ALASKA NON-NATIVE PLANT INVASIVENESS RANKING FORM

Botanical name: *Lupinus polyphyllus* ssp. *polyphyllus* Lindl.
Common name: bigleaf lupine
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Date: 3/17/2011
Date of previous ranking, if any: 8/1/2008

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)	24
Biological characteristics and dispersal ability	25 (23)	18
Ecological amplitude and distribution	25 (25)	20
Feasibility of control	10 (10)	8
Outcome score	100 (98)[b]	70[a]
Relative maximum score[2]		**71**[3]

[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
[3] **Special Note:** The nativity of *Lupinus polyphyllus* is disputed. Control should only be applied to populations for which non-nativity is known.

A. CLIMATIC COMPARISON

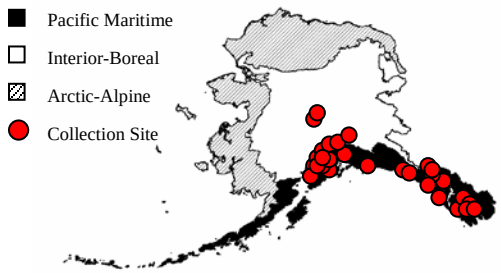
1.1. Has this species ever been collected or documented in Alaska?

☒ 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: *Lupinus polyphyllus* has been documented from the Pacific Maritime and Interior-Boreal ecogeographic regions of Alaska (Hultén 1968, AKEPIC 2011, UAM 2011).

Note on nativity: The native status of *Lupinus polyphyllus* ssp. *polyphyllus* in Alaska is disputed. Hultén (1968) lists this taxon as being introduced to Alaska, while Douglas et al. (1999) and Pojar and MacKinnon (1994) indicate that it is native to southeast Alaska. This taxon is considered native to British Columbia, where its range extends to the northern edge of the province adjacent to southeast Alaska (Douglas et al. 1999, Pojar and MacKinnon 1994, Klinkenberg 2010). Further research using collection records, molecular and morphological markers, and paleoecological methods is necessary to confirm the origin of this species in Alaska.

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: *Lupinus polyphyllus* has been documented from near Lærdalsøyri and Lillehammer, Norway, which have 45% and 49% climatic similarities with Nome, respectively (CLIMEX 1999, Norwegian Species Observation Service 2011, Vascular Plant Herbarium Oslo 2011). It is also known to grow in Kuopio, Vaasa, Kajaani, and Pielisjärvi, Finland, which have 54%, 54%, 58%, and 58% climatic similarities with Nome, respectively (CLIMEX 1999, 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 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)	10
e.	Unknown	U

Score **7**

Documentation: *Lupinus polyphyllus* likely delays the establishment of native species in disturbed sites (Densmore et al. 2001). Roots are associated with bacteria that fix atmospheric nitrogen, and infestations significantly increase the availability of nitrogen in the soil (Valtonen et al. 2006, Fremstad 2010, NatureGate 2011). The addition of nitrogen to the soil favors the establishment or increase of other non-native species. Removal of *Lupinus polyphyllus* may not immediately return nutrient cycling patterns to their pre-invasion states (Valtonen et al. 2006). Rhizome growth binds and stabilizes soil (Rapp 2009).

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: *Lupinus polyphyllus* can form a new mid-forb layer that outshades and reduces the density of underlying layers (NatureGate 2011). In Alaska, 11% of infestations have occurred at or above 50% ground cover (AKEPIC 2011). This species can form persistent populations in Alaska; it has been prevalent in a natural area in Dry Bay, Glacier Bay National Preserve, for at least 15 years (Rapp 2009).

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: Populations of *Lupinus polyphyllus* can outshade and displace native plants. Infestations reduce the diversity of native plant species along roadsides and in meadows in Europe (Valtonen et al. 2006, NatureGate 2011, Fremstad 2010). This species grows at high densities in Glacier Bay National Preserve, where it outcompetes and excludes native plants in meadows and shaded forest understories (Rapp 2009).

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 **7**

Documentation: *Lupinus polyphyllus* hybridizes freely with the native *L. nootkatensis* (Welsh 1974). Hybrid plants have been found in natural areas, such as subalpine meadows, in Alaska (UAM 2011). *Lupinus polyphyllus* is an important floral resource for bumblebees (Jennersten et al. 1988); the presence of this species may therefore alter native plant-pollinator interactions. Infestations can reduce the local abundance of butterflies (Valtonen et al. 2006). Many *Lupinus* species, including *Lupinus polyphyllus*, contain alkaloids that are toxic to animals (DiTomaso and Healy 2007, Fremstad 2010).

Total Possible	40
Total	**24**

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 **2**

Documentation: *Lupinus polyphyllus* reproduces sexually by seeds and vegetatively from rhizomes (Densmore et al. 2001). Plants produce an average of 2,654 seeds each (Aniszewski et al. 2001). However, some populations appear to expand more by rhizomes than by seeds (Rapp 2009).

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 **0**

Documentation: Pods open explosively, scattering seeds a few meters from the parent plant (Densmore et al. 2001, Fremstad 2010). Seeds have been transported from river banks by changing water levels, forming colonies in new areas (Rapp 2009).

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 **3**

Documentation: *Lupinus polyphyllus* is cultivated as an ornamental plant in Alaska (Welsh 1974, Rapp 2009). It often escapes and becomes locally well-established (Welsh 1974). Seeds can be dispersed on vehicles or in contaminated soil (Fremstad 2010), and this species is spreading along roads in Alaska (Hultén 1968, AKEPIC 2011).

2.4. Allelopathic

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

Score **U**

Documentation: The allelopathic potential of *Lupinus polyphyllus* is unknown. However, *L. albus* and *L. hispanicus* are known to produce and excrete alkaloids that suppress the germination of other plant species (Wink 1983, Muzquiz et al. 1994).

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: *Lupinus polyphyllus* is moderately competitive for limiting factors (Densmore et al. 2001). Roots are associated with bacteria that fix atmospheric nitrogen (Valtonen et al. 2006, NatureGate 2011).

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: *Lupinus polyphyllus* can form dense colonies that outshade and displace underlying vegetation (Rapp 2009, Valtonen et al. 2006, Fremstad 2010, NatureGate 2011). It rarely grows more than 1 m tall in Alaska (Carlson pers. obs.).

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 **3**

Documentation: *Lupinus polyphyllus* can germinate in vegetated areas (Densmore et al. 2001, Lapina pers. obs.). It has established in vegetated meadows and forest understories in Glacier Bay National Preserve (Rapp 2009). It grows in open to dense forests (Welsh 1974) and was found growing in a wetland amongst *Calamagrostis canadensis* and *Lathyrus palustris* in the Malaspina coastal plain (UAM 2011). This species invades vegetated areas in Finland, Germany, and Russia (Valtonen et al. 2006, Fremstad 2010, NatureGate 2011).

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

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

Documentation: *Lupinus arboreus* is known to occur as an invasive wildland pest plant in California (DiTomaso and Healy 2007). *L. nootkatensis*, which is native to Alaska, is known to occur as a non-native weed in northern Europe (Lid and Lid 1994).

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	**3**

Documentation: *Lupinus polyphyllus* has invaded riparian and wetland communities in Alaska (AKEPIC 2011, UAM 2011). It also invades riparian communities in Europe (Fremstad 2010).

Total Possible	23
Total	**18**

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: *Lupinus polyphyllus* is cultivated as an ornamental plant in Europe, Asia, and North America, including Alaska (Welsh 1974, Rapp 2009, eFloras 2008, Fremstad 2010). In Europe, it is also grown for fodder (Aniszewski et al. 2001, Fremstad 2010).

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 **4**

Documentation: *Lupinus polyphyllus* has become extremely widespread throughout most of Finland (NatureGate 2011). It invades roadsides, disturbed areas, semi-natural grasslands, and natural forest meadows, where it alters soil conditions by fixing atmospheric nitrogen, reduces plant biodiversity, and reduces the abundance of butterflies in Finland (Valtonen et al. 2006). In Germany and Russia, it invades natural acid grasslands, tall forb vegetation, meadows, pine forests, and forest edges (Fremstad 2010). Lupinus polyphyllus has been documented in the riverbeds of Canterbury, New Zealand where it has formed dense stands on bare gravel bars, stabilizing the previously unstable braided riverways (New Zealand DOC 2007).

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: *Lupinus polyphyllus* establishes in anthropogenically disturbed sites and along roadways in Alaska (Hultén 1968, AKEPIC 2011). It also establishes in areas that are naturally disturbed by river action, stream action, and fire (AKEPIC 2011, UAM 2011, Carlson pers. obs., Lapina pers. obs.). It has been documented in 16 separate areas of the Copper River Delta system and near Katalla Alaska (Develice pers. comm.). *Lupinus polyphyllus* has established in vegetated meadows and forest understories in Glacier Bay National Preserve (Rapp 2009). It grows in open to dense forests (Welsh 1974) and was found growing in a wetland amongst *Calamagrostis canadensis* and *Lathyrus palustris* in the Malaspina coastal plain (UAM 2011). This species invades vegetated areas in Finland, Germany, and Russia (Valtonen et al. 2006, Fremstad 2010, NatureGate 2011).

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: *Lupinus polyphyllus* is native to western North America (Douglas et al. 1999). It is widely naturalized in Europe (Aniszewski et al. 2001), including Scandinavia (Jennersten et al. 1988, Lid and Lid 1994, NatureGate 2011) and Russia (Gubanov et al. 1995). It has also been introduced to Asia, South America, and New Zealand (ILDIS 2010). This species is known to grow as far north as 70.6°N in Norway (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 **4**

Documentation: *Lupinus polyphyllus* grows in 16 states of the U.S. (USDA 2011). It is not considered a noxious weed in any states of the U.S. or provinces of Canada.

Total Possible 25
Total **20**

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: Seeds can remain viable for many years (Gisler pers. comm.), possibly more than 50 years (Fremstad 2010).

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 **2**

Documentation: *Lupinus polyphyllus* can resprout from the rhizomes following the removal of the aboveground growth (Densmore et al. 2001, Fremstad 2010).

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: Small populations of *Lupinus polyphyllus* can be eradicated by digging up rhizomes. However, manual treatments may need to be repeated to eliminate plants resprouting from rhizomes and seeds (Densmore et al. 2001). Mowing twice per year before plants flower prevents the spread of populations and may eradicate populations if repeated for three to five years (Valtonen et al. 2006, Fremstad 2010). Glyphosate herbicides likely control *Lupinus polyphyllus* (Fremstad 2010).

Total Possible	10
Total	**8**

Total for four sections possible	98
Total for four sections	**70**

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