, prostrate stems can sometimes root in bare soil (Turkington and Franko 1980), and some varieties have stoloniferous growth habits (Jones and Turkington 1986). This species can produce over 18,000 seeds per plant (Jones and Turkington 1986).

2.2. Innate potential for long-distance dispersal (wind-, water- or animal-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

d. Unknown U

Score **2**

Documentation: The pods open forcefully and can launch seeds up to 1.75 m from the parent plant (Jones and Turkington 1986). Seeds remain viable after being ingested and can be dispersed by birds and deer (Turkington and Franko 1980, Jones and Turkington 1986, Williams and Ward 2006).

2.3. Potential to be spread by human activities (both directly and indirectly – possible mechanisms include: commercial sale of species, use as forage or for revegetation, dispersal along highways, transport on boats, common contaminant of landscape materials, etc.).

a.	Does not occur	0
b.	Low (human dispersal is infrequent or inefficient)	1
c.	Moderate (human dispersal occurs regularly)	2
d.	High (there are numerous opportunities for dispersal to new areas)	3
e.	Unknown	U

Score **2**

Documentation: *Lotus corniculatus* is grown for forage, hay, and silage, and it escapes from pastures and fields (Turkington and Franko 1980, Dzyubenko and Dzyubenko 2009). It is a contaminant in low-grade grass seed. Seeds remain viable after being ingested and can be dispersed by cattle and sheep (Turkington and Franko 1980).

2.4. Allelopathic

a.	No	0
b.	Yes	2
c.	Unknown	U

Score **0**

Documentation: No evidence suggests that *Lotus corniculatus* is allelopathic.

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 able to fix nitrogen	3
d.	Unknown	U

Score **3**

Documentation: The roots of *Lotus corniculatus* are associated with bacteria that fix atmospheric nitrogen (Jones and Turkington 1986). This species is highly competitive on infertile, acidic, calcareous, dry, and water-logged soils (Turkington and Franko 1980).

2.6. Forms dense thickets, has a climbing or smothering growth habit, or is otherwise taller than the surrounding vegetation.

a.	Does not grow densely or above surrounding vegetation	0
b.	Forms dense thickets	1
c.	Has a climbing or smothering growth habit, or is otherwise taller than the surrounding vegetation	2
d.	Unknown	U

Score **1**

Documentation: *Lotus corniculatus* forms dense mats (Turkington and Franko 1980) but does not grow taller than 80 cm (eFloras 2008).

2.7. Germination requirements

a.	Requires sparsely vegetated soil and disturbance to germinate	0
b.	Can germinate in vegetated areas, but in a narrow range of or in special conditions	2
c.	Can germinate in existing vegetation in a wide range of conditions	3
d.	Unknown	U

Score **0**

Documentation: Seedlings are not likely to survive when shaded (Turkington and Franko 1980, Jones and Turkington 1986); few plants established when *Lotus corniculatus* was sown in an undisturbed, tall grass community in Argentina. Soil disturbance, removal of vegetation, and burning favor the establishment of this species (Petryna et al. 2002).

2.8. Other species in the genus invasive in Alaska or elsewhere

a.	No	0
b.	Yes	3
c.	Unknown	U

Score **3**

Documentation: *Lotus pedunculatus* is known to occur as a non-native weed in California (DiTomaso and Healy 2007).

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
d.	Unknown	U

Score **2**

Documentation: *Lotus corniculatus* invades wetland and riparian communities in California (DiTomaso and Healy 2007).

Total Possible 25
Total **16**

3. Ecological Amplitude and Distribution

3.1. Is the species highly domesticated or a weed of agriculture?

a.	Is not associated with agriculture	0
b.	Is occasionally an agricultural pest	2
c.	Has been grown deliberately, bred, or is known as a significant agricultural pest	4
d.	Unknown	U

Score **4**

Documentation: *Lotus corniculatus* is grown for forage in pastures and as a hay and silage crop (Turkington and Franko 1980, Dzyubenko and Dzyubenko 2009). It has been planted along

roadsides in the U.S. and Canada for erosion control (Winter and Yalch 1996). It occasionally grows as an agricultural weed (eFloras 2008).

3.2. Known level of ecological impact in natural areas

a.	Not known to impact other natural areas	0
b.	Known to impact other natural areas, but in habitats and climate zones dissimilar to those in Alaska	1
c.	Known to cause low impact in natural areas in habitats and climate zones similar to those in Alaska	3
d.	Known to cause moderate impact in natural areas in habitat and climate zones similar to those in Alaska	4
e.	Known to cause high impact in natural areas in habitat and climate zones similar to those in Alaska	6
f.	Unknown	U

Score **1**

Documentation: *Lotus corniculatus* grows in natural areas in lowlands immediately inland from coastal dunes in California (DiTomaso and Healy 2007) and in tallgrass prairies in the Midwestern U.S. (Winter and Yalch 1996).

3.3. Role of anthropogenic and natural disturbance in establishment

a.	Requires anthropogenic disturbance to establish	0
b.	May occasionally establish in undisturbed areas, readily establishes in naturally disturbed areas	3
c.	Can establish independently of natural or anthropogenic disturbances	5
e.	Unknown	U

Score **3**

Documentation: All infestations recorded in Alaska are associated with anthropogenically disturbed areas (AKEPIC 2011, UAM 2011). However, *Lotus corniculatus* is known to grow in natural areas in lowlands immediately inland from coastal dunes in California (DiTomaso and Healy 2007) and on glacial moraines in Europe (Jones and Turkington 1986). Populations in Alaska have expanded under alder canopies (DeVelice pers. obs.).

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
e.	Unknown	U

Score **5**

Documentation: *Lotus corniculatus* is native to Eurasia and North Africa (Jones and Turkington 1986, DiTomaso and Healy 2007). It has been introduced to North America, South America, Australia, and New Zealand (Johnston and Pickering 2001, eFloras 2008). This species is known to grow in Norway as far north as 70°N (Norwegian Species Observation Service 2011).

3.5. Extent of the species' U.S. range and/or occurrence of formal state or provincial listing

a.	Occurs in 0-5 percent of the states	0

b.	Occurs in 6-20 percent of the states	2
c.	Occurs in 21-50 percent of the states and/or listed as a problem weed (e.g., "Noxious," or "Invasive") in one state or Canadian province	4
d.	Occurs in more than 50 percent of the states and/or listed as a problem weed in two or more states or Canadian provinces	5
e.	Unknown	U

Score **5**

Documentation: *Lotus corniculatus* grows in 44 states of the U.S. and most of Canada (USDA 2011). It is not considered a noxious weed in any states of the U.S. or provinces of Canada.

Total Possible 25
Total **18**

4. Feasibility of Control

4.1. Seed banks

a.	Seeds remain viable in the soil for less than three years	0
b.	Seeds remain viable in the soil for three to five years	2
c.	Seeds remain viable in the soil for five years or longer	3
e.	Unknown	U

Score **3**

Documentation: Many seeds have hard seed coats, and some seeds can remain viable for 11 years (Turkington and Franko 1980).

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
e.	Unknown	U

Score **3**

Documentation: *Lotus corniculatus* can resprout from the roots after the removal of the aboveground growth (DiTomaso and Healy 2007). Stem fragments from prostrate stems sometimes root (Jones and Turkington 1986).

4.3. Level of effort required

a.	Management is not required (e.g., species does not persist in the absence of repeated anthropogenic disturbance)	0
b.	Management is relatively easy and inexpensive; requires a minor investment of human and financial resources	2
c.	Management requires a major short-term or moderate long-term investment of human and financial resources	3
d.	Management requires a major, long-term investment of human and financial resources	4
e.	Unknown	U

Score **3**

Documentation: Hand pulling and digging small populations of *Lotus corniculatus* appear to be effective, as plants that were removed by digging in 2006 along the Dalton highway were not found again in 2007 (Cortés-Burns et al. 2008). Removing plants manually can be difficult because of the stout roots. Digging of larger populations may need to be repeated for several years to provide effective control (DeVelice pers. obs.). Some varieties have developed resistance to certain herbicides (Turkington and Franko 1980). Foliar applications of MCPA and clopyralid can effectively control this species (Winter and Yalch 1996).

Total Possible	10
Total	**9**

Total for four sections possible	100
Total for four sections	**65**

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