# WEED RISK ASSESSMENT FORM

Botanical name: *Linaria vulgaris* P. Miller.

Common name: yellow toadflax, butter and eggs, wild snapdragon


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**Outcome score:**

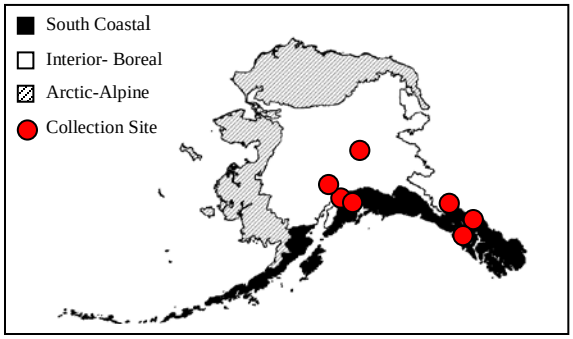
| **A.** | **Climatic Comparison** | | |
|---|---|---|---|
| | This species is present or may potentially establish in the following eco-geographic regions: | | |
| 1 | South Coastal | Yes | |
| 2 | Interior-Boreal | Yes | |
| 3 | Arctic-Alpine | Yes | |
| | This species is unlikely to establish in any region in Alaska | | |

| **B.** | **Invasiveness Ranking** | Total (Total Answered*) Possible | Total |
|---|---|---|---|
| 1 | Ecological impact | 40 (40) | 22 |
| 2 | Biological characteristic and dispersal ability | 25 (25) | 17 |
| 3 | Ecological amplitude and distribution | 25 (25) | 21 |
| 4 | Feasibility of control | 10 (10) | 9 |
| | Outcome score | 100 (100)[b] | 69 [a] |
| | Relative maximum score† | | 0.69 |

* For questions answered "unknown" do not include point value for the question in parentheses for "Total Answered Points Possible."
† Calculated as [a]/[b].

## A. CLIMATIC COMPARISON:

| | 1.1 Has this species ever been collected or documented in Alaska? |
|---|---|
| Yes | Yes – continue to 1.2 |
| | No – continue to 2.1 |
| | 1.2. Which eco-geographic region has it been collected or documented (see inset map)? *Proceed to Section B. Invasiveness Ranking.* |
| Yes | South Coastal |
| Yes | Interior-Boreal |
| Yes | Arctic-Alpine |



Documentation: *Linaria vulgaris* has been collected in 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 does not appear to be documented in the Arctic-Alpine ecoregion.
Sources of information:
AKNHP. 2003. Non-native plants survey of Mat-Su Valleys. Report for USFS, State and Private Forestry, Anchorage, AK.
Hultén, E. 1968. Flora of Alaska and Neighboring Territories. Stanford University Press, Stanford, CA. 1008 p.
University of Alaska Museum. University of Alaska Fairbanks. 2004. http://hispida.museum.uaf.edu:8080/home.cfm

2.1. Is there a 40% 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
Yes – *record locations and similarity; proceed to Section B. Invasiveness Ranking*
No
*– If "No" is answered for all regions, reject species from consideration*

Documentation: Using CLIMEX matching program, climatic similarity between Nome and areas where the species is documented is high. Native range of the species includes Roros, Norway, Zlatoust, Russia, and Stensele, Sweden (Hultén 1968), which has a 76%, 71%, and 70% climatic match with Nome, respectively.
Sources of information: CLIMEX for Windows, Version 1.1a. 1999. CISRO Publishing, Australia.
Hultén, E. 1968. Flora of Alaska and Neighboring Territories. Stanford University Press, Stanford, CA. 1008 p.

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## B. INVASIVENESS RANKING

*1. ECOLOGICAL IMPACT*

### 1.1. Impact on Natural Ecosystem Processes

| | | |
|---|---|---|
| A. | No perceivable impact on ecosystem processes | 0 |
| B. | Influences ecosystem processes to a minor degree (e.g., has a perceivable but mild influence on soil nutrient availability) | 3 |
| C. | Significant alteration of ecosystem processes (e.g., increases sedimentation rates along streams or coastlines, reduces open water that are important to waterfowl) | 7 |
| D. | 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 5

Documentation:
Identify ecosystem processes impacted:
Yellow toadflax likely reduces soil moisture and nutrient availability, changes texture and soil composition (M. L. Carlson pers. obs.)
Rational:

Sources of information:
Carlson M.L., Ph.D., Assistant Research Professor – Botany, Alaska Natural Heritage Program, University of Alaska Anchorage, 707 A Street, Anchorage, Alaska. Tel: (907) 257-2790 – Pers. obs.

### 1.2. Impact on Natural Community Structure

| | | |
|---|---|---|
| A. | No perceived impact; establishes in an existing layer without influencing its structure | 0 |
| B. | Influences structure in one layer (e.g., changes the density of one layer) | 3 |
| C. | Significant impact in at least one layer (e.g., creation of a new layer or elimination of an existing layer) | 7 |
| D. | Major alteration of structure (e.g., covers canopy, eradicating most or all layers below) | 10 |
| U. | Unknown | |

Score 5

Documentation:

Identify type of impact or alteration:

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.).

Rational:

Sources of information:

Carlson M.L., Ph.D., Assistant Research Professor – Botany, Alaska Natural Heritage Program, University of Alaska Anchorage, 707 A Street, Anchorage, Alaska. Tel: (907) 257-2790 – Pers. obs.

Carpenter, A., T. Murray. 1998. Element Stewardship Abstract for *Linaria dalmatica* and *Linaria vulgaris*. The Nature Conservancy, Wildlands Weeds Management & Research, Weed Science Program, University of California, Davis, CA.

1.3. Impact on Natural Community Composition

| | | |
|---|---|---|
| A. | No perceived impact; causes no apparent change in native populations | 0 |
| B. | Influences community composition (e.g., reduces the number of individuals in one or more native species in the community) | 3 |
| C. | 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. | Causes 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 7

Documentation:

Identify type of impact or alteration:

This plant can displace native perennial species (Carpenter and Murray 1998, Whitson et al. 2000).

Rational:

Sources of information:

Carpenter, A., T. Murray. 1998. Element Stewardship Abstract for *Linaria dalmatica* and *Linaria vulgaris*. The Nature Conservancy, Wildlands Weeds Management & Research, Weed Science Program, University of California, Davis, CA.

Whitson, T.D., L.C. Burrill, S.A. Dewey, D.W. Cudney, B.E. Nelson, R.D. Lee, R. Parker. 2000. Weeds of the West. The Western Society of Weed Science in cooperation with the Western United States Land Grant Universities, Cooperative Extension Services. University of Wyoming. Laramie, Wyoming. 630 pp.

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. | Minor alteration | 3 |
| C. | Moderate alteration (minor reduction in nesting/foraging sites, reduction in habitat connectivity, interference with native pollinators, injurious components such as spines, toxins) | 7 |
| D. | 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 5

Documentation:

Identify type of impact or alteration:

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 bees (*Halictus* spp.) pollinators and may alter pollination ecology of sites where it occurs. Flowers are also attacked by number of insect predators (Arnold 1982, M. L. Carlson pers. obs., Goltz 1988)

Rational:

Sources of information:

Arnold, R.M. 1982. Pollination, predation and seed set in *Linaria vulgaris* (Scrophulariaceae). American Midland Naturalist 107(2): 360-369.

Carlson M.L., Ph.D., Assistant Research Professor – Botany, Alaska Natural Heritage Program, University of Alaska Anchorage, 707 A Street, Anchorage, Alaska. Tel: (907) 257-2790 – Pers. obs.

Goltz, L. 1988. Honey and pollen plants. Part X. Miscellaneous honey plants. American Bee Journal 128: 97-100.

Royer, F. and R. Dickinson. 1999. Weeds of the Northern U.S. and Canada. The University of Alberta press. 434 pp.

Whitson, T.D., L.C. Burrill, S.A. Dewey, D.W. Cudney, B.E. Nelson, R.D. Lee, R. Parker. 2000. Weeds of the West. The Western Society of Weed Science in cooperation with the Western United States Land Grant Universities, Cooperative Extension Services. University of Wyoming. Laramie, Wyoming. 630 pp.

Total Possible 40

Total 22

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*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/$m^2$) 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

Score 3

Documentation:

Describe key reproductive characteristics (including seeds per plant):

Yellow toadflax reproduces by seeds and vegetatively. Seed count per individual is difficult as the definition of individual is unclear due to the 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 has also the ability to reproduce vegetatively from adventitious buds on the roots (Bakshi and Coupland 1960, Nadeau et al. 1991, Nadeau et al. 1992).

Rational:

Sources of information:

Bakshi, T.S. and R.T. Coupland. 1960. Vegetative propagation in *Linaria vulgaris*. Canadian Journal of Botany 38: 243-249.

Darwent, A.L., W. Lobay, W. Yarish and P. Harris. 1975. Distribution and importance in northwestern Alberta of toadflax and its insect enemies. Canadian Journal of Plant Science 55: 157-162.

Nadeau, L.B. and J.R. King. 1991. Seed dispersal and seedling establishment of *Linaria vulgaris* Mill. Canadian Journal of Plant Science 71: 771-782.
Nadeau, L.B., M.R.T. Dale and J.R. King. 1991. The development of spatial pattern in shoots of *Linaria vulgaris* (Scrophulariaceae) growing on fallow land or in a barley crop. Canadian Journal of Botany 69: 2539-2544.
Nadeau, L.B., J.R. King and K.N. Harker. 1992. Comparison of growth of seedlings and plants grown from root pieces of yellow toadflax (*Linaria vulgaris*). Weed Science 40: 43-47.
Stevens, O.A. 1932. The number and weight of seeds produced by weeds. American Journal of Botany 19(9): 784-794.

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 3

Documentation:
Identify dispersal mechanisms:
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).
Rational:
Seeds are small (1-2 mm long), flattened with papery wings.
Sources of information:
Nadeau, L.B., and J.R. King. 1991. Seed dispersal and seedling establishment of *Linaria vulgaris* Mill. Canadian Journal of Plant Science 71:771-782.
Royer, F. and R. Dickinson. 1999. Weeds of the Northern U.S. and Canada. The University of Alberta press. 434 pp.
Rutledge, C.R., and T. McLendon. 1996. An Assessment of Exotic Plant Species of Rocky Mountain National Park. Department of Rangeland Ecosystem Science, Colorado State University. 97 pp. Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/othrdata/Explant/explant.htm (Version 15DEC98).

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 3

Documentation:
Identify dispersal mechanisms:
Yellow toadflax is ornamental plant and it has been 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 still is sold by some nurseries (Beck 2001, Zouhar 2001).
Rational:

Sources of information:
Beck, K.G. 2001. Biology and management of the toadflaxes. Colorado State, University Cooperative Extension. Available online:

http://www.ext.colostate.edu/index.html
Densmore, R. V., P. C. McKee, C. Roland. 2001. Exotic plants in Alaskan National Park Units. Report on file with the National Park Service – Alaska Region, Anchorage, Alaska. 143 pp.
Rutledge, C.R., and T. McLendon. 1996. An Assessment of Exotic Plant Species of Rocky Mountain National Park. Department of Rangeland Ecosystem Science, Colorado State University. 97 pp. Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/othrdata/Explant/explant.htm (Version 15DEC98).
Zouhar, K. 2001. *Linaria* spp. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Science Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2004, April 13].

2.4. Allelopathic

| | | |
|---|---|---|
| A. | No | 0 |
| B. | Yes | 2 |
| U. | Unknown | |

Score 0

Documentation:
Describe effect on adjacent plants:
None
Rational:

Sources of information:
No records about allelopathy potential

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 3

Documentation:
Evidence of competitive ability:
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).
Rational:

Sources of information:
Carpenter, A., T. Murray. 1998. Element Stewardship Abstract for *Linaria dalmatica* and *Linaria vulgaris*. The Nature Conservancy, Wildlands Weeds Management & Research, Weed Science Program, University of California, Davis, CA.
Rutledge, C.R., and T. McLendon. 1996. An Assessment of Exotic Plant Species of Rocky Mountain National Park. Department of Rangeland Ecosystem Science, Colorado State University. 97 pp. Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/othrdata/Explant/explant.htm (Version 15DEC98).

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 1

Documentation:
Describe grow form:
Yellow toadflax is capable of forming colonies through buds from creeping rhizomes (Carpenter and Murray 1998). However, it is generally not taller than the surrounding vegetation (M. L. Carlson pers. obs.).
Rational:
In study of common toadflax in Alberta density of 180 stems per $m^2$ was recorded; however, in most areas this plant occurs at densities of 20 stems per $m^2$ or less (Darwent et al. 1975).
Sources of information:
Carlson M.L., Ph.D., Assistant Research Professor – Botany, Alaska Natural Heritage Program, University of Alaska Anchorage, 707 A Street, Anchorage, Alaska. Tel: (907) 257-2790 – Pers. obs.
Carpenter, A. and T. Murray. 1998. Element Stewardship Abstract for *Linaria dalmatica* and *Linaria vulgaris*. The Nature Conservancy, Wildlands Weeds Management & Research, Weed Science Program, University of California, Davis, CA.
Darwent, A.L., W. Lobay, W. Yarish and P. Harris. 1975. Distribution and importance in northwestern Alberta of toadflax and its insect enemies. Canadian Journal of Plant Science 55: 157-162.

## 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 0

Documentation:
Describe germination requirements:
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).
Rational:

Sources of information:
Densmore, R.V., P.C. McKee, C. Roland. 2001. Exotic plants in Alaskan National Park Units. Report on file with the National Park Service – Alaska Region, Anchorage, Alaska. 143 pp.
Rutledge, C.R., and T. McLendon. 1996. An Assessment of Exotic Plant Species of Rocky Mountain National Park. Department of Rangeland Ecosystem Science, Colorado State University. 97 pp. Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/othrdata/Explant/explant.htm (Version 15DEC98).
Zouhar, K. 2001. *Linaria* spp. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Science Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2004, April 13].

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

| | | |
|---|---|---|
| A. | No | 0 |
| B. | Yes | 3 |
| U. | Unknown | |

Score 3

Documentation:
Species:
*Linaria dalmatica* (L.) P. Mill. is declared noxious in some of American States and Canadian provinces (Invader Database System 2003, USDA, NRCS 2002).

Sources of information:
Invaders Database System. The University of Montana. 2003. Montana Noxious Weed Trust Fund. Department of Agriculture. http://invader.dbs.umt.edu/
USDA (United States Department of Agriculture), NRCS (Natural Resource Conservation Service). 2002. The PLANTS Database, Version 3.5 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

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 1

Documentation:
Describe type of habitat:
Yellow toadflax is most commonly found along roadsides, fences, range lands, croplands, clear cuts, and pastures (Carpenter and Murray 1998). However, it has been reported from cottonwood and spruce dominated riparian habitats in Colorado (Carpenter and Murray 1998, Zouhar 2003); and it is found along shore line of Cook Inlet and Turnagain Arm (AKEPIC 2003, M. Shephard – pers. comm.).
Rational:

Sources of information:
AKEPIC Databese. 2003. U.S. Department of the Interior, U.S. Geological Survey, Alaska Geogrphic Science Office, Anchorage, Alaska, USA URL: http://agdc.usgs.gov/akepic/ [April 26, 2004].
Carpenter, A. and T. Murray. 1998. Element Stewardship Abstract for *Linaria dalmatica* and *Linaria vulgaris*. The Nature Conservancy, Wildlands Weeds Management & Research, Weed Science Program, University of California, Davis, CA.
Shephard, M., Vegetation Ecologist, USDA, Forest Service, Forest Health Protection, State and Private Forestry, 3301 C Street, Suite 202, Anchorage, Alaska 99503 Division. Tel: (907) 743-9454 - Pers. comm.
Zouhar, K. 2001. *Linaria* spp. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Science Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2004, April 13].

Total Possible 25
Total 17

*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 4

Documentation:
Identify reason for selection, or evidence of weedy history:
The species was introduced to North America in the late 1600s as a garden ornamental (Beck 2001, Carpenter and Murray 1998). In present in is a weed of range land and pastures (Darwent et al. 1975, Whitson et al. 2000).
Rational:

Sources of information:
Beck, K.G. 2001. Biology and management of the toadflaxes. Colorado State, University Cooperative Extension. Available online:

http://www.ext.colostate.edu/index.html
Carpenter, A. and T. Murray. 1998. Element Stewardship Abstract for *Linaria dalmatica* and *Linaria vulgaris*. The Nature Conservancy, Wildlands Weeds Management & Research, Weed Science Program, University of California, Davis, CA
Darwent, A.L., W. Lobay, W. Yarish and P. Harris. 1975. Distribution and importance in northwestern Alberta of toadflax and its insect enemies. Canadian Journal of Plant Science 55: 157-162.
Whitson, T.D., L.C. Burrill, S.A. Dewey, D.W. Cudney, B.E. Nelson, R.D. Lee, R. Parker. 2000. Weeds of the West. The Western Society of Weed Science in cooperation with the Western United States Land Grant Universities, Cooperative Extension Services. University of Wyoming. Laramie, Wyoming. 630 pp.

3.2. Known level of 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 4

Documentation:

Identify type of habitat and states or provinces where it occurs:

Yellow toadflax invades high quality areas with no known disturbance for last 100 years in Rocky Mountain National Park, Colorado and has 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).

Sources of information:

Rutledge, C.R., and T. McLendon. 1996. An Assessment of Exotic Plant Species of Rocky Mountain National Park. Department of Rangeland Ecosystem Science, Colorado State University. 97 pp. Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/othrdata/Explant/explant.htm (Version 15DEC98).
Zouhar, K. 2001. *Linaria* spp. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Science Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2004, April 13].

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 3

Documentation:

Identify type of disturbance:

Disturbance may be necessary for establishment to occur. Once established, it readily spreads into adjacent non-disturbed 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).

Rational:

Arnold, R.M. 1982. Pollination, predation and seed set in Linaria vulgaris

(Scrophulariaceae). American Midland Naturalist. 107 (2): 360-369.
Beck, K.G. 2001. Biology and management of the toadflaxes. Colorado State, University Cooperative Extension. Available online: http://www.ext.colostate.edu/index.html
Zouhar, K. 2001. *Linaria* spp. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Science Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2004, April 13].

## 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 5

### Documentation:

Describe distribution:
*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).
Rational:

Sources of information:
Hultén, E. 1968. Flora of Alaska and Neighboring Territories. Stanford University Press, Stanford, CA. 1008 p.

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

| | | |
|---|---|---|
| A. | 0-5% of the states | 0 |
| B. | 6-20% of the states | 2 |
| C. | 21-50%, and/or state listed as a problem weed (e.g., “Noxious,” or “Invasive”) in 1 state or Canadian province | 4 |
| D. | Greater than 50%, and/or identified as “Noxious” in 2 or more states or Canadian provinces | 5 |
| U. | Unknown | |

Score 5

### Documentation:

Identify states invaded:
This weed is declared noxious in 9 states and 4 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).
Rational:

Sources of information:
Alaska Administrative Code. Title 11, Chapter 34. 1987. Alaska Department of Natural Resources. Division of Agriculture.
Carpenter, A. and T. Murray. 1998. Element Stewardship Abstract for *Linaria dalmatica* and *Linaria vulgaris*. The Nature Conservancy, Wildlands Weeds Management & Research, Weed Science Program, University of California, Davis, CA
Invaders Database System. The University of Montana. 2003. Montana Noxious Weed Trust Fund. Department of Agriculture. http://invader.dbs.umt.edu/
USDA (United States Department of Agriculture), NRCS (Natural Resource Conservation Service). 2002. The PLANTS Database, Version 3.5 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Total Possible 25

Total 21

*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 3

Documentation:
Identify longevity of seed bank:
Seeds can remain dormant for up to ten years (Carpenter and Murray 1998, Rutledge and McLendon 1996).
Rational:

Sources of information:
Carpenter, A., T. Murray. 1998. Element Stewardship Abstract for *Linaria dalmatica* and *Linaria vulgaris*. The Nature Conservancy, Wildlands Weeds Management & Research, Weed Science Program, University of California, Davis, CA.
Rutledge, C.R., and T. McLendon. 1996. An Assessment of Exotic Plant Species of Rocky Mountain National Park. Department of Rangeland Ecosystem Science, Colorado State University. 97 pp. Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/othrdata/Explant/explant.htm (Version 15DEC98).

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 2

Documentation:
Describe vegetative response:
Vegetative regeneration is possible from root fragments as short as 1 cm (Carpenter Murray 1998, Rutledge and McLendon 1996).
Rational:

Sources of information:
Carpenter, A. and T. Murray. 1998. Element Stewardship Abstract for *Linaria dalmatica* and *Linaria vulgaris*. The Nature Conservancy, Wildlands Weeds Management & Research, Weed Science Program, University of California, Davis, CA.
Rutledge, C.R. and T. McLendon. 1996. An Assessment of Exotic Plant Species of Rocky Mountain National Park. Department of Rangeland Ecosystem Science, Colorado State University. 97 pp. Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/othrdata/Explant/explant.htm (Version 15DEC98).

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 4

Documentation:

Identify types of control methods and time-term required:
Successful control can be obtained by mechanical and chemical treatment. The treatments must be repeated every year for at least ten years due to vegetative propagation and longevity of the seed bank (Carpenter and Murray 1998).
Rational:

Sources of information:
Carpenter, A. and T. Murray. 1998. Element Stewardship Abstract for *Linaria dalmatica* and *Linaria vulgaris*. The Nature Conservancy, Wildlands Weeds Management & Research, Weed Science Program, University of California, Davis, CA.

| | |
|---|---|
| Total Possible | 10 |
| Total | 9 |
| **Total for 4 sections Possible** | 100 |
| **Total for 4 sections** | 69 |

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