ALASKA NON-NATIVE PLANT INVASIVENESS RANKING FORM

Botanical name: *Amaranthus retroflexus* L.
Common name: redroot pigweed
Assessors:

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Date: 2/6/2011
Date of previous ranking, if any: 5T

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)	12
Biological characteristics and dispersal ability	25 (25)	14
Ecological amplitude and distribution	25 (25)	15
Feasibility of control	10 (10)	4
Outcome score	100 (100)[b]	45[a]
Relative maximum score[2]		**45**

[1] For questions answered "unknown" do not include point value for the question in parentheses for "total answered points possible."
[2] Calculated as a/b × 100

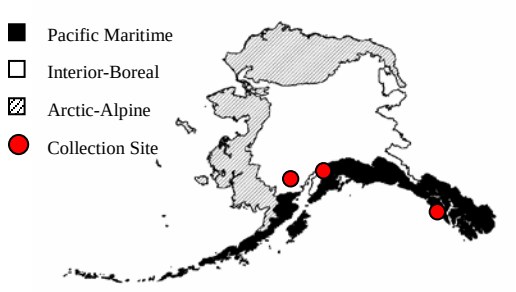
A. CLIMATIC COMPARISON

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

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

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

☒ Pacific Maritime
☒ Interior-Boreal
☐ Arctic-Alpine



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

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

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

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

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

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

Documentation: *Amaranthus retroflexus* is known to grow in many areas in western Russia, Estonia, Latvia, Lithuania, and Belarus that have 40% or greater climatic similarities with Nome (CLIMEX 1999, Solokova and Budrevskaya 2003). However, *Amaranthus retroflexus* has a C_4 photosynthetic pathway and therefore has reduced photosynthetic capacity at lower temperatures; the base temperature necessary for seedling shoot elongation is 14.4°C, and the optimal temperature is 32.9°C (Costea el al. 2004).

B. INVASIVENESS RANKING

1. Ecological Impact

1.1. Impact on Natural Ecosystem Processes

a.	No perceivable impact on ecosystem processes	0
b.	Has the potential to influence ecosystem processes to a minor degree (e.g., has a perceivable but mild influence on soil nutrient availability)	3
c.	Has the potential to cause significant alteration of ecosystem processes (e.g., increases sedimentation rates along streams or coastlines, degrades habitat important to waterfowl)	7
d.	Has the potential to cause major, possibly irreversible, alteration or disruption	10

of ecosystem processes (e.g., the species alters geomorphology, hydrology, or affects fire frequency thereby altering community composition; species fixes substantial levels of nitrogen in the soil making soil unlikely to support certain native plants or more likely to favor non-native species)

e. Unknown U

Score **1**

Documentation: *Amaranthus retroflexus* reduces the availability of light, moisture, and nutrients for surrounding plants in agricultural fields. It is a pioneer species (Costea et al. 2004) and likely reduces nutrients and moisture in disturbed areas as well. However, this species is often replaced by other vegetation in one to two years if natural successional processes are allowed to proceed (Costea et al. 2004).

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 **3**

Documentation: *Amaranthus retroflexus* rapidly colonizes disturbed areas and can grow at high densities in agricultural fields (Costea et al. 2004); it may therefore increase the density of vegetation in disturbed areas in Alaska.

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 **1**

Documentation: *Amaranthus retroflexus* can significantly reduce crop yields in agricultural fields (Costea et al. 2004) and may reduce native plant populations in disturbed areas. However, populations are not likely to persist more than one or two years when natural successional processes are allowed to proceed (Hultén 1968, Costea et al. 2004).

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: *Amaranthus retroflexus* contains toxic oxalates, which can form precipitates with metallic cations when ingested. High nitrogen levels in the soil, partial drought, and low light levels favor the accumulation of toxic nitrates in this species. Illness or death can result when animals ingest plants with high nitrate concentrations (Walsh 1993, Herbarium of the University of Georgia 2002, Costea et al. 2004). Wind-borne pollen can cause allergic reactions in people. Domestic herbivores are known to consume young plants. Seeds are commonly consumed by insects, small mammals, and birds. This species is a known host for many nematodes, fungi, and plant diseases (Costea et al. 2004).

Total Possible 40
Total **12**

2. Biological Characteristics and Dispersal Ability

2.1. Mode of reproduction

a.	Not aggressive (produces few seeds per plant [0-10/m^2] and not able to reproduce vegetatively).	0
b.	Somewhat aggressive (reproduces by seed only [11-1,000/m^2])	1
c.	Moderately aggressive (reproduces vegetatively and/or by a moderate amount of seed [<1,000/m^2])	2
d.	Highly aggressive (extensive vegetative spread and/or many seeded [>1,000/m^2])	3
e.	Unknown	U

Score **3**

Documentation: *Amaranthus retroflexus* reproduces by seeds only. It is self-fertile, and seed production is prolific; figures of up to 1,900,000 seeds per plant have been reported. Plants that emerge late in the growing season are still able to produce seeds (Costea et al. 2004).

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

a.	Does not occur (no long-distance dispersal mechanisms)	0
b.	Infrequent or inefficient long-distance dispersal (occurs occasionally despite lack of adaptations)	2
c.	Numerous opportunities for long-distance dispersal (species has adaptations such as pappus, hooked fruit coats, etc.)	3
d.	Unknown	U

Score **2**

Documentation: Most seeds land within 2 m of the parent plant; however, seeds are small and can be dispersed short distances by wind. They can also be transported when dried inflorescences are blown across snow during winter. Seeds float and can be dispersed in runoff from rain, streams, rivers, and other moving water. Birds and small mammals commonly consume the seeds; seeds can survive ingestion and are dispersed in excrement (Costea et al. 2004).

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

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

Score **2**

Documentation: Seeds can be dispersed by farm machinery, livestock, and the spreading of manure (Costea et al. 2004). *Amaranthus retroflexus* has been identified as a contaminant in hay and straw imported from Washington and Oregon (Conn et al. 2010).

2.4. Allelopathic

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

Score **2**

Documentation: *Amaranthus retroflexus* produces secondary chemicals that have been shown to remain in soil over winter and reduce crop yields the following year (Costea et al. 2004).

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 **1**

Documentation: *Amaranthus retroflexus* competes strongly with cultivated crops for light, moisture, and nutrients, resulting in significant reductions in crop yield and quality. It consumes large amounts of nitrogen and phosphorous. However, in the absence of regular disturbance, it is replaced by other species after one to two years (Costea et al. 2004).

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 **0**

Documentation: *Amaranthus retroflexus* does not form dense patches or significantly overtop surrounding vegetation (Costea et al. 2004, Klinkenberg 2010).

2.7. Germination requirements

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

Score **0**

Documentation: *Amaranthus retroflexus* rapidly colonizes disturbed areas but does not invade closed plant communities unless gaps are created by disturbances (Costea et al. 2004). Plant height, vegetation biomass, and reproductive biomass increase significantly as the size of gaps increases (McConnaughay and Bazzaz 1987).

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

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

Score **3**

Documentation: *Amaranthus* species are considered noxious in Alaska. *A. albus* is considered a noxious weed in Manitoba, and *A. blitoides* is considered a noxious weed in Minnesota (Invaders 2011). Several *Amaranthus* species are known to occur as non-native weeds in the western U.S. (DiTomaso and Healy 2007).

2.9. Aquatic, wetland, or riparian species

a.	Not invasive in wetland communities	0
b.	Invasive in riparian communities	1
c.	Invasive in wetland communities	3
d.	Unknown	U

Score **1**

Documentation: *Amaranthus retroflexus* grows in stream valleys in North America (Walsh 1993) and has been documented invading disturbed riparian communities along the Adour River in southwestern France (Planty-Tabacchi et al. 1996) and in the Rio Grande Valley in New Mexico (Battacharjee et al. 2008).

Total Possible 25
Total **14**

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: *Amaranthus retroflexus* is a weed of 60 crops in 70 countries, including Pakistan, Russia, China, Canada, and the U.S. (Costea et al. 2004, eFloras 2008, Sokolova 2009). Infestations in agricultural fields reduce crop yield and quality (Costea et al. 2004).

3.2. Known level of ecological impact in natural areas

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

Score **1**

Documentation: *Amaranthus retroflexus* is known to grow in disturbed riparian communities along the Adour River in southwestern France (Planty-Tabacchi et al. 1996) and in the Rio Grande Valley in New Mexico (Battacharjee et al. 2008); however, it has not been documented invading natural habitats.

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 **0**

Documentation: *Amaranthus retroflexus* does not establish in undisturbed areas and only persists in regularly disturbed areas (Hultén 1968, Costea et al. 2004). In Canada and Alaska, it grows in agricultural fields, gardens, abandoned fields, waste places, and disturbed areas, and populations are often located near places of human habitation (Costea et al. 2004, Klinkenberg 2010, AKEPIC 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: *Amaranthus retroflexus* is native to eastern and central North America. It has been introduced to all inhabited continents (Mosyakin and Robertson 2003) and has been documented from arctic regions in central Russia (Sokolova and Budrevskaya 2003).

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

a.	Occurs in 0-5 percent of the states	0
b.	Occurs in 6-20 percent of the states	2
c.	Occurs in 21-50 percent of the states and/or listed as a problem weed (e.g., "Noxious," or "Invasive") in one state or Canadian province	4
d.	Occurs in more than 50 percent of the states and/or listed as a problem weed in two or more states or Canadian provinces	5
e.	Unknown	U

Score **5**

Documentation: *Amaranthus retroflexus* grows in all states of the U.S. and most of Canada (USDA 2011). It is considered a noxious weed in Manitoba, Minnesota, and Quebec and a nuisance weed in Alberta (Costea et al. 2004, Invaders 2011).

Total Possible 25
Total **15**

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 often remain viable in the soil for 6 to 10 years. In Michigan, 2% of seeds germinated after being buried in soil for 40 years. Seed longevity increases as the depth at which seeds are buried increases (Costea et al. 2004).

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 **0**

Documentation: New shoot buds cannot develop from the roots of *Amaranthus retroflexus*.

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 **1**

Documentation: Control of *Amaranthus retroflexus* may not be necessary in some cases because populations in disturbed areas are displaced by other vegetation after one to two years if natural successional processes are allowed to proceed. Most methods documented are specific to agricultural systems. Populations can be contained by mowing before flowering and seed set. Emergence can be reduced by applying a layer of mulch. *Amaranthus* species are susceptible to most herbicides. However, some strains of *Amaranthus retroflexus* associated with agriculture have developed resistance to the following herbicides: atrazine, simazine, imazethapyr, thifensulfuron, and linuron. Several insect species have been tested as prospective biological control agents, but none have provided effective control (Costea et al. 2004). *Phomopsis amaranthicola*, a fungus specific to the *Amaranthus* genus, has proven effective in controlling several *Amaranthus* species under field conditions (Rosskopf et al. 2000).

Total Possible	10
Total	**4**

Total for four sections possible	100
Total for four sections	**45**

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