

# NEW YORK NON-NATIVE PLANT INVASIVENESS RANKING FORM

Scientific name: Alliaria petiolata USDA Plants Code: ALPE4  
 Common names: Garlic mustard  
 Native distribution: Throughout most of Europe  
 Date assessed: September 10, 2008; edited 2-11-2009  
 Assessors: Gerry Moore  
 Reviewers: LIISMA SRC  
 Date Approved: 9-24-2008 Form version date: 22 October 2008

**New York Invasiveness Rank:** Very High (Relative Maximum Score >80.00)

<b>Distribution and Invasiveness Rank</b> ( <i>Obtain from PRISM invasiveness ranking form</i> )		
Status of this species in each PRISM:	Current Distribution	PRISM Invasiveness Rank
1 Adirondack Park Invasive Program	Not Assessed	Not Assessed
2 Capital/Mohawk	Not Assessed	Not Assessed
3 Catskill Regional Invasive Species Partnership	Not Assessed	Not Assessed
4 Finger Lakes	Not Assessed	Not Assessed
5 Long Island Invasive Species Management Area	Widespread	Very High
6 Lower Hudson	Not Assessed	Not Assessed
7 Saint Lawrence/Eastern Lake Ontario	Not Assessed	Not Assessed
8 Western New York	Not Assessed	Not Assessed

<b>Invasiveness Ranking Summary</b> (see details under appropriate sub-section)		Total (Total Answered*) Possible	Total
1	Ecological impact	40 (40)	37
2	Biological characteristic and dispersal ability	25 (25)	20
3	Ecological amplitude and distribution	25 (25)	21
4	Difficulty of control	10 (10)	6
	Outcome score	100 (100) <sup>b</sup>	84 <sup>a</sup>
	Relative maximum score †		84.00
	New York Invasiveness Rank §	High (Relative Maximum Score 70.00-80.00)	

\* For questions answered "unknown" do not include point value in "Total Answered Points Possible." If "Total Answered Points Possible" is less than 70.00 points, then the overall invasive rank should be listed as "Unknown."

† Calculated as 100(a/b) to two decimal places.

§ Very High >80.00; High 70.00-80.00; Moderate 50.00-69.99; Low 40.00-49.99; Insignificant <40.00

## A. DISTRIBUTION (KNOWN/POTENTIAL): Summarized from individual PRISM forms

A1.1. Has this species been documented to persist without cultivation in NY? (reliable source; voucher not required)		
<input checked="" type="checkbox"/>	Yes – continue to A1.2	
<input type="checkbox"/>	No – continue to A2.1	
A1.2. In which PRISMs is it known (see inset map)?		
<input checked="" type="checkbox"/>	Adirondack Park Invasive Program	
<input checked="" type="checkbox"/>	Capital/Mohawk	
<input checked="" type="checkbox"/>	Catskill Regional Invasive Species Partnership	
<input checked="" type="checkbox"/>	Finger Lakes	
<input checked="" type="checkbox"/>	Long Island Invasive Species Management Area	
<input checked="" type="checkbox"/>	Lower Hudson	
<input checked="" type="checkbox"/>	Saint Lawrence/Eastern Lake Ontario	
<input checked="" type="checkbox"/>	Western New York	

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**Documentation:**

Sources of information:

Weldy & Werier, 2005; Brooklyn Botanic Garden, 2008.

A2.1. What is the likelihood that this species will occur and persist outside of cultivation given the climate in the following PRISMs? (obtain from PRISM invasiveness ranking form)

Not Assessed	Adirondack Park Invasive Program
Not Assessed	Capital/Mohawk
Not Assessed	Catskill Regional Invasive Species Partnership
Not Assessed	Finger Lakes
Very Likely	Long Island Invasive Species Management Area
Not Assessed	Lower Hudson
Not Assessed	Saint Lawrence/Eastern Lake Ontario
Not Assessed	Western New York

**Documentation:**

Sources of information (e.g.: distribution models, literature, expert opinions):

Weldy & Werier, 2005; Brooklyn Botanic Garden, 2008.

***If the species does not occur and is not likely to occur with any of the PRISMs, then stop here as there is no need to assess the species.***

A2.2. What is the current distribution of the species in each PRISM? (obtain rank from PRISM invasiveness ranking forms)

	Distribution
Adirondack Park Invasive Program	Not Assessed
Capital/Mohawk	Not Assessed
Catskill Regional Invasive Species Partnership	Not Assessed
Finger Lakes	Not Assessed
Long Island Invasive Species Management Area	Widespread
Lower Hudson	Not Assessed
Saint Lawrence/Eastern Lake Ontario	Not Assessed
Western New York	Not Assessed

**Documentation:**

Sources of information:

Weldy & Werier, 2005; Brooklyn Botanic Garden, 2008.

A2.3. Describe the potential or known suitable habitats within New York. Natural habitats include all habitats not under active human management. Managed habitats are indicated with an asterisk.

<p><b>Aquatic Habitats</b></p> <input type="checkbox"/> Salt/brackish waters <input type="checkbox"/> Freshwater tidal <input type="checkbox"/> Rivers/streams <input type="checkbox"/> Natural lakes and ponds <input type="checkbox"/> Vernal pools <input type="checkbox"/> Reservoirs/impoundments*	<p><b>Wetland Habitats</b></p> <input type="checkbox"/> Salt/brackish marshes <input type="checkbox"/> Freshwater marshes <input type="checkbox"/> Peatlands <input type="checkbox"/> Shrub swamps <input checked="" type="checkbox"/> Forested wetlands/riparian <input checked="" type="checkbox"/> Ditches* <input type="checkbox"/> Beaches and/or coastal dunes	<p><b>Upland Habitats</b></p> <input checked="" type="checkbox"/> Cultivated* <input type="checkbox"/> Grasslands/old fields <input type="checkbox"/> Shrublands <input checked="" type="checkbox"/> Forests/woodlands <input type="checkbox"/> Alpine <input checked="" type="checkbox"/> Roadsides*
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Other potential or known suitable habitats within New York:  
 Need to investigate possible presence in freshwater marshes.

**Documentation:**

Sources of information:

Cavers et al., 1979; Byers & Quinn, 1987; Nuzzo, 1992a, 1993a; Brooklyn Botanic Garden, 2008.

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**B. INVASIVENESS RANKING**

*1. ECOLOGICAL IMPACT*

**1.1. Impact on Natural Ecosystem Processes and System-Wide Parameters (e.g. fire regime, geomorphological changes (erosion, sedimentation rates), hydrologic regime, nutrient and mineral dynamics, light availability, salinity, pH)**

- A. No perceivable impact on ecosystem processes based on research studies, or the absence of impact information if a species is widespread (>10 occurrences in minimally managed areas), has been well-studied (>10 reports/publications), and has been present in the northeast for >100 years. 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 and/or hydrology, affects fire frequency, alters soil pH, or 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:**

Identify ecosystem processes impacted (or if applicable, justify choosing answer A in the absence of impact information)

Produces large quantities of secondary compounds, including glucosinates and cyanide, some of which end up in the soil where they affect the mineral dynamics and nutrient availability in ways that negatively impact the growth of many native plant species (Prati & Bossdorf, 1994; Stinson et al., 2006; Cippolini & Gruner, 2007; Rodgers et al., 2008). Large stands also reduce light availability in Spring for species growing on forest floor (Meekins & McCarthy, 1999; author's personal observations).

Sources of information:

Meekins & McCarthy, 1999; Prati & Bossdorf, 1994; Rodgers et al., 2008; author's personal observations.

**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 7

**Documentation:**

Identify type of impact or alteration:

Significantly impacts the density of the herb layer; dense infestations may create an herb layer in areas where other herbaceous plants were absent. Suppresses growth of seedlings of sugar maple, red maple and white ash, possibly leading to altered tree canopy with time (Stinson et al., 2006).

Sources of information:

Meekins & McCarthy, 2001, Nuzzo, 1999; Nuzzo, 2000; Fellows, 2006; Stinson et al., 2006.

**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

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- native species in the community)
- 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 

10
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**Documentation:**

Identify type of impact or alteration:

Dramatically outcompetes native herb species, especially early in the season. Also inhibits the seed germination of many native species (Prati & Bosdorf, 2004; Stinson et al., 2006). Suppresses the growth of seedlings of sugar maple, red maple and white ash (Stinson et al. 2006). Not browsed by deer or other herbivores (including insects), which places further browsing stress on native species (Szentesi, 1991; Nuzzo, 2000; Blossey et al., 2001; Renwick et al., 2001; Williams and Ward, 2006; Eschtruth and Battles 2008).

Sources of information:

Nuzzo, 1999, 2000; Prati & Bosdorf, 2004; Fellows, 2006; Stinson et al., 2006.

1.4. Impact on other species or species groups (cumulative impact of this species on the animals, fungi, microbes, and other organisms in the community it invades. Examples include reduction in nesting/foraging sites; reduction in habitat connectivity; injurious components such as spines, thorns, burrs, toxins; suppresses soil/sediment microflora; interferes with native pollinators and/or pollination of a native species; hybridizes with a native species; hosts a non-native disease which impacts a native species)

- A. Negligible perceived impact 0
- B. Minor impact 3
- C. Moderate impact 7
- D. Severe impact on other species or species groups 10
- U. Unknown

Score 

10
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**Documentation:**

Identify type of impact or alteration:

Leaching of garlic mustard's secondary compounds dramatically impacts growth of mycorrhizae and other microbes in the soil (Blossey et al., 2001; Prati & Bosdorf, 2004; Stinson et al., 2006; Rodgers et al. 2008). Also there is preliminary evidence that the presence of garlic mustard is decreasing the abundance of the native West Virginia White butterfly *Pieris virginiensis* (Porter 1994; Courant et al. 1994) and the white mustard butterfly (*Pieris napi oleracea*) (Renwick et al., 2001; Rodgers et al., 2008).

Sources of information:

Blossey et al. 2001; Prati & Bosdorf, 2004; Stinson et al., 2006; Rodgers et al., 2008.

Total Possible 

40
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Section One Total 

37
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**2. BIOLOGICAL CHARACTERISTICS AND DISPERSAL ABILITY**

- 2.1. Mode and rate of reproduction (provisional thresholds, more investigation needed)
- A. No reproduction by seeds or vegetative propagules (i.e. plant sterile with no sexual or asexual reproduction). 0
  - B. Limited reproduction (fewer than 10 viable seeds per plant AND no vegetative reproduction; if viability is not known, then maximum seed production is less than 100 seeds per plant and no vegetative reproduction) 1

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- C. Moderate reproduction (fewer than 100 viable seeds per plant - if viability is not known, then maximum seed production is less than 1000 seeds per plant - OR limited successful vegetative spread documented) 2
- D. Abundant reproduction with vegetative asexual spread documented as one of the plants prime reproductive means OR more than 100 viable seeds per plant (if viability is not known, then maximum seed production reported to be greater than 1000 seeds per plant.) 4
- U. Unknown

Score 

4
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**Documentation:**

Describe key reproductive characteristics (including seeds per plant):  
Larger plants can produce over 1000 (up to 7900 per plant) seeds per plant with germinations rates between 12% and 100%.

Sources of information:

Cavers et al., 1979; Byers & Quinn, 1988; 1988; Baskin & Baskin, 1992.

**2.2. Innate potential for long-distance dispersal (e.g. bird dispersal, sticks to animal hair, buoyant fruits, pappus for 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) 1
- C. Moderate opportunities for long-distance dispersal (adaptations exist for long-distance dispersal, but studies report that 95% of seeds land within 100 meters of the parent plant) 2
- D. Numerous opportunities for long-distance dispersal (adaptations exist for long-distance dispersal and evidence that many seeds disperse greater than 100 meters from the parent plant) 4
- U. Unknown

Score 

4
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**Documentation:**

Identify dispersal mechanisms:

Seeds generally fall within 100 m. of parent plant but there are numerous opportunities for long distance dispersal of these small seeds by water and animals (Lhotska, 1975; Cavers et al., 1979; Nuzzo, 1999, 2000).

Sources of information:

Lhotska, 1975; Cavers et al., 1979; Nuzzo, 1999, 2000; A. Entrup, Dwight Andrews, pers. obs..

**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, contaminated compost, land and vegetation management equipment such as mowers and excavators, etc.)**

- A. Does not occur 0
- B. Low (human dispersal to new areas occurs almost exclusively by direct means and is infrequent or inefficient) 1
- C. Moderate (human dispersal to new areas occurs by direct and indirect means to a moderate extent) 2
- D. High (opportunities for human dispersal to new areas by direct and indirect means are numerous, frequent, and successful) 3
- U. Unknown

Score 

3
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**Documentation:**

Identify dispersal mechanisms:

Seeds are widely dispersed indirectly by humans through clothing and directly by soil transport, yard waste, earth moving machinery, and snow plows.

Sources of information:

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Cavers et al., 1979; Nuzzo, 1999; Nuzzo, 2000; Fellows, 2006.

2.4. Characteristics that increase competitive advantage, such as shade tolerance, ability to grow on infertile soils, perennial habit, fast growth, nitrogen fixation, allelopathy, etc.

- A. Possesses no characteristics that increase competitive advantage 0
- B. Possesses one characteristic that increases competitive advantage 3
- C. Possesses two or more characteristics that increase competitive advantage 6
- U. Unknown

Score

**Documentation:**

Evidence of competitive ability:

Shade tolerance; infertile soils, allelopathy; low palatability to white tailed deer.

Sources of information:

Cavers et al., 1979; Fellows, 2006; Eschtruth and Battles, 2008; author's personal observations..

2.5. Growth vigor

- A. Does not form thickets or have a climbing or smothering growth habit 0
- B. Has climbing or smothering growth habit, forms a dense layer above shorter vegetation, forms dense thickets, or forms a dense floating mat in aquatic systems where it smothers other vegetation or organisms 2
- U. Unknown

Score

**Documentation:**

Describe growth form:

Does not form thickets or a smothering growth habit.

Sources of information:

Cavers et al., 1979; Fellows, 2006; author's personal observations.

2.6. Germination/Regeneration

- A. Requires open soil or water and disturbance for seed germination, or regeneration from vegetative propagules. 0
- B. Can germinate/regenerate in vegetated areas but in a narrow range or in special conditions 2
- C. Can germinate/regenerate in existing vegetation in a wide range of conditions 3
- U. Unknown (No studies have been completed)

Score

**Documentation:**

Describe germination requirements:

Germinates in existing vegetation in a wide variety of conditions.

Sources of information:

Roberts & Boddrell, 1983; Baskin & Baskin 1992; author's personal observations.

2.7. Other species in the genus invasive in New York or elsewhere

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

Score

**Documentation:**

Species:

Weldy & Werier, 2005; Brooklyn Botanic Garden, 2008

Total Possible

Section Two Total

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**3. ECOLOGICAL AMPLITUDE AND DISTRIBUTION**

3.1. Density of stands in natural areas in the northeastern USA and eastern Canada (use same definition as Gleason & Cronquist which is: “The part of the United States covered extends from the Atlantic Ocean west to the western boundaries of Minnesota, Iowa, northern Missouri, and southern Illinois, south to the southern boundaries of Virginia, Kentucky, and Illinois, and south to the Missouri River in Missouri. In Canada the area covered includes Nova Scotia, Prince Edward Island, New Brunswick, and parts of Quebec and Ontario lying south of the 47th parallel of latitude”)

- A. No large stands (no areas greater than 1/4 acre or 1000 square meters) 0
- B. Large dense stands present in areas with numerous invasive species already present or disturbed landscapes 2
- C. Large dense stands present in areas with few other invasive species present (i.e. ability to invade relatively pristine natural areas) 4
- U. Unknown

Score

**Documentation:**

Identify reason for selection, or evidence of weedy history:  
Large dense stands present with few to no other invasives present.  
Sources of information:  
Fellows, 2006; Rodgers et al, 2008; author's personal observations.

3.2. Number of habitats the species may invade

- A. Not known to invade any natural habitats given at A2.3 0
- B. Known to occur in two or more of the habitats given at A2.3, with at least one a natural habitat. 1
- C. Known to occur in three or more of the habitats given at A2.3, with at least two a natural habitat. 2
- D. Known to occur in four or more of the habitats given at A2.3, with at least three a natural habitat. 4
- E. Known to occur in more than four of the habitats given at A2.3, with at least four a natural habitat. 6
- U. Unknown

Score

**Documentation:**

Identify type of habitats where it occurs and degree/type of impacts:  
See A2.3.  
Sources of information:  
Cavers et al., 1979; Byers & Quinn, 1987; Nuzzo, 1992a, 1993a; Brooklyn Botanic Garden, 2008.

3.3. Role of 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 or anthropogenic disturbances. 2
- C. Can establish independent of any known natural or anthropogenic disturbances. 4
- U. Unknown

Score

**Documentation:**

Identify type of disturbance:  
Usually establishes in areas with anthropogenic disturbance but can establish in areas

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without any recent natural or anthropogenic disturbance.  
Sources of information:  
Nuzzo, 1999; Nuzzo, 2000, Fellows, 2006; author's personal observations; Jordan pers.obs.  
Cold Spring Harbor, NY.

**3.4. Climate in native range**

- A. Native range does not include climates similar to New York 0
- B. Native range possibly includes climates similar to at least part of New York. 1
- C. Native range includes climates similar to those in New York 3
- U. Unknown

Score

**Documentation:**  
Describe what part of the native range is similar in climate to New York:  
Europe.  
Sources of information:  
U.S.D.A., 2008; Brooklyn Botanic Garden, 2008

**3.5. Current introduced distribution in the northeastern USA and eastern Canada (see question 3.1 for definition of geographic scope )**

- A. Not known from the northeastern US and adjacent Canada 0
- B. Present as a non-native in one northeastern USA state and/or eastern Canadian province. 1
- C. Present as a non-native in 2 or 3 northeastern USA states and/or eastern Canadian provinces. 2
- D. Present as a non-native in 4–8 northeastern USA states and/or eastern Canadian provinces, and/or categorized as a problem weed (e.g., “Noxious” or “Invasive”) in 1 northeastern state or eastern Canadian province. 3
- E. Present as a non-native in >8 northeastern USA states and/or eastern Canadian provinces, and/or categorized as a problem weed (e.g., “Noxious” or “Invasive”) in 2 northeastern states or eastern Canadian provinces. 4
- U. Unknown

Score

**Documentation:**  
Identify states and provinces invaded:  
Present in all northeastern states in the U.S and all eastern Canadian provinces.  
Sources of information:  
See known introduced range in plants.usda.gov, and update with information from states and Canadian provinces.  
U.S.D.A., 2008.

**3.6. Current introduced distribution of the species in natural areas in the eight New York State PRISMs (Partnerships for Regional Invasive Species Management)**

- A. Present in none of the PRISMs 0
- B. Present in 1 PRISM 1
- C. Present in 2 PRISMs 2
- D. Present in 3 PRISMs 3
- E. Present in more than 3 PRISMs or on the Federal noxious weed lists 4
- U. Unknown

Score

**Documentation:**  
Describe distribution:  
In all PRISMs; see A1.1.



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Sources of information:  
Weldy & Werier, 2005; Brooklyn Botanic Garden, 2008.

Total Possible	25
Section Three Total	21

**4. DIFFICULTY OF CONTROL**

**4.1. Seed banks**

- A. Seeds (or vegetative propagules) remain viable in soil for less than 1 year, or does not make viable seeds or persistent propagules. 0
- B. Seeds (or vegetative propagules) remain viable in soil for at least 1 to 10 years 2
- C. Seeds (or vegetative propagules) remain viable in soil for more than 10 years 3
- U. Unknown

Score 2

**Documentation:**  
Identify longevity of seed bank:  
Seeds remain viable for over 1 year; no evidence for 10 years.  
Sources of information:  
Byers & Quinn, 1998; Fellows, 2006

**4.2. Vegetative regeneration**

- A. No regrowth following removal of aboveground growth 0
- B. Regrowth from ground-level meristems 1
- C. Regrowth from extensive underground system 2
- D. Any plant part is a viable propagule 3
- U. Unknown

Score 0

**Documentation:**  
Describe vegetative response:  
Biennial; no regrowth following removal of aboveground growth at proper time of year after flowering has begun.  
Sources of information:  
Byers & Quinn, 1998; Fellows, 2006; author's personal observations.

**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: e.g. 10 or fewer person-hours of manual effort (pulling, cutting and/or digging) can eradicate a 1 acre infestation in 1 year (infestation averages 50% cover or 1 plant/100 ft<sup>2</sup>). 2
- C. Management requires a major short-term investment: e.g. 100 or fewer person-hours/year of manual effort, or up to 10 person-hours/year using mechanical equipment (chain saws, mowers, etc.) for 2-5 years to suppress a 1 acre infestation. Eradication is difficult, but possible (infestation as above). 3
- D. Management requires a major investment: e.g. more than 100 person-hours/year of manual effort, or more than 10 person hours/year using mechanical equipment, or the use of herbicide, grazing animals, fire, etc. for more than 5 years to suppress a 1 acre infestation. Eradication may be impossible (infestation as above). 4
- U. Unknown

Score 4

**Documentation:**  
Identify types of control methods and time-term required:  
Hand pulling in light infestations, clipping close to the ground but must remove seed

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heads; herbicide can include Roundup. Very difficult to eradicate once established due to seed bank.

Sources of information:

Rowe & Swearingen, 1997; Nuzzo, 2000; Fellows, 2000; author's personal observations.

Total Possible	10
Section Four Total	6

<b>Total for 4 sections Possible</b>	<b>100</b>
<b>Total for 4 sections</b>	<b>84</b>

**C. STATUS OF CULTIVARS AND HYBRIDS:**

At the present time (May 2008) there is no protocol or criteria for assessing the invasiveness of cultivars independent of the species to which they belong. Such a protocol is needed, and individuals with the appropriate expertise should address this issue in the future. Such a protocol will likely require data on cultivar fertility and identification in both experimental and natural settings.

Hybrids (crosses between different parent species) should be assessed individually and separately from the parent species wherever taxonomically possible, since their invasiveness may differ from that of the parent species. An exception should be made if the taxonomy of the species and hybrids are uncertain, and species and hybrids can not be clearly distinguished in the field. In such cases it is not feasible to distinguish species and hybrids, and they can only be assessed as a single unit.

Some cultivars of the species known to be available:

**References for species assessment:**

Brooklyn Botanic Garden. 2008. AILANTHUS database. [Accessed on September 10, 2008. ]

Blossey, B., V. Nuzzo, H. Hinz, and E. Gerber. 2001. Developing biological control of *Alliaria petiolata* (M.Bieb.) Cavara and Grande (garlic mustard). *Natural Areas Journal* 21: 357-367.

Byers, D.L. and J.A. Quinn. 1998. Demographic variation in *Alliaria petiolata* (Brassicaceae) in four contrasting habitats. *Journal of the Torrey Botanical Society* 125(2): 138-149.

Cavers, P.B., M.I. Heagy, R.F. Kokron. 1979. The biology of Canadian weeds 35: *Alliaria petiolata* (M.Bieb.) Cavara and Grande. *Canadian Journal of Plant Sciences* 59: 217-229.1

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Cippolini, D. and B. Gruner. 2007. Cyanide in the chemical arsenal of garlic mustard, *Alliaria petiolata*. *Journal of Chemical Ecology* 33: 85-94.

Courant, A.V., A.E. Holbrook, E.D. Van der Reijden & F.S. Chew. 1994. Native pierine butterfly (Pieridae) adapting to naturalized crucifer? *Journal of the Lepidopterists' Society*, 48 (2): 168 - 169.

Crude, R.W., A.M. McClain, G.P. Shrivastava. 1996. Pollination biology and breeding system of *Alliaria petiolata* (Brassicaceae). *Bulletin of the Torrey Botanical Club* 123(4): 273-280.

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- McCarthy, B.C. and S.L. Hanson. 1998. An assessment of the allelopathic potential of the invasive weed *Alliaria petiolata* (Brassicaceae). *Castanea* 63(1): 68-73.
- Meekins, J.F., H.E. Ballard, B.C. McCarthy. 2001. Genetic variation and molecular biogeography of a North American invasive plant species (*Alliaria petiolata*, Brassicaceae). *International Journal of Plant Sciences* 162(1): 161-169.
- Meekins, J.F. and B.C. McCarthy. 1999. Competitive ability of *Alliaria petiolata* (Garlic Mustard, Brassicaceae), an invasive nonindigenous forest herb. *International Journal of Plant Sciences* 160(4): 743-752.
- Meekins, J.F. and B.C. McCarthy. 2000. Responses of the biennial forest herb *Alliaria petiolata* to variation in population density, nutrient addition, and light availability. *The Journal of Ecology* 88(3): 447-463.
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## APPENDIX

Temporary compilation of information to be used in Phase Two assessment of economic and human health impacts of non-native species

Information in this section may be useful for assessing the invasiveness of particular species, for developing strategies for prevention/early detection of potential new invaders, and for assessing economic and human health impacts. No scores are given to this section at this time, though these factors are important. In the future, separate assessments for economic impacts, human health impacts, agricultural impacts, and other categories may need to be developed in order to arrive at an overall NYS invasiveness rank that takes all factors into account.

### 1. *PATHWAYS OF INTRODUCTION*

#### 1.1. Potential pathways of introduction into and within New York

Describe the potential pathways by which this species may be introduced into New York or may be spread within New York (e.g., natural migration, spread through canal system, movement of contaminated soil, etc):

Sources of information:

#### 1.2. Likelihood of survival and spread within each pathway

Describe the likelihood of this species to survive and spread within the various pathways mentioned above, including any thoughts about whether multiple introductions may be required before species becomes establish or if a single introduction will likely be successful:

Sources of information:

### 2. *KNOWN BENEFITS*

#### 2.1. Benefits this species provides

By definition, a non-native species must cause more harm than good before it is considered invasive. Even the worst species may provide some sort of ecosystem service (e.g., nesting habitat for common birds, erosion control, and landscape beautification). To ensure that all the benefits are weighed against the negative impacts, list the potential benefits this species provides. Weigh the benefits of this invasive species against the benefits provided by those native species that would typically be present in the habitat, in the absence of the invasive species:

Sources of information:

### 3. *ECONOMIC IMPACTS*

#### 3.1. Potential negative economic impacts (e.g., potential to reduce crop yields, lower commodity values, management and restoration costs, lower real estate value, limit recreational opportunities, cause loss of markets for US goods, etc)

- A. Negligible perceived impact
- B. Causes minor damage or requires minimal output to prevent economic impacts
- C. Damage significant but economic costs attributed to this species has been estimated at less than \$1 million annually or studies indicate that potential damage could result in impacts more than \$3 million but less than \$10 million over a ten year period.
- D. Damage attributed to this species has been estimated at more than \$1 million annually or studies indicate that the potential damage could result in impacts greater than \$10 million over a ten year period.
- U. Unknown

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Documentation:

Identify type of impact or alteration:

Sources of information:

3.2. Potential positive economic impacts (e.g., nursery sales, honey production, farm products, biofuels, timber production, food resource, etc)

- A. Negligible benefits
- B. Species of minor economic importance
- C. Economic benefits more than \$100K but less than \$1 million annually or more than \$3 million but less than \$10 million over the last ten years.
- D. Economics benefits surpassing \$1 million annually or great than \$10 million over the last ten years.
- U. Unknown

Documentation:

Identify type of impact or alteration:

Sources of information:

*4. HUMAN HEALTH IMPACTS*

4.1. Potential human health impacts

- A. Negligible perceived impact
- B. Known to cause human health problems, but full recover
- C. Documented cases where this species has caused permanent bodily harm, health issues, or death.
- U. Unknown

Documentation:

Identify type of impact or alteration:

Sources of information: