

**Predicting invasive plant response to climate change: Prioritization and mapping of new potential threats to Alberta's biodiversity**  
(Chai et al. 2014)

**Supplemental Information: Alberta non-native plant invasiveness ranking form**  
(Adapted from Carlson et al. 2008)

Full report available at <http://www.biodiversityandclimate.abmi.ca>

Scientific name:	<i>Echinops sphaerocephalus</i>
Common name:	Globe thistle/Arctic glow
Assessor:	Shauna-Lee Chai
Reviewer:	Kurt Dreisilker
Date:	November 6, 2013

Outcome score:

A. Climatic Comparison

This species is present or may potentially establish in the following natural regions:

	Collected in Alberta regions	CLIMEX similarity in 1975	CLIMEX similarity in 2050
Boreal	No	0.739	0.795
Parkland	No	0.806	0.834
Foothills	No	0.828	0.862
Grassland	Yes	0.832	0.858
Rocky Mountains	No	0.781	0.809
Shield	No	0.647	0.720

\*train tracks in Calgary

B. Invasiveness Ranking

	Total (Total answered <sup>1</sup> points possible)	Total score
1. Ecological impact	40(27)	6
2. Biological characteristic and dispersal ability	25(20)	13
3. Ecological amplitude and distribution	25(25)	17
4. Feasibility of control	10(7)	5
Outcome score	100(79) <sup>b</sup>	<sup>a</sup> 41
Relative maximum score <sup>2</sup>	52	<i>Modestly Invasive</i>

<sup>1</sup>For questions answered "unknown" do not include point value for the question in parentheses for "Total answered points possible."

<sup>2</sup>Calculated as a/b x 100.

A. Climatic Comparison:

1.1 Has this species ever been collected or documented in Alberta?

x Yes – continue to 1.2

No – continue to 2.1

1.2 Which natural region has it been collected or documented? Proceed to section B. Invasiveness

Ranking.

Boreal

Rockies

x Grassland

Foothills

Parkland

Shield

Documentation:

Sources of information: ANPC Rogues gallery, ACIMS, PLANTS database, GBIF

2.1 Is there a 70 percent or higher similarity (based on CLIMEX climate matching) between climates anywhere the species currently occurs and

a. Boreal - Yes

b. Rockies - Yes

c. Grassland - Yes

d. Foothills - Yes

e. Parkland - Yes

f. Shield – Not in 1975, but in 2050

-If “no” is answered for all regions, reject species from consideration

Documentation:

Sources of information:

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B. Invasiveness Ranking

1. Ecological Impact

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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, 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:unknown

Documentation: likely low

Identify ecosystem processes impacted:

Rationale:

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 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, eradicating most or all layers below) 10
- u. Unknown

Score:3

Documentation: In NE Illinois, invaded areas mostly have low density or have disappeared from their historical introduction site (Dreisilker pers. comm.). Found to dominate herb layer up to 38% in Czech Republic (Petrik et al. 2009)

Identify type of impact or alteration:

Rationale:

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 influence 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:3

Documentation: In NE Illinois, invaded areas mostly have low density or have disappeared from their historical introduction site (Dreisilker 2012). Due to dominance, it results in impoverishment of vegetation in Czech Republic (Petrik et al. 2009)

Identify type of impact or alteration:

Rationale:

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: unknown

Documentation:

Identify type of impact or alteration:

Rationale:

Sources of information:

Total Possible:27

Total:6

## 2. Biological Characteristics and Dispersal Ability

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### 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<sup>2</sup>)) 1
- c. Moderately aggressive (reproduces vegetatively and/or by a moderate amount of seed, <1,000/m<sup>2</sup>) 2
- d. Highly aggressive reproduction (extensive vegetative spread and/or many seeded, >1,000/m<sup>2</sup>) 3
- u. Unknown

Score:3

Documentation: Reproduction is mainly by seed, with 1400 seeds produced per plant, and up to 5075 propagules per m<sup>2</sup> (Moravcova 2010).

Describe key reproductive characteristics (including seeds per plant):

Rationale:

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:2

Documentation: wind dispersed

Identify dispersal mechanisms:

Rationale:

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: 2

Documentation: cultivated and spread by humans as a honey producing plant becoming naturalised in the Czech Republic (Petrik et al. 2009). Horticultural interest-recent references of this species and related species being used as ornamental herbs although, it's not all that common to use this species in NE Illinois as an ornamental plant (Dreisilker pers. comm.).

Identify dispersal mechanisms:

Rationale:

Sources of information:

2.4 Allelopathic

- a. no 0
- b. yes 2
- u. unknown

Score:unknown

Documentation:

Describe effect on adjacent plants:

Rationale:

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:unknown

Documentation:

Evidence of competitive ability:

Rationale:

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:0

Documentation: This hasn't formed a dense, impenetrable thicket as a shrub patch would. Nor does it have a climbing or smothering growth habit. However, it was found growing in an area with shrubs, where the Echinops appeared to be outcompeted by the growing woody shrubs and trees as though the woody plants would eventually push the Echniops sp. out of the site. The Echinops sp. was often leaning away from overhanging shrub growth as though it was trying to "reach" for the sunlight (Dreisilker pers.comm.).

Describe growth form:

Rationale:

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:3

Documentation: Can germinate in full sun to partial shade and decreases with increasing shade (Dreisilker 2012).I germinated seeds from local two local populations. 100 seeds from the two populations were planted in trays and placed in cold storage. Germination soil mix consisted of 55% Canadian sphagnum, 20% perlite, 25% vermiculite. After 70 days of cold storage the trays were placed in the greenhouse to germinate. Ambient temperature ranged 65-68 degrees (F) with 18 hours of sunlight (natural and artificial). High rates of seed germination (up to 75%) were observed within 7 days (Dreisilker pers.comm.).

Describe germination requirements:

Rationale:

Sources of information:

2.8 Other species in the genus invasive in Alberta or elsewhere

- a. No 0
- b. Yes 3
- u. Unknown

Score:3

Documentation: Echinops exaltatus invasive in Sweden <http://www.nobanis.org/speciesInfo.asp?taxaID=2161>.  
E. exaltatus, E. ritro, and E. sphaerocephalus have been introduced to North America (Fl. of N. Am. 2011).

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:0

Documentation: (Dreisilker pers.comm.).

Describe type of habitat:

Rationale:

Sources of information:

Total Possible:20

Total:13

3. Distribution

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- 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: Cultivated and can escape cultivation (FNO 1993). Cultivated as a honey producing plant (Petrik et al. 2009)

Identify reason for selection, or evidence of weedy history:

Rationale:

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 Alberta 1
  - c. Known to cause low impact in natural areas in similar habitats and climate zones to those present in Alberta 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:3

Documentation: The species can invade both mesophilous species-poorer, human-influenced and natural communities. Recently, the invasion of *E. sphaerocephalus* to the species-rich, dry plant communities of the Sedo-Scleranthetea and Festuco-Brometea classes was documented. However, in these communities, *E. sphaerocephalus* is usually not a dominant species (Petrik et al. 2009). Low impact on natural areas in Illinois (Dreisilker pers.comm.).

Diagnostic

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:3

Documentation: Establishes in both human-influenced and natural communities (Petrik et al. 2009).

Identify type of disturbance:

Rationale:

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:3

Documentation: Europe, Asia, North America. Globe thistle is native to central and southern Europe, central Asia (Flora of North America 2011, Enc. of Life 2011, & Hortus Third 1976). Globe thistle is documented 22 states around the United States, ranging from the Pacific coast, central Rockies, Great Lakes, and New England regions. However, it is largely absent from the southern and southwestern states [United States Department of Agriculture (USDA) 2011]. Although it initially seems to be widespread throughout the United States, a closer inspection of its distribution within those states reveals that it is only reported in isolated, geographically dispersed counties within each state (USDA 2011).

Describe distribution:

Rationale:

Sources of information:

3.5 Extent of the species Canada range and/or occurrence of formal state or provincial listing



- a. 0-5 percent of the states/provinces 0
- b. 6-20 percent of the states/provinces 2
- c. 21-50 percent, and/or state/province 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:4

Documentation: Not noxious in any state or province. According to Flora of North America it is introduced in; Man., Ont., Que., Sask. Globe thistle is documented 22 states around the United States, ranging from the Pacific coast, central Rockies, Great Lakes, and New England regions.

[http://www.efloras.org/florataxon.aspx?flora\\_id=1&taxon\\_id=200023870](http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=200023870)

Identify provinces invaded:

Rationale:

Sources of information:

Total possible:25

Total:17

#### 4. Feasibility of Control

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##### 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:unknown

Documentation:

Identify longevity of seed bank

Rationale:

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:2

Documentation: I observed this species resprouting after being mowed. It appeared to be resprouting from the taproot (Dreisilker pers. comm)

Describe vegetative response: The mowing process that I observed removed the plant above the ground at a height of about 4 inches. Then the plant resprouted growth from the taproot and was capable of flowering (Dreisilker pers. comm).

Rationale:

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:3

Documentation: Land managers in NE Illinois do not appear to consistently control globe thistle where it is currently found. Some land managers control it, while others don't. Those who control it do not appear to have invested major resources into managing this species.

Globe thistle was observed resprouting from its base after being mown to the ground. Routine mowing appears to limit globe thistle occurrence. Manicured lawns mowed several times per year seem to reduce the frequency of this species.

Herbicide appears effective at killing globe thistle, but types and concentration details are lacking from site visits (Dreisilker pers. comm.)

Identify types of control methods and time-term required:

Rationale:

Sources of information:

Total Possible: 7

Total: 5

Total for 4 sections Possible: 79

Total for 4 sections: 41

References:

Carlson, M. 2008. Invasiveness Ranking System for Non-Native Plants of Alaska. USDA. Available at: [http://www.fs.usda.gov/Internet/FSE\\_DOCUMENTS/fsbdev2\\_037575.pdf](http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev2_037575.pdf)

Dreisilker, K. 2012. Investigation and control of new invasive plant species at the Morton Arboretum. Final report to northeast Illinois invasive plant partnership. The Morton Arboretum. [http://niipp.net/wp-content/uploads/2011/01/Morton\\_Arboretum\\_Final\\_Report\\_2012.pdf](http://niipp.net/wp-content/uploads/2011/01/Morton_Arboretum_Final_Report_2012.pdf)

USDA PLANTS database

FNO 1993. Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico. 16+ vols. New York and Oxford.

ILPIN. (Illinois Plant Information Network) <http://www.fs.fed.us/ne/delaware/ilpin/1143.co>

Moracova, L. et al. 2010. Reproductive characteristics of neophytes in the Czech Republic: traits of invasive and non-invasive species. *Preslia* 82:365-390

Petrik, P., et al. 2009. Combining numerical and traditional approaches to classify *Echinops sphaerocephalus* invaded communities in the Czech Republic. 3, pp.253–264.

#### Notes

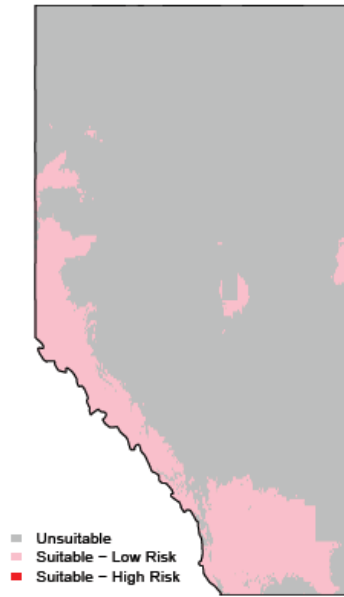
A species of roadsides and fields (ILPIN), but may also have effects in natural areas (Petrik et al. 2009)

#### Score Interpretation

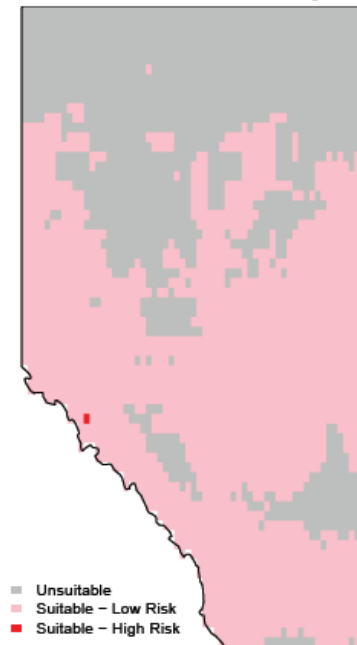
While different users will have different concepts of what constitutes various levels of invasiveness (e.g., what is “highly invasive” vs. “moderately invasive” may differ among management agencies), we divided the ranks into six blocks in Appendix A. We consider species with scores  $\geq 80$  as “Extremely Invasive” and species with scores 70–79 as “Highly Invasive;” both of these groups are composed of species estimated to be very threatening to Alberta. 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.

Species Distribution Models  
Current=1975, future=2050

**Current Climate --- Binary**

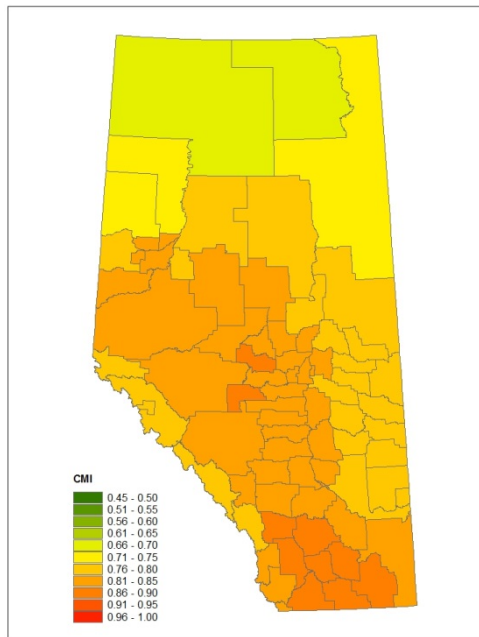


**Future Climate --- Binary**



CLIMEX climate match

1975



2050

