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:	*Elaeagnus umbellata*
Common name:	Autumn Olive
Assessor:	Shauna-Lee Chai
Reviewers:	Peter Rice
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	0.674	0.729
Parkland	No	0.746	0.789
Foothills	No	0.757	0.786
Grassland	No	0.740	0.761
Rocky Mountains	No	0.762	0.763
Shield	No	0.590	0.661

B. Invasiveness Ranking

	Total (Total answered[1] points possible)	Total score
1. Ecological impact	40(40)	37
2. Biological characteristic and dispersal ability	25(25)	20
3. Ecological amplitude and distribution	25(25)	16
4. Feasibility of control	10(7)	6
Outcome score	100(97)[b]	[a]79
Relative maximum score[2]	81	*Extremely Invasive*

[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 x 100.

A. Climatic Comparison:

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

__Yes – continue to 1.2

x No – continue to 2.1

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

__Boreal

__Rockies

__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 – Not in 1975, but in 2050

b. Rockies - Yes

c. Grassland - Yes

d. Foothills - Yes

e. Parkland -Yes

f. Shield -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 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:10

Documentation: Nitrogen-fixing capabilities of *E. umbellata* has the capacity to adversely affect the nitrogen cycle of native communities that may depend on infertile soils (Eckardt and Sather, 1987)

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:10

Documentation: can reach high densities in forest understorey being the only species present in the understorey (Edgin and Ebinger 2001)

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: 10

Documentation: displaces native plants and can form dense thickets (Munger 2003, Eckardt and Sather (1987)

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: 7

Documentation: invades prairies after fire and has ability to reduce prairie habitat (Eckardt and Sather 1987)

Identify type of impact or alteration:

Rationale:

Sources of information:

Total Possible:40

Total:37

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:3

Documentation: 66,000 seeds per year can be produced by a plant (USDA 1987)

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:3

Documentation: Birds use it as a food source (USDA)

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:3

Documentation: It was planted and has escaped. Autumn-olive has been promoted for reclamation of mine spoils and other disturbed soils and is an ornamental. It has been planted for reclamation of surface coal mine sites because it is tolerant of low pH soil conditions often found on these sites. It has also been suggested for use in stabilizing eroded soils in exposed coastal areas due to its salt spray tolerance. An additional benefit to planting autumn-olive in these and other situations, where reclamation of disturbed and frequently nutrient-poor soils is an important objective, is its ability to fix atmospheric nitrogen. Autumn-olive has been a recommended species for planting as a tall shrub component in windbreaks in the Great Plains, in part due to its wildlife food and cover value.

Identify dispersal mechanisms:

Rationale:

Sources of information:

2.4 Allelopathic

a. no 0
b. yes 2
u. unknown

Score:0

Documentation: USDA PLANTS

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: 3

Documentation: High drought tolerance, able to fix nitrogen, rapid growth rate (USDA PLANTS)
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:2

Documentation: Autumn-olive is a many-branched, deciduous shrub or shrubby tree, growing 10 to16 feet (3-5 m) tall
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:2

Documentation: Grows well on variety of soils, is moderately shade tolerant, but is thought to be generally absent from areas with very low light intensity, such as under a dense forest canopy (Nestleroad and Zimmerman 1987). It has been recorded under canopy however in Illinois (Ebinger and Lehnen 1981). Primarily a ruderale and not particularly invasive of undisturbed vegetated habitats even under favorable climatic conditions (Munger 2003).
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: Invasive Russian Olive (*Elaeagnus angustifolia*) sold as an ornamental in Alberta

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:1

Documentation: does not grow well on very wet sites (Eckardt and Sather, 1987). Found on riparian rangeland (Munger 2003)
Describe type of habitat:
Rationale:
Sources of information:

Total Possible:25
Total:20

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: Deliberately grown although not an agricultural weed. Autumn olive was first imported for cultivation into the U.S. in 1830 from Japan (Invasive Plant Atlas of New England - IPANE). It has been promoted as a landscape, reclamation and wildlife food planting ever since.
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:1

Documentation: Problem in natural areas (Nestleroad et al. 1987). Rice pers. comm-score b.
Identify type of habitat and states or provinces where it occurs: forests prairies fields
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:
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: North America, Asia, Australia
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:5

Documentation: Noxious in Connecticut, Massachusetts, New Hampshire and West Virginia (USDA Plants)
Identify provinces invaded:
Rationale:
Sources of information:

Total possible:25
Total:16

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:unknown

Documentation: unknown (Munger 2003)
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: vigorous re-sprouting from burned, cut or mowed plants (Szafoni 1991)
Describe vegetative response:
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:4

Documentation: Control requires frequent monitoring and repeated treatments
Identify types of control methods and time-term required: hand pulling seedlings, treating cut surfaces with glyphosate. For larger plants, basal-bark application of triclopyr or 2,4-D (Edgin, Bob; Ebinger, John E. 2001)
Rationale:
Sources of information:

Total Possible:7
Total: 6
Total for 4 sections Possible: 97
Total for 4 sections: 82

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

Catling, P. M.; Oldham, M. J.; Sutherland, D. A.; Brownell, V. R.; Larson, B. M. H. 1997. The recent spread of autumn-olive, Elaeagnus umbellata, into southern Ontario and its current status. Canadian Field Naturalist. 111(3): 376-380.

Ebinger, John; Lehnen, Larry. 1981. Naturalized autumn olive in Illinois. Transactions, Illinois State Academy of Science. 74(3&4): 83-85.

Eckhardt, N. and Sather, N. (1987) Element Stewardship Abstract for *Elaeagnus umbellata*

Edgin, Bob; Ebinger, John E. 2001. Control of autumn olive (Elaeagnus umbellata Thunb.) at Beall Woods Nature Preserve, Illinois, USA. Natural Areas Journal. 21(4): 386-388

Henry, Jimmy. 1980. A bonanza for wildlife. Soil Conservation. 45(8): 13.

Munger, Gregory T. 2003. Elaeagnus umbellata. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2013, November 6].

Nestleroad, James; Zimmerman, Douglas; Ebinger, John. 1987. Autumn olive reproduction in three Illinois state parks. Transactions, Illinois Academy of Science. 80(1&2): 33-39.

Szafoni, Robert E. 1991. Vegetation management guideline: autumn olive, Elaeagnus umbellata Thunb. Natural Areas Journal. 11(2): 121-122.

USDA PLANTS database

U.S. Department of Agriculture, Soil Conservation Service. 1987. `Redwing' autumn olive. Program Aid Number 1392. Washington, DC. 4 p

Notes

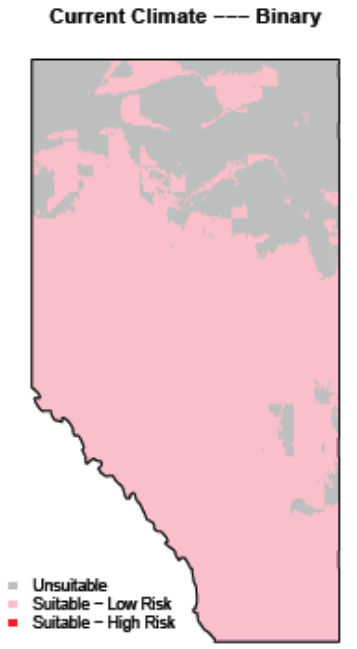
A serious threat to native communities across many parts of the Eastern USA. Top invasive plants in natural habitats of Canada in 2005- http://www.ou.edu/cas/botany-micro/ben/ben345.html

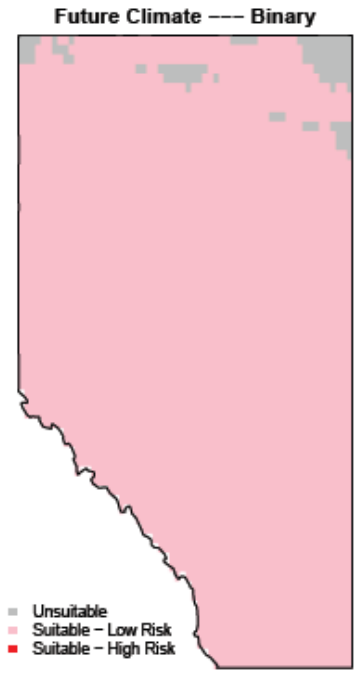
Peter Rice pers. comm.-Autumn olive was first imported for cultivation into the U.S. in 1830 from Japan Invasive Plant Atlas of New England - IPANE). It has been promoted as a landscape, reclamation and wildlife food planting ever since. Autumn olive seeds are dispersed by birds into natural and semi-natural habitats. These efficient dispersal mechanisms, particularly birds, are what have allowed the plant to spread throughout New England (IPANE). However, autumn olive is currently not reported as prevalent in the interior west by EDDMaps. The one occurrence record for Montana (from 1953) in the INVADERS Database System (http://invader.dbs.umt.edu) was in a university town (Bozeman) nursery. There have been no additional reports of autumn olive in Montana although the state has a strong and active new invaders and EDRR program. A new (Lesica 2012) Manual of Montana Vascular Plants does not recognize autumn olive as present in Montana. The single Idaho record (from 2006) in INVADERS is in a university urban (Moscow) riparian area. The INVADERS record for Idaho not suggest a significant infestation.

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 ≥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.

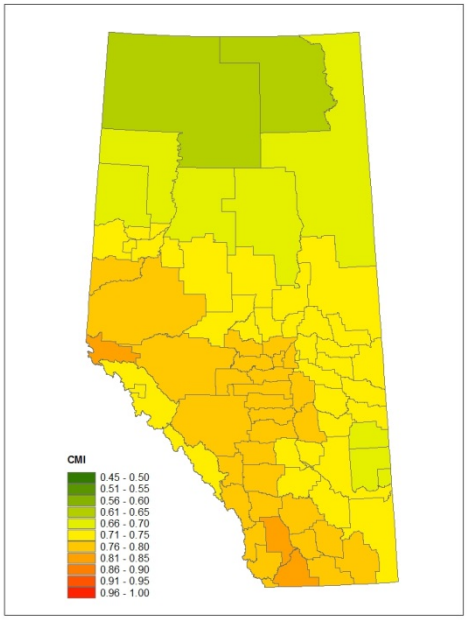
Species Distribution Models
Current=1975, future=2050





CLIMEX climate match

1975



2050