

Oregon Department of Agriculture
Noxious Weed Pest Risk Assessment for
Garlic Mustard
Alliaria petiolata
Brassicaceae
February 2008, Revised February 2015

Findings of Review and Assessment: Garlic mustard meets the criteria of a “B” Listed Noxious Weed as defined by the ODA Noxious Weed Policy and Classification System. This determination is based on two independent risk assessments and a review of the literature. Using a rating system as outlined by the USDA-APHIS Weed Risk Assessment Guidelines, garlic mustard received a score of 46 out of a potential score of 89. Using the ODA Noxious Weed Rating system, garlic mustard received a score of 14 supporting a “B” listing.

Introduction: Europeans originally introduced garlic mustard as a garden herb to supplement their springtime diet. It quickly escaped cultivation and began to colonize New England forests (Davis et. al. 2012). The first wild specimens were collected in North America on Long Island, New York in 1868. Since that early collection, garlic mustard has spread to 30 eastern/midwestern states, the Pacific Northwest and three Canadian provinces. Garlic mustard is a rapidly expanding species, often completely colonizing fresh habitats in a few years. The partial sunlight found in deciduous or open-canopy conifer forests, along with roadside and riparian habitat provides the perfect conditions for garlic mustard establishment. Trails, parks or the fringes of agriculture lands are also commonly invaded habitat types. Once established, garlic mustard is very difficult to eradicate. Annual monitoring and removal of initial populations are the most effective measures in preventing the expansion of garlic mustard infestations.

Reproduction: Garlic mustard is a biennial herb. Seedlings emerge in the Fall to early March, and form basal rosettes by midsummer. In the spring of the plant's second year, the basal rosettes bolt producing flower stalks. The plant dies after setting seed. Basal leaves are dark green and kidney shaped with scalloped edges and are 6-10 cm in diameter. Stem-leaves are alternate, sharply toothed, and triangular in shape. The stem leaves are 3-8 cm in both length and width, and are smaller towards the top of the stem. The leaves produce a distinct garlic odor when crushed.

Each plant usually produces a single, unbranched (or weakly branched) flower stalks in early April though some plants have been recorded with up to 12 separate flowering stalks. Flowering plants average 0.7-1.5 m in height, but tiny 5 cm tall flowering specimens have been observed. The mustard-like flowers consist of four 3-6 mm long white petals that narrow abruptly at the base.



Garlic mustard infestation in Hood River

Garlic mustard will set seed through apomixis (self fertilization) even if pollinators are not present. In the basal rosette and bolting stage, garlic mustard can easily be confused with the escaped ornamental, silver dollar plant, but its strong garlic odor (in the spring and summer) is distinctive.

Reproduction is entirely by seeds. The seedpods are linear, 2.5-6 cm long and 2 mm wide, ripening by mid-June. Since each fruit contains an average of 16 seeds, a single plant produces 194--8,000 seeds. The seeds are black, cylindrical, and remain viable in the soil for 5 or more years. Garlic mustard seeds are spread locally by flood events or by humans, deer and elk, and on road maintenance equipment. Long distance dispersal is primarily through human activities.

Factors Effecting Establishment: Garlic mustard is very resistant to grazing by both invertebrates and vertebrates. Slugs are one of the most common herbivores on garlic mustard in Pacific Northwest forests (Miller 2015) but in eastern forests, garlic mustard inhibits slug herbivory on itself and native plants interspersed with it (Waller and Maas 2013). Generally, seed establishment rates are high and more influenced by inter-species competition than intra-species competition.

Probability of Detection: Garlic mustard can be showy during bloom time and is easily recognizable to both the public and land managers. Most new discoveries tend to establish near places with active human visitation aiding in early detection.

Distribution in Oregon: Garlic mustard has spread to North Africa, India, Sri Lanka, New Zealand, and North America. In the USA, it is most abundant in New England and other midwestern states. Populations have established as far west as North Dakota and Kansas, and south to Tennessee and North Carolina. Oregon's infestation is centered on the northern end of the Willamette Valley and was probably introduced in the 1930's. Newly recorded infestations now occur in other western states (Washington, Utah, Colorado, and Idaho) (Nuzzo 1994).

Environmental Impacts: The most widely recognized impact of garlic mustard involves its ability to displace native forest understory species, reducing diversity and in eastern forests, decreasing forage availability for browsers. Nationwide, deciduous forests are the most impacted forest type with reductions in forest tree regeneration and soil mycorrhiza observed. Allelopathy has also been identified in garlic mustard stands with the effects variable, depending on the native species (Cipollini et. al. 2011). Research has also identified below ground threats. Garlic mustard infestations appear to reduce or eliminate certain symbiotic fungi, which are needed for healthy plant growth and forest regeneration. Studies have shown that forest regeneration is severely reduced when these fungi are eliminated by weed invasion.

Economic Impacts: Less easy to measure are the costs associated with large-scale garlic mustard invasion. Additional right-of-way maintenance costs may occur along with increased control costs in parkland and natural areas. These impacts are incurred annually in the north Willamette Valley around Portland and in the Columbia River Gorge. In Oregon, these represent the greatest financial impact of the plant.

Control: Controlling garlic mustard requires a long-term commitment no matter what methodology is used. Soil seed banks and new seed introduction often frustrate weed removal programs for many years. Late winter applications of glyphosate to seedlings and rosettes followed by manual removal of flowering plants offer an excellent selective control method on small and large scales. Mature hand-pulled plants will continue to flower and set seed requiring bagging of plant material. Spraying older flowering plants often results in mixed control results as well as impacting non-target effects. Mowing is ineffective as a stand-alone treatment with mowed plants re-flowering near the ground level.

Noxious Weed Qualitative Risk Assessment 3.8
Oregon Department of Agriculture

Common Name: Garlic mustard
Scientific Name: *Alliaria petiolata*
Family: Brassicaceae

For use with plant species that occur or may occur in Oregon to determine their potential to become serious noxious weeds. For each of the following categories, select the number that best applies. Numerical values are weighted to increase priority categories over less important ones. Choose the best number that applies, intermediate scores can be used.

Total Score: 46 Risk Category: B

GEOGRAPHICAL INFORMATION

- 1) **Invasive in Other Areas**
0 Low- not known to be invasive elsewhere.
2 Known to be invasive in climates dissimilar to Oregon's current climates.
6 Known to be invasive in geographically similar areas.
Comments: Known to be invasive in a wide range of habitats
- 2) **Habitat Availability:** Are there susceptible habitats for this species and how common or widespread are they in Oregon?
1 *Low* – Habitat is very limited, usually restricted to a small watershed or part of a watershed (e.g., tree fern in southern Curry County).
3 *Medium* – Habitat encompasses 1/4 or less of Oregon (e.g., oak woodlands, coastal dunes, eastern Oregon wetlands, Columbia Gorge).
6 *High* – Habitat covers large regions or multiple counties, or is limited to a few locations of high economic or ecological value (e.g., threatened and endangered species habitat).
Comments: Habitat includes much of Western Oregon and certain parts of Eastern Oregon.
- 3) **Proximity to Oregon:** What is the current distribution of the species?
0 *Present* – Occurs within Oregon.
1 *Distant* – Occurs only in distant US regions or foreign countries.
3 *Regional* – Occurs in Western regions of US but not adjacent to Oregon border.
6 *Adjacent* – Weedy populations occur adjacent (<50 miles) to Oregon border.
Comments: Occurs in Oregon
- 4) **Current Distribution:** What is the current distribution of escaped populations in Oregon?
0 *Not present* – Not known to occur in Oregon.
1 *Widespread* – Throughout much of Oregon (e.g., cheatgrass).
5 *Regional* – Abundant (i.e., occurs in eastern, western, central, coastal, areas of Oregon) (e.g., gorse, tansy ragwort).
10 *Limited* – Limited to one or a few infestations in state (e.g., kudzu).
Comments: Primarily limited to the northern Willamette Valley region.

BIOLOGICAL INFORMATION

- 5) **3** **Environmental Factors:** Do abiotic (non-living) factors in the environment effect establishment and spread of the species? (e.g., precipitation, drought, temperature, nutrient availability, soil type, slope, aspect, soil moisture, standing or moving water).
- 1 *Low* – Severely confined by abiotic factors.
 - 2 *Medium* – Moderately confined by environmental factors
 - 4 *High* – Highly adapted to a variety of environmental conditions (e.g., tansy ragwort, Scotch broom).

Comments: Primarily limited by growing season moisture.

- 6) **5** **Reproductive Traits:** How does this species reproduce? Traits that may allow rapid population increase both on and off site.
- 0 *Negligible* – Not self-fertile, or is dioecious and opposite sex not present.
 - 1 *Low* – Reproduction is only by seed, produces few seeds, or seed viability and longevity are low.
 - 3 *Medium* – Reproduction is vegetative (e.g., by root fragments, rhizomes, bulbs, stolons).
 - 3 *Medium* – Produces many seeds, and/or seeds of short longevity (< 5 years).
 - 5 *High* – Produces many seeds and/or seeds of moderate longevity (5-10 years) (e.g., tansy ragwort).
 - 6 *Very high* – Has two or more reproductive traits (e.g., seeds are long-lived >10 years and spreads by rhizomes).

Comments: Produces many seeds of moderate longevity.

- 7) **4** **Biological Factors:** Do biotic (living) factors restrict or aid establishment and spread of the species? (What is the interaction of plant competition, natural enemies, native herbivores, pollinators, and pathogens with species?)
- 0 *Negligible* – Host plant not present for parasitic species.
 - 1 *Low* – Biotic factors highly suppress reproduction or heavily damage plant for an extended period (e.g., biocontrol agent on tansy ragwort).
 - 2 *Medium* – Biotic factors partially restrict or moderately impact growth and reproduction, impacts sporadic or short-lived.
 - 4 *High* – Few biotic interactions restrict growth and reproduction. Species expresses full growth and reproductive potential.

Comments: Plant highly resistant to herbivory.

- 8) **2** **Reproductive Potential and Spread After Establishment - Non-human Factors:**
How well can the species spread by natural means?
- 0 *Negligible* – No potential for natural spread in Oregon (e.g., ornamental plants outside of climate zone).
 - 1 *Low* – Low potential for local spread within a year, has moderate reproductive potential or some mobility of propagules (e.g., propagules transported locally by animals, water movement in lakes or ponds, not wind blown).
 - 3 *Medium* - Moderate potential for natural spread with either high reproductive potential or highly mobile propagules (e.g., propagules spread by moving water, or dispersed over longer distances by animals) (e.g., perennial pepperweed).
 - 5 *High* – Potential for rapid natural spread throughout the susceptible range, high reproductive capacity and highly mobile propagules. Seeds are wind dispersed over large areas (e.g., rush skeletonweed).

Comments: Spread locally by water, or animals. Not wind dispersed.

- 9) **2** **Potential of Species to be Spread by Humans.** What human activities contribute to spread of species? Examples include: interstate or international commerce; contaminated commodities; packing materials or products; vehicles, boats, or equipment movement; logging or farming; road maintenance; intentional introductions of ornamental and horticultural species, or biofuel production.
- 1 *Low* – Potential for introduction or movement minimal (e.g., species not traded or sold, or species not found in agricultural commodities, gravel or other commercial products).
 - 3 *Medium* – Potential for introduction or off-site movement moderate (e.g., not widely propagated, not highly popular, with limited market potential; may be a localized contaminant of gravel, landscape products, or other commercial products) (e.g., lesser celandine, Canada thistle).
 - 5 *High* – Potential to be introduced or moved within state high (e.g., species widely propagated and sold; propagules common contaminant of agricultural commodities or commercial products; high potential for movement by contaminated vehicles and equipment, or by recreational activities) (e.g., butterfly bush, spotted knapweed, Eurasian watermilfoil).

Comments: Long distance movement by human activity limited. Locally right of way maintenance and recreational activities can spread plant.

IMPACT INFORMATION

- 10) **2** **Economic Impact:** What impact does/can the species have on Oregon's agriculture and economy?
- 0 *Negligible* – Causes few, if any, economic impacts.
 - 1 *Low* - Potential to, or causes low economic impact to agriculture; may impact urban areas (e.g., puncture vine, pokeweed).
 - 5 *Medium* – Potential to, or causes moderate impacts to urban areas, right-of-way maintenance, property values, recreational activities, reduces rangeland productivity (e.g., English ivy, Himalayan blackberry, cheatgrass).
 - 10 *High* – Potential to, or causes high impacts in agricultural, livestock, fisheries, or timber production by reducing yield, commodity value, or increasing production costs (e.g., gorse, rush skeleton weed, leafy spurge).

Comments: Economic impacts related to control costs.

- 11) **4** **Environmental Impact:** What risks or harm to the environment does this species pose? Plant may cause negative impacts on ecosystem function, structure, and biodiversity of plant or fish and wildlife habitat; may put desired species at risk.
- 0 *Negligible* – None of the above impacts probable.
 - 1 *Low* – Can or does cause few or minor environmental impacts, or impacts occur in degraded or highly disturbed habitats.
 - 4 *Medium* – Species can or does cause moderate impacts in less critical habitats (e.g., urban areas, sagebrush/ juniper stands).
 - 6 *High* – Species can or does cause significant impacts in several of the above categories. Plant causes severe impacts to limited or priority habitats (e.g., aquatic, riparian zones, salt marsh; or T&E species sites).

Comments: Often causes significant competition to native plants in forest understories and in riparian habitat.

12) **0** **Impact on Health:** What is the impact of this species on human, animal, and livestock health? (e.g., poisonous if ingested, contact dermatitis, acute and chronic toxicity to livestock, toxic sap, injurious spines or prickles, causes allergy symptoms).

- 0 *Negligible* – Has no impact on human or animal health.
- 2 *Low* – May cause minor health problems of short duration, minor allergy symptoms (e.g., leafy spurge).
- 4 *Medium* – May cause severe allergy problems, death or severe health problems through chronic toxicity, spines or toxic sap may cause significant injury. (e.g., giant hogweed, tansy ragwort).
- 6 *High* – Causes death from ingestion of small amounts, acute toxicity (e.g. poison hemlock).

Comments: No impact on human health.

CONTROL INFORMATION

13) **2** **Probability of Detection at Point of Introduction:** How likely is detection of species after introduction and naturalization in Oregon?

- 1 *Low* – Grows where probability of early detection is high, showy and easily recognized by public; access to habitat not restricted (e.g., giant hogweed).
- 5 *Medium* – Easily identified by weed professionals, ranchers, botanists; some survey and detection infrastructure in place. General public may not recognize or report species (e.g., leafy spurge).
- 10 *High* – Probability of initial detection by weed professionals low. Plant shape and form obscure, not showy for much of growing season, introduction probable at remote locations with limited access (e.g., weedy grasses, hawkweeds, skeletonweed).

Comments: Plant is showy when in bloom and is easily recognizable by both public and professionals alike.

14) **3** **Control Efficacy:** What level of control of this species can be expected with proper timing, herbicides, equipment, and biological control agents?

- 1 *Negligible* – Easily controlled by common non-chemical control measures (e.g., mowing, tillage, pulling, and cutting; biocontrol is very effective at reducing seed production and plant density) (e.g., tansy ragwort).
- 2 *Low* – Somewhat difficult to control, generally requires herbicide treatment (e.g., mechanical control measures effective at preventing flowering and but not reducing plant density; herbicide applications provide a high rate of control in a single application; biocontrol provides partial control).
- 4 *Medium* – Treatment options marginally effective or costly. Tillage and mowing increase plant density (e.g., causes tillering, rapid regrowth, spread from root fragments). Chemical control is marginally effective. Crop damage occurs or significant non-target impacts result from maximum control rates. Biocontrol agents ineffective.
- 6 *High* – No effective treatments known or control costs very expensive. Species may occur in large water bodies or river systems where containment and complete control are not achievable. Political or legal issues may prevent effective control.

Comments: Control costly, requiring both herbicides and manual removal of flowering plants.

Category Scores:

19 Geographic score (Add scores 1-4)

16 Biological Score (Add lines 5-9)

6 Impact Score (Add lines 10-12)

5 Control Score (Add Lines 13-14)

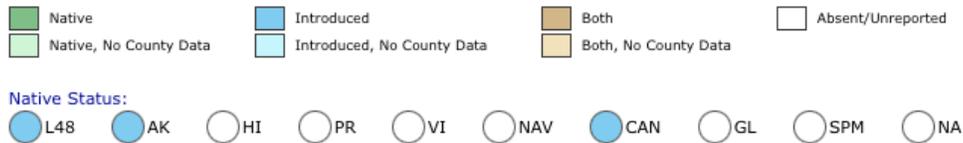
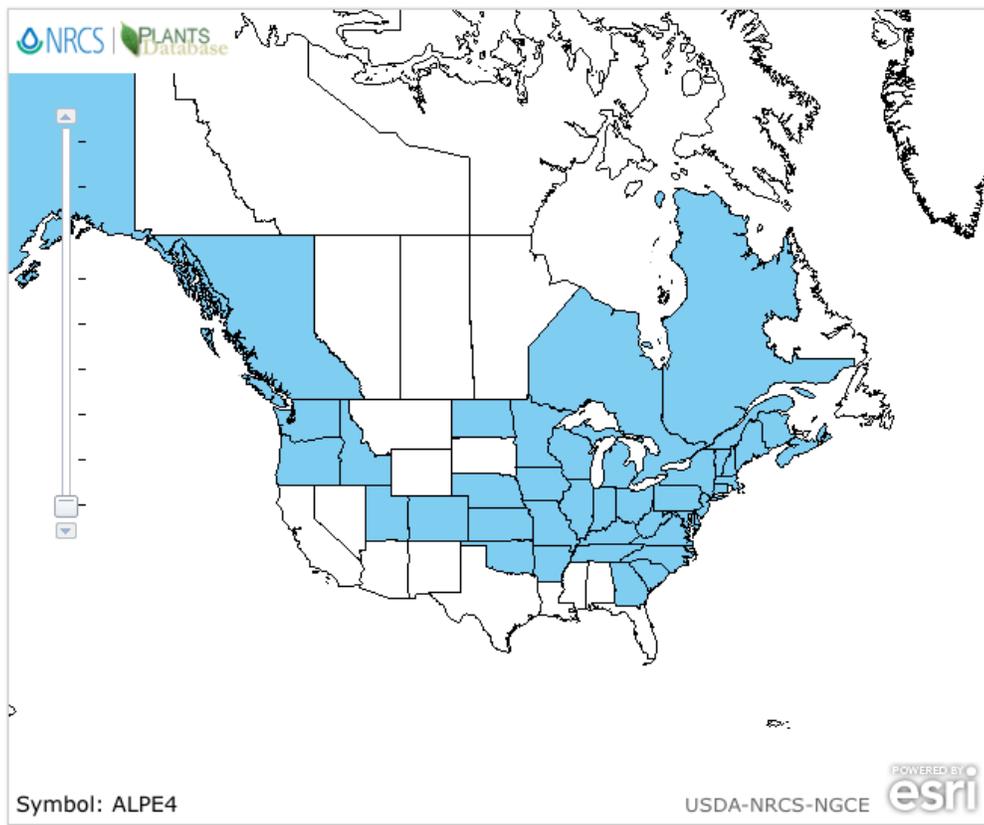
46 Total Score (Add scores 1-14 and list on front of form)

Risk Category: 55-89 = A 24-54 = B < 24 = unlisted.

This Risk Assessment was modified by ODA from the USDA-APHIS Risk Assessment for the introduction of new plant species.

V3.8 2/19/2016

US Distribution of garlic mustard



Oregon Department of Agriculture
Noxious Weed Rating System

Common Name: Garlic mustard
Scientific Name: *Alliaria petiolata*
Point Total: 13

Rating: B

1) Detrimental Effects: Check all that apply, add number of checks

- 1. *Health*: causes poisoning or injury to humans or animals
- 2. *Competition*: strongly competitive with crops, forage, or native flora
- 3. *Host*: host of pathogens and/or pests of crops or forage
- 4. *Contamination*: causes economic loss as a contaminate in seeds and/or feeds
- 5. *Interference*: interferes with recreation, transportation, harvest, land value, or wildlife and livestock movement

2) Reproduction & Capacity for Spread: Check the number that best describes, enter that number

- 1. Few seeds, not wind blown, spreads slowly
- 2. Many seeds, slow spread
- 3. Many seeds, spreads quickly by vehicles or animals
- 4. Windblown seed, or spreading rhizomes, or water borne
- 5. Many wind-blown seeds, high seed longevity, spreading rhizomes, perennials

3) Difficulty to Control: Check the number that best describes, enter that number

- 1. Easily controlled with tillage or by competitive plants
- 2. Requires moderate control, tillage, competition or herbicides
- 3. Herbicides generally required, or intensive management practices
- 4. Intensive management generally gives marginal control
- 5. No management works well, spreading out of control

4) Distribution: Check the number that best describes, enter that number

- 1. Widely distributed throughout the state in susceptible habitat
- 2. Regionally abundant, 5 or more counties, more than 1/2 of a county
- 3. Abundant throughout 1- 4 counties, or 1/4 of a county, or several watersheds
- 4. Contained in only 1 watershed, or less than 5 square miles gross infestation
- 5. Isolated infestation less than 640 acres, more than 10 acres

5) Ecological Impact: Check the number that best describes, enter that number

- 1. Occurs in most disturbed habitats with little competition
- 2. Occurs in disturbed habitats with competition
- 3. Invades undisturbed habitats and crowds out native species
- 4. Invades restricted habitats (i.e. riparian) and crowds out native species

13 TOTAL POINTS

Note: Noxious weeds are non-native plants with scores of 11 points or higher. Any plants in 4.1, 4.2, and 4.3 should not be classified as “A” rated weeds. Ratings: 16+ = A, 15 – 11 = B
ODA Weed Rating System 2/22/16 V3.8

References:

Cipollini K., Titus K., Wagner C. (2012) Allelopathic effects of invasive species (*Alliaria petiolata*, *Lonicera maackii*, *Ranunculus ficaria*) in the Midwestern United States. *Allelopathy Journal* 29 (1): 63-76 (2012) International Allelopathy Foundation 2012

Davis M. A., Golehour A., Daney J., Foster E., Magmillan G., Merrill E., O'Neil J., Pearson M, Whitney M., Anderson M. D., Dosgh A. (2012) The Population Dynamics and Ecological Effects of Garlic Mustard, *Alliaria petiolata*, in a Minnesota Oak Woodland. *Am. Midi. Nat.* (2012) 168:364-374

Frey M.N., Herms C.P., Cardina J. 2007 Cold weather application of glyphosate for garlic mustard (*Alliaria petiolata*) control. *Weed Technology* Volume 21, Issue 3, July 2007, Pages 656-660

Nuzzo, V. 1994. *Alliaria petiolata* Element Stewardship Abstract (ESA), The Nature Conservancy. Updated June 2000, author: Tunya Lee Morisawa

Miller 2015 Oregon Department of Agriculture. Personal observations.

Stinson K., Kaufman S., Durbin L., Lowenstein F. 2007 Impacts of garlic mustard invasion on a forest understory community. *Northeastern Naturalist* Volume 14 Issue 1. pp. 73-88

Waller D., Maas L. 2013. Do white-tailed deer and the exotic plant garlic mustard interact to affect the growth and persistence of native forest plants? *Forest Ecology and Management* 304 (2013) 296-302

Reported by: Glenn Miller, ODA

USDA Plant Hardiness Zone

