INDIANA

NON-NATIVE PLANT INVASIVENESS RANKING FORM

ASSESSMENT FOR INVASIVE PLANTS NOT IN TRADE

Form originally created for use in New York. Indiana Form version date: November 1, 2010

Scientific name:	Lepidium latifolium L.	USDA Plants Code: LELA2
Common names:	Broadleaved Pepperweed	
Native distribution:	Central Eurasia	
Date assessed:	July 16, 2012	
Assessors:	Pia Marie Paulone and Ellen Jacquart	
Reviewers:	Scott Namestnik and Stuart Orr	
Date Approved:	September 21, 2012	

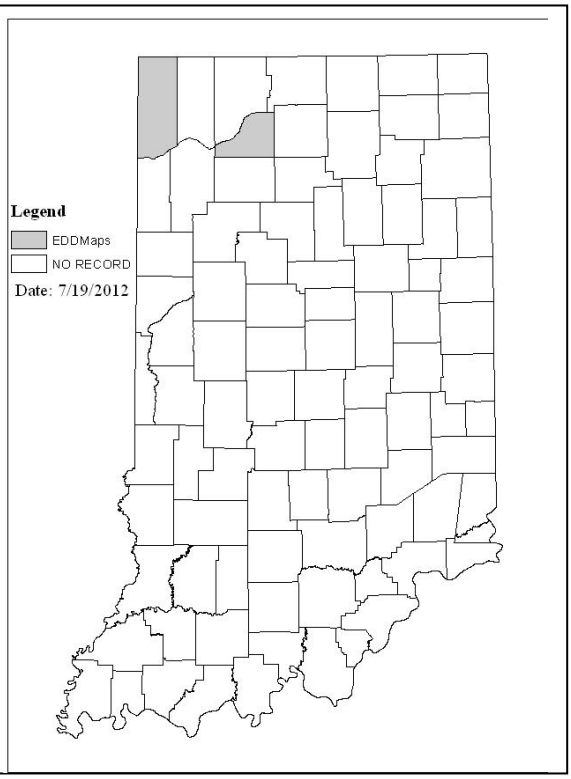
Indiana Invasiveness Rank: High 70.00−80.00

Invasiveness Ranking Summary (see details under appropriate sub-section)		Total (Total Answered*) Possible	Total
1	Ecological impact	40 (40)	31
2	Biological characteristic and dispersal ability	25 (25)	20
3	Ecological amplitude and distribution	25 (25)	18
4	Difficulty of control	10 (7)	6
	Outcome score	100 (97)[b]	75 [a]
	Relative maximum score †		77.32
	Indiana Invasiveness Rank §	High 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):

A1. Has this species been documented to persist without cultivation in IN? (reliable source; voucher not required)	
x	Yes – continue to A2.2
☐	No – continue to A2.1
A2. What is the likelihood that this species will occur and persist outside of cultivation given the climate in Indiana? (obtain from occurrence data in other states with similar climates)	
☐	Likely – continue to A3
☐	Not likely



Documentation:
Sources of information: Range maps compiled from PLANTS database, http://plants.usda.gov/java/; Indiana CAPS database, http://extension.entm.purdue.edu/CAPS/index.html; Indiana IPSAWG reports (unpublished); and EDDMapS reports, http://eddmaps.org/

A3 Describe the potential or known suitable habitats within Indiana (underlined). Natural habitats include all habitats not under active human management. Managed habitats are indicated with an asterisk.

Aquatic Habitats	**Wetland Habitats**	**Upland Habitats**
Rivers/streams	**Marshes**	Forest
Natural lakes and ponds	Fens	**Savannas**
Reservoirs/impoundments*	Bogs	Barrens
	Shrub swamps	Prairies
	Forested wetlands/riparian	**Cultivated***
	Beaches/dunes	**Old Fields***
	Ditches*	**Roadsides***

Other potential or known suitable habitats within Indiana:
No additional habitats.

Documentation:
Sources of information:
Maybury, 2003; Francis & Warwick. 2007; Renz 2000; Brooklyn Botanic Garden, 2008.

B. INVASIVENESS RANKING
Questions apply to areas similar in climate and habitats to Indiana unless specified otherwise.

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)
Roots grow deeper than 3 m, and can increase soil salinity by moving salt from deep in a soil profile closer to the surface. Can impede tidal circulation (with a resulting increase in mosquito populations).
Sources of information:

Blank & Young, 1997; Maybury, 2003; Francis & Warwick, 2007.

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:
Can form dense stands up to 1.5 m tall, increasing the structure in one layer. Dense litter layer (up to 10cm deep) under large infestations blocks light and inhibits the emergence of annual plants, thus reducing or possibly eliminating the lower growing herbaceous layer. In riparian areas it interferes with regeneration of willows and cottonwoods, which would alter the tree layer.
Sources of information:
Renz, 2000; Maybury, 2003; Francis & Warwick, 2007.

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 native species in the community)	3
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 7

Documentation:
Identify type of impact or alteration:
Outcompetes many native plant species. Dense monospecific stands shown to reduce the number of individuals of native species. In California it threatens populations of several rare plant species, and poses a threat to the endangered salt marsh harvest mouse, the California black rail, and California clapper rail (Howald, cited by Maybury 2003). Hard evidence lacking showing significant reduction or extirpation of native species populations, especially from the Northeastern United States but very dense stands at West Meadow Beach (New York) with nothing growing below.
Sources of information:
Maybury, 2003; Francis & Warwick 2007.

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 7

Documentation:
Identify type of impact or alteration:
Interferes with the regeneration of willows and cottonwoods, reducing food and cover for bird species in riparian areas (Krueger and Sheley 1999, Morisawa 1999). The species' semi-woody stems inhibit nesting of waterfowl (Trumbo 1994 as cited in Renz 2000) and it outcompetes the native grasses that provide food for native waterfowl (Howald, not dated). Outcompetes many native plant species. Dense litter layers form under big infestations, inhibiting the emergence of annual plants (Renz 2000) (Copied from Maybury 2004).
Sources of information:
Blank & Young, 1997; Maybury, 2004; Francis & Warwick, 2007.

Total Possible 40
Section One Total 31

2. BIOLOGICAL CHARACTERISTICS AND DISPERSAL ABILITY

2.1. Mode and rate of reproduction

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
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

Documentation:
Describe key reproductive characteristics (including seeds per plant):
Abundant seed productions and rhizomes.
Sources of information:
Maybury, 2003; Francis & Warwick, 2007.

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

Documentation:

Identify dispersal mechanisms:
Mucilaginous seed coat allows for adhesion to mammals and birds. Seeds dispersed in manure of grazing animals. Also salt-water tolerance in seeds suggests dispersal by tidal currents. Also extensive vegetative spread by root fragments (e.g. in flowing waters).

Sources of information:
Renz, 2000; Maybury, 2003; Francis & Warwick. 2007.

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 2

Documentation:
Identify dispersal mechanisms:
Both seeds and root fragments can be transported through indirect means, such as: in contaminated soil and beach goers by attachment to socks, pants, etc. May have been introduced at West Meadow Beach (NY) through horse shows (hay, horses or equipment)
Sources of information:
Renz, 2000; Maybury, 2003; Francis & Warwick, 2007.

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 6

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.

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 2

Documentation:
Describe growth form:

Forms dense stands. Standing dead stems are slow to decay, and combined with dense litter layer inhibit growth of shorter plants.
Sources of information:
Maybury, 2004.

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 2

Documentation:
Describe germination requirements:
Seeds most likely to germinate on exposed soil surface with soil moisture conditions maintained near field capacity for 4-5 days, but can germinate with some vegetation present.
Sources of information:
Renz, 2000; Maybury, 2004; Francis & Warwick, 2007.

2.7. Other species in the genus invasive in Indiana or elsewhere

A.	No	0
B.	Yes	3
U.	Unknown	

Score 0

Documentation:
Species:
Several non-native Lepidium species are ubiquitous in Indiana, but none identified as invasive.

Total Possible 25
Section Two Total 20

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 2

Documentation:

Identify reason for selection, or evidence of weedy history:
Species spread in the Northeast too recent to evaluate this very well for Indiana.
Sources of information:

3.2. Number of habitats the species may invade

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

Score 6

Documentation:
Identify type of habitats where it occurs and degree/type of impacts:
See A2.2.
Sources of information:
Maybury, 2004; Francis & Warwick, 2007

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 2

Documentation:
Identify type of disturbance:
Areas where established (e.g., salt marshes, riparian) have natural disturbances from tides and flooding.
Sources of information:
Francis & Warwick, 2007.

3.4. Climate in native range

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

Score 3

Documentation:
Describe what part of the native range is similar in climate to Indiana:
Native to central Eurasia, spreading into Siberia and northwest China. Maybury (2003): "There seems to be no climatic reason why this plant could not invade the Mid-Atlantic and southeastern U.S.".
Sources of information:
Maybury, 2003; Francis & Warwick, 2007.

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 4

Documentation:
Identify states and provinces invaded:
CT, IL, IN, MA, MO, NY; Quebec, Canada. Considered Invasive in CT and MA
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 Indiana

A.	Present in no Indiana counties	0
B.	Present in 1-10 Indiana counties	1
C.	Present in 11-20 Indiana counties	2
D.	Present in 21-50 Indiana counties	3
E.	Present in more than 50 Indiana counties or on Federal noxious weed list	4
U.	Unknown	

Score 1

Documentation:
Describe distribution:
See A1.1.
Sources of information:

Total Possible 25
Section Three Total 18

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 U

Documentation:

Identify longevity of seed bank:
Seed viability is probably less than one year; plant is transported by root fragments but it is not clear how long these can persist.
Sources of information:
Renz, 2000; Maybury, 2003; Francis & Warwick, 2007.

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 2

Documentation:
Describe vegetative response:
Extensive perennial rhizome system.
Sources of information:
Renz, 2000; Maybury, 2003; Francis & Warwick, 2007.

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^2).	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:
Herbicidal, mechanical, controlled burning, prolonged flooding; control measures have had mixed success in the western US.
Sources of information:
Renz, 2000; Maybury, 2003; Francis & Warwick, 2007.

Total Possible	7
Section Four Total	6
Total for 4 sections Possible	
Total for 4 sections	

References for species assessment:

Blank, R. and J. A. Young. 1997. Lepidium latifolium: Influences on soil properties, rates of spread, and competitive stature. Pages 69-80 in J. H. Brock, M. Wade, P. Pysek, and D. Green, eds. Plant Invasions: Studies from North America and Europe. Backhuys, Leiden.

Brooklyn Botanic Garden. 2008. AILANTHUS database. [Accessed June. 4, 2008].

Francis, A. & S. I. Warwick. 2007. The biology of invasive alien plants in Canada. 8. Lepidium latifolium. L. Canad. J. Pl. Sci. 87: 639-658.

Glenn, S. 2008. Invasiveness ranking system for non-native plants of New York: Lepidium latifolium L. Unpublished. The Nature Conservancy, Cold Spring Harbor, NY; Brooklyn Botanic Garden, Brooklyn, NY; The Nature Conservancy, Albany, NY.

Krueger, J. and R. Sheley. 1999. Perennial pepperweed (Lepidium latifolium). Montguide 9906, May 1999. Montana State University Extension Service. [Contains no citations; source of information not known or verifiable]. <http://http://ipm.montana.edu/Training/CPMS/2008/perennial%20pepperweed.pdf>. [Accessed on 2008].

Maybury, K. 2003. Lepidium latifolium. U.S. Invasive Species Impact Rank (I-Rank). NatureServe Explorer. <www.natureserve.org>. [Accessed Sept. 4, 2008.]

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United States Department of Agriculture, National Resources Conservation Service. 2008. The PLANTS Database. National Plant Data Center, Baton Rouge, Louisiana. <plants.usda.gov>. [Accessed on June. 4, 2008].

Weldy, T. and D. Werier. 2005. New York Flora Atlas. [S.M. Landry, K.N. Campbell, and L.D. Mabe (original application development), Florida Center for Community Design and Research. University of South Florida]. New York Flora Association, Albany, New York. [Accessed on June. 4, 2008].

Citation: This IN ranking form may be cited as: Jacquart, E.M. 2012. Invasiveness ranking system for non-native plants of Indiana. Unpublished. Invasive Plant Advisory Committee (IPAC) to the Indiana Invasive Species Council, Indianapolis, IN.

Acknowledgments: The IN ranking form is an adaptation for Indiana use of the form created for New York by Jordan et al. (2009), cited below. Documentation for species assessed for New York are used for Indiana where they are applicable. The Invasive Plant Advisory Committee was created by the Indiana Invasive Species Council in October 2010, and is made up of the original members of the Indiana Invasive Plant Assessment Working Group (IPSAWG). Original members of IPSAWG included representatives of the The Nature Conservancy; Indiana Native Plant and Wildflower Society; Indiana Nursery and Landscape Association; Indiana Chapter of the American Society of Landscape Architects; Indiana Forage Council; Indiana Wildlife Federation; Indiana State Beekeepers Association; Indiana Beekeeper's Association; Department of Natural Resources; Hoosier National Forest; Indiana Academy of Science; Natural Resources Conservation Service; Indiana Department of Environmental Management; Indiana Department of Transportation; Purdue Cooperative Extension Service; Seed Administrator, Office of the Indiana State Chemist.

References for the Indiana ranking form:

Jordan, M.J., G. Moore, and T.W. Weldy. 2009. Invasiveness ranking system for non-native plants of New York. Unpublished. The Nature Conservancy, Cold Spring Harbor, NY; Brooklyn Botanic Garden, Brooklyn, NY; The Nature Conservancy, Albany, NY.

References for the New York ranking form:

Carlson, Matthew L., Irina V. Lapina, Michael Shephard, Jeffery S. Conn, Roseann Densmore, Page Spencer, Jeff Heys, Julie Riley, Jamie Nielsen. 2008. Invasiveness ranking system for non-native plants of Alaska.

Technical Paper R10-TPXX, USDA Forest Service, Alaska Region, Anchorage, AK XX9. Alaska Weed Ranking Project may be viewed at: http://akweeds.uaa.alaska.edu/akweeds_ranking_page.htm.

Heffernan, K.E., P.P. Coulling, J.F. Townsend, and C.J. Hutto. 2001. Ranking Invasive Exotic Plant Species in Virginia. Natural Heritage Technical Report 01-13. Virginia Dept. of Conservation and Recreation, Division of Natural Heritage, Richmond, Virginia. 27 pp. plus appendices (total 149 p.).

Morse, L.E., J.M. Randall, N. Benton, R. Hiebert, and S. Lu. 2004. An Invasive Species Assessment Protocol: Evaluating Non-Native Plants for Their Impact on Biodiversity. Version 1. NatureServe, Arlington, Virginia. http://www.natureserve.org/getData/plantData.jsp

Randall, J.M., L.E. Morse, N. Benton, R. Hiebert, S. Lu, and T. Killeffer. 2008. The Invasive Species Assessment Protocol: A Tool for Creating Regional and National Lists of Invasive Nonnative Plants that Negatively Impact Biodiversity. Invasive Plant Science and Management 1:36–49

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