Invasive Species Assessment Protocol:
U.S. National Assessments

Alternanthera sessilis

ELEMENT NATIONAL ID: 235065
SCIENTIFIC NAME: *Alternanthera sessilis*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-13
EVALUATOR: Tomaino, A.

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:
An agricultural weed that invades disturbed wet areas in tropical and subtropical areas of the U.S. It is rare or occasional in scattered counties from eastern Texas to South Carolina but more common in Hawaii. Very little information was found about its impacts on native species habitats in the U.S. It is still available for sale.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Insignificant

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: China, Taiwan, Bhutan, India, Nepal, Cambodia, Laos, Myanmar, Thailand, Vietnam, Indonesia, Malaysia, Philippines (USDA 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Established outside cultivation in the U.S. (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Occurs in wet disturbed areas (FNA 2003).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No mention of changes in abiotic ecosystem processes or system-wide parameters found in the literature; assumption is that any alterations are not high or moderate.

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2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Herbaceous annual or perennial with procumbent stems (FNA 2003). Up to 1 m tall (Scher 2004). No mention of impacts on ecological community structure found in the literature; assumption is that any impacts are not high or moderate.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C - LOW SIGNIFICANCE

COMMENTS: No mention of impacts on ecological community composition found in the literature; assumption is that impacts are not high or moderate.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No mention of impacts on ecological community composition found in the literature; assumption is that any impacts are not high or moderate.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: Occurs in wet disturbed areas (FNA 2003). It is a common weed in Hawaii (Wagner et al. 1999) so presumeably impacts some elements of conservation significance there. No mention of threats to elements of conservation significance found in the literature; assumption is that it is not often threatening elements of conservation significance.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Established in scattered counties from eastern Texas to South Carolina and on most of the islands of Hawaii; also reported from Maryland (J. Kartesz, unpublished data).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: It is a common weed in Hawaii and was first collected there in 1935 (Wagner et al. 1999). No mention of negative impacts on biodiversity found in the literature; assumption is that impacts occur in <50% of the species' current generalized range.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

C - LOW SIGNIFICANCE

COMMENTS: Inferred from distribution as currently understood (J. Kartesz, unpublished data; TNC 2001).

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9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Damp shady areas, swamps, pond margins, shallow ditches, roadsides, low-lying waste places, damp pastures, cultivated areas (Scher 2004). It prefers wet conditions but occurs in both wetlands and uplands (Scher 2004). In Georgia and South Carolina, rare in disturbed wet muck on the coastal plain (Weakley 2006). In Florida, occasional on wet disturbed sites (Wunderlin and Hansen 2003).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: It is still available for sale. Occurs in disturbed areas; assumption is that disturbed areas are not declining and therefore this species' total range is not declining.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

A - HIGH SIGNIFICANCE

COMMENTS: Inferred from USDA (1990) and J. Kartesz, unpublished data. Apparently confined to tropical and subtropical areas.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: *Alternanthera sessilis* can be purchased as a water garden plant (Maki and Galatowitsch 2004). It is sold on the internet as an aquarium plant. Its seeds are also wind and water dispersed (Scher 2004).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Occurs in disturbed areas; assumption is that disturbed areas are not decreasing or remaining stable and therefore this species' local range is not decreasing or remaining stable.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: No mention of invasion of undisturbed habitats found in the literature. Occurs in wet disturbed areas (FNA 2003). In Georgia and South Carolina, rare in disturbed wet muck on the coastal plain (Weakley 2006). In Florida, occasional on wet disturbed sites (Wunderlin and Hansen 2003).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

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COMMENTS: Wet disturbed areas in Mexico, West Indies, Central America, South America, Africa (FNA 2003). In New Guinea, "a plant of damp places; ditches, wet headlands, roadsides; sometimes a weed of plantations, particularly at altitudes of 1500 m or higher. From near sea level to over 2000m" (Henty & Pritchard 1975 cited by PIER 2005). In Tonga, "occasional as a waste area weed" (Yuncker 1959 cited by PIER 2005).

16. REPRODUCTIVE CHARACTERISTICS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Spreads by seeds which are wind and water dispersed and by rooting at stem nodes (Scher 2004).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: No mention of control requiring a major long-term investment found in the literature; assumption is that a major long-term investment is not required.

18. MINIMUM TIME COMMITMENT

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: No mention of control requiring more than 10 years found in the literature; assumption is that control requires less than 10 years.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

U - UNKNOWN

COMMENTS:

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Classified as a noxious weed; assumption is accessibility problems are not severe or substantial.

REFERENCES:

Flora of North America Editorial Committee. 2003. Flora of North America North of Mexico, Volume 4, Magnoliophyta: Caryophyllidae, Part 1. Oxford University Press, New York.

Kartesz, J.T. 1999. A synonymized checklist and atlas with biological attributes for the vascular flora of the United States, Canada, and Greenland. First edition. In: Kartesz, J.T., and C.A. Meacham. Synthesis of the North American Flora, Version 1.0. North Carolina Botanical Garden, Chapel Hill, N.C.

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Maki, K. C., and S. M. Galatowitsch. 2004. Incidental Movement of Aquatic Organisms in Water Garden Sales. Abstract. In: Minnesota Water 2004: Policy and Planning to Ensure Minnesota's Water Supplies, March 23-24, 2004. East Bank Campus of the University of Minnesota. Online. Available: http://wrc.coafes.umn.edu/Water2004/Water2004_abstracts.html (accessed 4 January 2006).

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Scher, J. 2004. Federal Noxious Weed disseminules of the U.S. Center for Plant Health Science and Technology, Plant Protection and Quarantine, Animal and Plant Health Inspection Service, U. S. Department of Agriculture. Online. Available: http://www.lucidcentral.org/keys/v3/FNW/ (Accessed 2006).

The Nature Conservancy. 2001. Map: TNC Ecoregions of the United States. Modification of Bailey Ecoregions. Online <ftp://ftp.tnc.org/data/national/usa/tnc_us_eco2001.zip>. Accessed May 2003.

USDA, ARS, National Genetic Resources Program. 2005. December 9 last update. Germplasm Resources Information Network (GRIN) Online Database. National Germplasm Resources Laboratory, Beltsville, Maryland. Available: http://www.ars-grin.gov2/cgi-bin/npgs/html/index.pl (Accessed 2006).

USDA Agricultural Research Service. 1990. USDA Plants Hardiness Zone Map. Misc. Publ. Number 1475.

Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1999. Manual of the flowering plants of Hawaii. Revised edition. Volumes 1 and 2. Univ. Hawaii Press and Bishop Museum Press, Honolulu. 1919 pp.

Weakley, A. S. 2006. Flora of the Carolinas, Virginia, Georgia, and surrounding areas. Working draft of 17 January 2006. University of North Carolina Herbarium, North Carolina Botanical Garden, Chapel Hill. Online. Available: http://www.herbarium.unc.edu/flora.htm (accessed 2006).

Wunderlin, R.P. and B.F. Hansen. 2003. Guide to the Vascular Plants of Florida. 2nd edition. University Press of Florida, Tampa. 788 pp.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Arthraxon hispidus

ELEMENT NATIONAL ID: 203230
SCIENTIFIC NAME: *Arthraxon hispidus*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-14
EVALUATOR: Tomaino, A.

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:
Largest populations are concentrated in the southeast U.S. where it is increasing in abundance. Apparently restricted to habitats with some disturbance. It can form dense stands, particularly along shorelines, that may threaten native vegetation.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Insignificant

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Russian Federation, China, Japan, Korea, Taiwan, India, Indochina, Philippines, and Australia (USDA 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Established outside cultivation in the U.S. (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Spreading along roadsides, shores, ditches, and in low woods and fields of the eastern United States (FNA 2003).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: No mention of changes in abiotic ecosystem processes or system-wide parameters found in the literature; assumption is that any alterations are not major.

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2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: An annual grass with culms usually 0.5 to 1 meter tall (FNA 2003). It can form dense stands, particularly along shorelines, that may threaten native vegetation (IPANE, not dated).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Competes with indigenous species in riverine habitats (Cusick 1986).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not high or moderate.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Occurs along shores, low woods (FNA 2003), shores of streams and lakes, sand bars, moist bottoms, low woods, (Kriger 1971), and bottomlands (Weakley 2006). At least some of these communities may be of conservation significance but apparently, it is not often threatening elements of conservation significance.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Established in 26 eastern states from Massachusetts to Texas. Established widely in region from southern Pensylvania to northern Alabama and Georgia and also in Louisiana; scattered in other eastern states (J. Kartesz, unpublished data). In Massachusetts, the last report is from 1973 (IPANE, not dated). In Oregon, it was reported from 1 site in 1971 (Kiger 1971). In Hawaii, its documented from only a single collection made in 1972 (Wagner et al. 1999).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B - MODERATE SIGNIFICANCE

COMMENTS: In GA, NC, SC, VA, it is common and steadily increasing in abundance (Weakely 2006).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Inferred from distribution as currently understood (J. Kartesz, unpublished data; TNC 2001).

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9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Spreading along roadsides, shores, ditches, and in low woods and fields in the eastern United States (FNA 2003). Occurs in a variety of wet to moderately dry habitats, including shallow water, shores of streams and lakes, sand bars, moist bottoms, low woods, ditches, roadsides, fields, gardens, and pavement crevices in the U.S. (Kriger 1971). In GA, NC, SC, VA, it occurs in moist ditches, bottomlands, and disturbed ares (Weakley 2006).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: In GA, NC, SC, VA, it is steadily increasing its abundance (Weakely 2006). Occurs in disturbed areas; assumption is that disturbed areas are not declining or remaining stable and therefore this species' total range is not declining or remaining stable.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Inferred from USDA (1990) and J. Kartesz, unpublished data. Kiger (1971) described it as having a broad ecological amplitude which has allowed it to flourish widely since its introduction into the U.S.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: Reproduces by seeds that are dispersed mechanically and may be spread further by water (IPANE, not dated). Not known to be sold commercially.

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: In GA, NC, SC, VA, it is steadily increasing its abundance (Weakely 2006). Occurs in disturbed areas; assumption is that disturbed areas are not decreasing or remaining stable and therefore this species' local range is not decreasing or remaining stable.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: The habitats it is described in suggests it requres some disturbance (FNA 2003, IPANE, not dated, Kiger 1971). No mention of invasion of undisturbed habitats found in the literature; assumption is that it rarely or seldom invades undisturbed habitats.

15. SIMILAR HABITATS INVADED ELSEWHERE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Naturalized in Mexico, Central America, and the West Indies (FNA 2003).

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16. REPRODUCTIVE CHARACTERISTICS

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: An annual grass (FNA 2003). Reproduces by seeds (IPANE, not dated). It has a fibrous root system with sheaths that root at the nodes (Virginia Cooperative Extension, not dated). Apparently not extremely aggressive.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: An annual grass (FNA 2003). There is a possle biocontrol option; one species of fungus is likely host specific to *Arthraxon hispidus* (Zheng et al. 2001). No mention of control requiring a major long-term investment found in the literature; assumption is that a major long-term investment is not required.

18. MINIMUM TIME COMMITMENT

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: An annual grass (FNA 2003). No mention of control requiring more than 10 years found in the literature; assumption is that control requires less than 10 years.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Biocontrol may impact non-target species but fungus is likely host specific to *Arthraxon hispidus* (Zheng et al. 2001).

20. ACCESSIBILITY OF INVADED AREAS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: It is a weed of pastures and hayfields in piedmont areas of the southeast (Virginia Cooperative Extension, not dated). Classified as a noxious weed in Connecticut. Assumption is at least in some areas, accessibility may be a problem but problems are not severe or substantial.

REFERENCES:

Cusick, A.W. 1986. Significant additions to the vascular flora of western Maryland. Castanea 51: 129-136.

Flora of North America Editorial Committee. 2003. Flora of North America North of Mexico. Vol. 25. Magnoliophyta: Commelinidae (in part): Poaceae, part 2. Oxford Univ. Press, New York. xxv + 781 pp.

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Kartesz, J.T. 1999. A synonymized checklist and atlas with biological attributes for the vascular flora of the United States, Canada, and Greenland. First edition. In: Kartesz, J.T., and C.A. Meacham. Synthesis of the North American Flora, Version 1.0. North Carolina Botanical Garden, Chapel Hill, N.C.

Kiger, Robert W. 1971. Anthraxon hispidus (Gramineae) in the United States: Taxonomic and floristic status. Rhodora. 73:39-46.

The Nature Conservancy. 2001. Map: TNC Ecoregions of the United States. Modification of Bailey Ecoregions. Online <ftp://ftp.tnc.org/data/national/usa/tnc_us_eco2001.zip>. Accessed May 2003.

USDA Agricultural Research Service. 1990. USDA Plants Hardiness Zone Map. Misc. Publ. Number 1475.

Virginia Cooperative Extension. No date. Virginia Tech weed identification guide. Online: http://www.ppws.vt.edu/weedindex.htm. Accessed 2006.

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Wunderlin, R.P. and B.F. Hansen. 2003. Guide to the Vascular Plants of Florida. 2nd edition. University Press of Florida, Tampa. 788 pp.

Zheng, H., Y. Wu, J. Ding, D. Binion, W. Fu, and R. Reardon. 2004. Invasive plants of Asian origin established in
the United States and their natural enemies. Volume 1. USDA Forest Service, FHTET-2004-05[http://www.invasive.org/weeds/asian/].

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Invasive Species Assessment Protocol:
U.S. National Assessments

Avena sterilis

ELEMENT NATIONAL ID: 240765
SCIENTIFIC NAME: *Avena sterilis*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-19
EVALUATOR: Tomaino, A.

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:
An agricultural weed that is sometimes cultivated as a curiosity, but apparently rarely establishs in native species habitats in the U.S. In California, it occurs on disturbed sites in the San Francisco Bay Area including a creek bank and a roadside.

SUBRANK I - ECOLOGICAL IMPACT:	Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Unknown

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: North Africa, southern Europe, Ukraine, temperate Asia, India, and Pakistan (USDA 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Established outside cultivation in the U.S. (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Occurs on disturbed sites in the San Francisco Bay Area of California (Baldwin et al. 2006).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

D - INSIGNIFICANT

COMMENTS: No mention of changes in abiotic ecosystem processes or system-wide parameters found in the literature; assumption is that any alterations are not significant.

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2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

D - INSIGNIFICANT

COMMENTS: An annual grass, 30 to 120 cm high (Baum, not dated). No mention of impacts on ecological community structure found in the literature; assumption is that any impacts are not significant.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No mention of impacts on ecological community composition found in the literature; assumption is that any impacts are not high or moderate.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not significant.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: In California, it occurs on disturbed sites in the San Francisco Bay Area including a creek bank and a roadside (Baldwin et al. 2006). No mention of threats to elements of conservation significance found in the literature; assumption is that it is not often or occasionally threatening elements of conservation significance.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Established in the San Francisco Bay area of California (Baldwin et al. 2006). Rarely adventive in the northeastern U.S. (Gleason and Cronquist 1991). Also reported from Oregon (Baum, not dated, J. Kartesz, unpublished data).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: No mention of negative impacts on biodiversity found in the literature; assumption is that impacts occur in <50% of the species' current generalized range.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

C - LOW SIGNIFICANCE

COMMENTS: Inferred from distribution as currently understood (J. Kartesz, unpublished data; TNC 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

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COMMENTS: In California, it occurs on disturbed sites in the San Francisco Bay Area including a creek bank and a roadside (Baldwin et al. 2006). It can also be found in fields, vineyards, orchards, and on hillsides (Baum, not dated).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Occurs in disturbed areas; assumption is that disturbed areas are not declining or remaining stable and therefore this species' total range is not declining or remaining stable.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

A - HIGH SIGNIFICANCE

COMMENTS: Inferred from USDA (1990) and J. Kartesz, unpublished data.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Sometimes cultivated as a curiosity and occasionally spontaneous (Hitchcock 1951). A noxious weed of cropland (USDA 2005), so presumeably transported with crops.

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Occurs in disturbed areas; assumption is that disturbed areas are not decreasing or remaining stable and therefore this species' local range is not decreasing or remaining stable.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: In California, it occurs on disturbed sites in the San Francisco Bay Area including a creek bank and a roadside (Baldwin et al. 2006). No mention of invasion of undisturbed habitats found in the literature; assumption is that it seldom if ever invades undisturbed habitats.

15. SIMILAR HABITATS INVADED ELSEWHERE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: In Australia, it is a weed of cultivated crops (Medd et al. 1996). In Ontario, it is sometimes cultivated in gardens as a curiosity (because of the reaction of its twisted awns to changes in moisture) but does not persist as a weed (Dore and McNeill 1980).

16. REPRODUCTIVE CHARACTERISTICS

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

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COMMENTS: An annual grass (Baum, not dated). No mention of aggressive reproductive characteristics found in the literature; assumption is that the species is not extremely aggressive.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Some Avena sterilis is tolerant to herbicides (Somody et al. 1984).

18. MINIMUM TIME COMMITMENT

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: No mention of control requiring more than 10 years found in the literature; assumption is that control requires less than 10 years.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Chemical control is suggested for Avena sterilis (USACE 2003). Herbicides may impact non-target species.

20. ACCESSIBILITY OF INVADED AREAS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Considered a noxious weed by USDA-APHIS (USDA 2005). However, sometimes cultivated in gardens as a curiosity (because of the reaction of its twisted awns to changes in moisture) (Hitchcock 1951). Assumption is that accessibility problems are not severe or substantial but at least in some areas accessibility may be a problem.

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Baldwin, B.G., S. Boyd, B.J. Ertter, D.J. Keil, R.W. Patterson, T.J. Rosatti and D.H. Wilken. 2006. Jepson Flora Project, Jepson Online Interchange for California Floristics. Regents of the University of California, Berkeley. Online. Available: http://ucjeps.berkeley.edu/jepson_flora_project.html (accessed 2006).

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Invasive Species Assessment Protocol:
U.S. National Assessments

Azolla pinnata

ELEMENT NATIONAL ID: 755182
SCIENTIFIC NAME: *Azolla pinnata*
COMMON NAME:
I-RANK REVIEW DATE: 2006-06-26
EVALUATOR: J. Cordeiro

I-RANK: Not Applicable

I-RANK REASONS SUMMARY:
This species is native to Africa and Madagascar, India, southeast Asia, China, Japan, Malaya and the Philippines, the New Guinea mainland, and Australia (Croft, 1986), but introduced into Papua New Guinea, parts of Australia, China, Japan, New Zealand, and Vietnam. Reports from the Pacific islands in the United States are likely false and may be *Azolla filiculoides* (Wilson, 2002). It has been found in an aquarium/water garden shop in Raleigh, North Carolina, in 1999, but has not become established in the U.S. (Kay and Hoyle, 2003).

SUBRANK I - ECOLOGICAL IMPACT:
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:
SUBRANK IV - MANAGEMENT DIFFICULTY:

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: This species is native to Africa and Madagascar, India, southeast Asia, China, Japan, Malaya and the Philippines, the New Guinea mainland, and Australia (Croft, 1986), but introduced into Papua New Guinea, parts of Australia, China, Japan, New Zealand, and Vietnam. Reports from the Pacific islands in the United States are likely false and may be Azolla filiculoides (Wilson, 2002). It has been found in an aquarium/water garden shop in Raleigh, North Carolina, in 1999, but has not become established in the U.S. (Kay and Hoyle, 2003).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? NO - I-RANK NOT APPLICABLE
COMMENTS: This species is native to Africa and Madagascar, India, southeast Asia, China, Japan, Malaya and the Philippines, the New Guinea mainland, and Australia (Croft, 1986), but introduced into Papua New Guinea, parts of Australia, China, Japan, New Zealand, and Vietnam. Reports from the Pacific islands in the United States are likely false and may be Azolla filiculoides (Wilson, 2002). It has been found in an aquarium/water garden shop in Raleigh, North Carolina, in 1999, but has not become established in the U.S. (Kay and Hoyle, 2003).

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S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Not Applicable

COMMENTS:

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

COMMENTS:

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

COMMENTS:

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

COMMENTS:

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

COMMENTS:

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

COMMENTS:

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

COMMENTS:

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

COMMENTS:

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

COMMENTS:

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9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

COMMENTS:

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

COMMENTS:

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

COMMENTS:

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

COMMENTS:

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

COMMENTS:

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

COMMENTS:

15. SIMILAR HABITATS INVADED ELSEWHERE

COMMENTS:

16. REPRODUCTIVE CHARACTERISTICS

COMMENTS:

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SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

COMMENTS:

18. MINIMUM TIME COMMITMENT

COMMENTS:

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

COMMENTS:

20. ACCESSIBILITY OF INVADED AREAS

COMMENTS:

REFERENCES:

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Invasive Species Assessment Protocol:
U.S. National Assessments

Barbarea vulgaris

ELEMENT NATIONAL ID: 215711
SCIENTIFIC NAME: *Barbarea vulgaris*
COMMON NAME:
I-RANK REVIEW DATE: 2005-12-12
EVALUATOR: Gravuer, K.

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:

Yellow rocket (*Barbarea vulgaris*) is well-established in the northeast and Lake states, reasonably well-established in the Pacific northwest, and scattered in the great plains, northern plains, and northern southeast states. It is an important agricultural weed, regulated as a noxious weed seed in at least 6 states. From its usual initial establishment points of cultivated fields or waste places, it can spread to a variety of upland and wetland habitats, including prairies/grasslands, upland forests and woodlands, riparian herbaceous vegetation and wet meadows, wetland forests (riparian and swamps), and partially open upland habitats (old fields and forest edges). Although it can achieve reasonably high abundance in invaded areas, especially areas with intermittent disturbance, it does not appear to have significant impacts on biodiversity; the species is a weak competitor and does not influence ecosystem processes. Control is easily accomplished through hand-pulling, mowing, or herbicide, although the seed bank may persist for 10 years or more.

SUBRANK I - ECOLOGICAL IMPACT:	Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low/Insignificant

NON-NATIVE THROUGHOUT NATION

NATIVE RANGE: Native to a substantial area of Eurasia as well as part of northern Africa.
Northern Africa: Algeria, Tunisia. Asia: Afghanistan, Iran, Iraq, Turkey, Armenia, Azerbaijan, Georgia, Russian Federation (Ciscaucasia, Dagestan, Eastern Siberia [s.w.], Western Siberia), Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Mongolia, China (Xinjiang [n.]), Nepal, Pakistan. Europe: Denmark, Ireland, United Kingdom, Austria, Belgium, Czechoslovakia, Germany, Hungary, Netherlands, Poland, Switzerland, Belarus, Estonia, Latvia, Lithuania, Russian Federation (European part), Ukraine [incl. Krym], Albania, Bulgaria, Italy [incl. Sardinia, Sicily], Romania, Yugoslavia, France [incl. Corsica], Portugal, Spain (GRIN 2001).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

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COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Invades prairies/grasslands, upland forests and woodlands, riparian herbaceous vegetation and wet meadows, wetland forests (riparian and swamps), and partially open upland habitats (old fields, forest edges, and roadsides) (Wisconsin State Herbarium 2005).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

D - INSIGNIFICANT

COMMENTS: This species was introduced to North America around 1800 (MacDonald and Cavers 1991). Despite being present for over 200 years and being reasonably well-studied because of its significance as an agricultural weed, no reports of impacts on ecosystem processes or system-wide parameters were found. Therefore, assume impacts insignificant.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

D - INSIGNIFICANT

COMMENTS: Often noted to be abundant at sites where naturalized (e.g. Voss 1985). This abundance may slightly increase the density of the herbaceous layer in the habitats it invades. No other impacts on community structure reported.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Although a few sources noted this species to be aggressive (e.g. Voss 1985), this description is most likely in reference to its rapid colonization ability rather than its competitive impact within invaded communities. Indeed, MacDonald and Cavers (1991) note that the main contributor to the weediness of this species is its ability to establish rapidly (often from the seed bank) when sites become available; they note that its competitive ability (especially with grasses) is limited, particularly in dry or mesic soils. Similarly, Egler (1983) observed the species in the field for several years in Connecticut and noted that it was never aggressive. Therefore, some limited impacts on community composition may occur when this species establishes abundantly in sites where native might otherwise establish, but impacts should not be significant due to its limited competitive ability.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not significant. The possibility of hybridization is difficult to evaluate (MacDonald and Cavers 1991).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

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COMMENTS: Common associates of this species include brome grass, Kentucky bluegrass, wild carrot, and ragweed (Kline 2002), suggesting that it does not often threaten rare elements or high-quality communities. However, it has been found in relatively intact natural communities such as prairies and herbaceous wetlands (Wisconsin State Herbarium 2005), so it may pose a minimal threat to high-quality community occurrences in some cases.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Well-established in the northeastern states, south to about NC, TN, and AR. Absent from MS and LA, questionably present in FL, and scattered in the northern southeast. Also well-established in the lake states west to e. MN, e. IA, e. KS, and e. OK. Scattered on the great plains and northern plains. Reasonably well-established in the Pacific northwest, south to n. CA, ne. UT, and n. NM. Absent from AK and HI. Generalized range estimated to cover approximately 50% of the U.S. (Kartesz 1999, Great Plains Flora Association 1977, NRCS 2005, Rice 2005).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: The seeds of this species have been declared noxious weeds in Connecticut, Indiana, Maine, Michigan, New Hampshire, and Wisconsin (GRIN 2001, NRCS 2005). It is also listed in weed manuals for at least the Northeast, Kentucky and adjacent states, and Nebraska and the Great Plains (NRCS 2005). However, these listings likely reflect its importance as an agricultural weed rather than its impacts on biodiversity. It has been reported as invasive in Michigan by two sources (Swearingen 2005). It appears that the impacts if this species are confined to a small part of its range.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: Approximately 37 ecoregions are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: The rosettes can tolerate a wide range of soil moisture regimes (dry to subhydric) and can withstand submersion and silt deposition (MacDonald and Cavers 1991). Plants will grow in a range of light intensities from open, bare ground to woodland with complete canopy (MacDonald and Cavers 1991). 4-5 major habitat types are invaded: prairies/grasslands and their human-influenced analogues (cultivated fields, pastures, disturbed open areas, waste places), upland forests and woodlands, riparian herbaceous vegetation and wet meadows, wetland forests (riparian and swamps), and partially open upland habitats (old fields, forest edges, and roadsides) (Wisconsin State Herbarium 2005).

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SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Spread into western states is apparently relatively recent (MacDonald and Cavers 1991). It is possible that the species is still invading new areas on this front.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: The southward spread of this species is limited to areas with several weeks at 5 degrees C or less because it has an obligate requirement for vernalization (MacDonald and Cavers 1991). However, there do not appear to be abiotic limits on its increase within the Great Plains region, where it currently exhibits only scattered establishment.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Through biological dispersal mechanisms alone, most seeds are deposited within a meter of the parent (MacDonald and Cavers 1991). However, seeds can pass through a variety of animals (e.g. cattle, horses, pigs, rabbits) and remain viable. This species is also a known contaminant of seed lots of timothy and similar-sized grains (MacDonald and Cavers 1991). Although its presence in seed lots is prohibited or regulated in several states (GRIN 2001, NRCS 2005), contamination still likely provides at least some long-distance transport opportunities.

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B - MODERATE SIGNIFICANCE

COMMENTS: Exhibiting local spread in regions it has invaded relatively recently, such as California (Kozak 1999), but apparently stable in regions where it has been present for several decades, such as Wisconsin (MacDonald and Cavers 1991).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Although this species does best on recently-disturbed sites, it can also take advantage of openings in older communities, such as woodlands (MacDonald and Cavers 1991). However, it does poorly in open, established vegetation such as grassland (Egler 1983, MacDonald and Cavers 1991). It often first establishes in highly-disturbed areas, then spreads from those into more natural habitats such as woods (especially along roads and trails) and shores (Voss 1985).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Naturalized in at least Canada, New Zealand, and Japan (Randall 2002); one source noted it to be widely naturalized (GRIN 2001). However, it appears to invade similar habitats in these locations (e.g. Scoggan 1978).

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16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: In an experiment in Ontario, seed production per plant ranged from 280 in an unfavorable habitat to 88,000 in an ideal habitat; another estimate of seed production under favorable conditions was 40,000-116,000 seeds per plant (MacDonald and Cavers 1991). Therefore, assumed that the typical plant would probably produce more than 1,000 seeds annually. The longevity of some natural seed banks has been estimated at around 3 years (Buchholtz et al. 1960, Peat and Fitter 2005), but longevity of 10-20 years is also possible under the right conditions (MacDonald and Cavers 1991). Apparently exhibits weak vegetative reproduction (e.g. from cauline rosettes or rosettes that arise from root fragments exposed to sunlight; MacDonald and Cavers 1991), but this does not appear to make a significant contribution to its ecology.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

C - LOW SIGNIFICANCE

COMMENTS: Control of this species has been described as not difficult (Drew and Helm 1941). Scattered plants can be pulled out without fear of re-sprouting (Muenscher 1955). For larger infestations, mowing or topping of flowering plants is recommended to prevent seed set, while plants in the rosette stage can be controlled by herbicide or cultivation (Muenscher 1955, MacDonald and Cavers 1991). Restoration strategies which include re-planting should be very successful, as this species is not a strong competitor (MacDonald and Cavers 1991).

18. MINIMUM TIME COMMITMENT

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: The longevity of some natural seed banks has been estimated at around 3 years (Buchholtz et al. 1960, Peat and Fitter 2005), but longevity of 10-20 years is also possible under the right conditions (MacDonald and Cavers 1991).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: The opportunity for control by hand-pulling or topping means that, in many cases, management could result in only very minor impacts on native species. If herbicide application to rosettes becomes necessary, however, there is the potential for some impact to occur.

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Because infestations with biodiversity impact often spread from recently disturbed areas, infestations that are targets for control should be relatively accessible. However, some target infestations may occur on privately-owned farmlands (e.g. in woodlands owned by farmers).

REFERENCES:

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Invasive Species Assessment Protocol:
U.S. National Assessments

Berberis vulgaris

ELEMENT NATIONAL ID: 194961
SCIENTIFIC NAME: *Berberis vulgaris*
COMMON NAME:
I-RANK REVIEW DATE: 2005-11-18
EVALUATOR: Maybury, K.

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:
Berberis vulgaris is a formerly widely cultivated and widely naturalized species that is still widespread, but thanks to intense eradication efforts, is now only sporadically and locally abundant. Where it does persist in abundance, it can crowd out native understory species. Although found in many disturbed sites, it can also invade fairly intact native ecosystems, especially open woodlands, coastal areas, and other open areas such as shrub wetlands.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Insignificant

OTHER CONSIDERATIONS:
Could once again become a more signficant weed if allowed to spread. Hybridizes with the invasive plant *Berberis thunbergii*.

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Europe (FNA 1997).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS:

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes
COMMENTS:

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

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COMMENTS: No indication of alterations in abiotic processes found in the literature for this species, although Kourtev et al. (2003) found that a related species, *Berberis thunbergii,* may cause higher nitrate concentrations, as well as changes in the soil microbial community.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

COMMENTS: Although more upright and tree-like than *Berberis thunbergii* (Dirr 1990), it is similar to that species in replacing plants in native understory layers, but probably not changing the number of layers or overall vegetation structure that much.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Where allowed to become abundant, this speices, like *B. thunbergii,* can crowd out native understory plants (Piscataquog Watershed Association 2005).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: *Berberis vulgaris* is known as a host for *Puccinia graminis,* a rust disease. This fungus has several physiological races that can infect several genera of grasses, including native grasses (University of Nebraska-Lincoln 2003). Primarily known as a disease of wheat and other (non-native) cereal grains, the disease requires two hosts to complete its life cycle. The primary host is wheat and *B. vulgaris* is the most widely distributed alternate host in the U.S. (University of Nebraska-Lincoln 2003). Native barberry (*B. canadensis*) and other natives can also serve as hosts, however (FNA 1997), so the level of impact on native grasses is difficult to assess. (The fact that *B. vulgaris* is no longer the "common barberry" of the northcentral and northeastern U.S. is largely due to major early 20th century eradication efforts by the U.S. Dept. of Agriculture and to a prohibition on the sale of seeds and plants in many states [Muencher 1955, IPANE 2004]. These measures were taken to to minimize impacts on cereal crop production.)

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B - MODERATE SIGNIFICANCE

COMMENTS: Although often found in disturbed habitats (roadsides, pastures, etc.), this species also invades open coastal forests, shrub wetlands, and coastal grasslands (IPANE 2004).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Per map in Kartesz (1999) found throughout New England south to North Carolina, throughout much of the midwest south to Kansas and Missouri, and in several western states. Not known from Alaska or from most of the southern half of the lower 48.

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7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C - LOW SIGNIFICANCE

COMMENTS: Eradicated in some areas and not very abundant in most others; only locally abundant, especially in areas of coastal New England (IPANE 2004). However, when this species was frequently cultivated it became widely naturalized in eastern North America (FNA 1997), suggesting that it could once again impact large areas.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS:

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Open forests, coastal grasslands, some wetlands (IPANE 2004).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: Inferred: there are many restrictions on the sale of plants and seeds and the species is no longer cultivated. It seems to persist locally but may not be spreading.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

D - INSIGNIFICANT

COMMENTS: Inferred: the current generalized range is similar to *B. thunbergii*, which (unfortunately) was considered to be a good substitute for *B. vulgaris* in cultivation (IPANE 2004).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Fruits are largely bird dispersed (CIPWG 2001, IPANE 2004).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Inferred.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: When this species was frequently cultivated it became widely naturalized in eastern North America (FNA 1997). Like *B. thunbergii*, it is primarily known from disturbed areas, but can invade forests, at least open forests (IPANE 2004).

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15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Escaped and naturalized in Canada but in similar habitats to those invaded in the U.S.

16. REPRODUCTIVE CHARACTERISTICS

D - INSIGNIFICANT

COMMENTS: Prolific seed producer (CIPWG 2001) but no other notably aggressive traits.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

C - LOW SIGNIFICANCE

COMMENTS: Control methods are the same as for *B. thunbergii* (IPANE 2004): handpulling and digging up all roots so that they don't resprout (CIPWG 2001, Czarapata 2005). Herbicide applied in early spring when most other plants have not leafed-out is effective; CIPWG (2001) suggests that for such early season treatments, triclopyr is usually more effective than glyphosate.

18. MINIMUM TIME COMMITMENT

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Resprouts; mowing will not erradicate the plant.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

D - INSIGNIFICANT

COMMENTS: Relatively low impact assuming any herbicide application is targeted.

20. ACCESSIBILITY OF INVADED AREAS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS:

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Invasive Species Assessment Protocol:
U.S. National Assessments

Berteroa incana

ELEMENT NATIONAL ID: 227577
SCIENTIFIC NAME: *Berteroa incana*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-03
EVALUATOR: Gravuer, K.

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:

Berteroa incana predominantly invades disturbed, open habitats such as roadsides, railroad rights-of-way, waste places, pastures, and agricultural fields, where it poses a minimal threat to native biodiversity. However, it does rarely invade more natural habitats such as prairies, open woods, and marshes, and is apparently increasing in woodland habitats in Michigan. It is not a strong competitor with native species; it cannot establish in intact native grasslands and declines as native species become established on prairie restoration sites. It is established throughout the northern U.S., most abundantly in the Great Lakes states and the northeast, and it appears to be increasing locally in a number of different parts of its range. Management by hand-pulling or herbicide requires minimal effort.

SUBRANK I - ECOLOGICAL IMPACT:	Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low/Insignificant

NON-NATIVE THROUGHOUT NATION

NATIVE RANGE: Native to Europe and temperate Asia, including the European nations of Denmark, Austria, Czechoslovakia, Germany, Hungary, Poland, Switzerland, Belarus, Lithuania, Russian Federation (European part), Ukraine (incl. Krym.), Albania, Bulgaria, Greece, Italy, Romania, and Yugoslavia, and the temperate Asian nations of Georgia, Russian Federation (Ciscaucasia, Dagestan, Eastern Siberia, Western Siberia), Kazakhstan, and Kyrgyzstan (USDA ARS 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

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COMMENTS: Predominantly occurs on dry, sandy or gravelly soils in disturbed, open habitats and secondarily in partially open disturbed habitats such as old fields and forest edges. Also occurs on creek banks and lake shores. Much less frequently found in more natural habitats - these include natural grasslands (e.g. prairies, meadows, and bracken grassland), open woods, marshes, and rock outcrops (Wisconsin State Herbarium 2006). Apparently increasing in woodland habitats in Michigan (Voss 1985).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

D - INSIGNIFICANT

COMMENTS: This species has been naturalized in North America since at least 1900 (Voss 1985). Despite being present for over 100 years, no reports of impacts on ecosystem processes or system-wide parameters were found. Therefore, assume impacts insignificant.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Can displace native species in dry prairies and sand blowouts where vegetation is sparse, and can be abundant in the early stages of prairie restorations (White et al. 1993, Minnesota DNR 2006). These occurrences could potentially changing the density or cover of the herbaceous layer.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Can displace native species in dry prairies and sand blowouts where vegetation is sparse, and can be abundant in the early stages of prairie restorations (White et al. 1993, Minnesota DNR 2006). These occurrences may reduce the abundance of some native species, although such reductions will likely often be transient.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not significant.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

D - INSIGNIFICANT

COMMENTS: A large majority of occurrences are in disturbed, open habitats or in partially open disturbed habitats such as old fields and forest edges (Wisconsin State Herbarium 2006). These areas have minimal conservation significance.

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SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Established throughout the northern U.S. There are some scattered occurrences in the southwest, but there are no known reports of the species in CA, TX, or the southeast (NC, SC, GA, AL, MS, LA, or FL) (Kartesz 1999). Appears to be locally abundant in the Great Lakes states (MN, MI, WI) and the northeastern states (Muenscher 1955, Reichman 1988, Wisconsin State Herbarium 2006), but less frequent in other regions.

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C - LOW SIGNIFICANCE

COMMENTS: A declared noxious weed in MI, MN, and WI (USDA ARS 2005), and also locally abundant in the northeastern states (Muenscher 1955). However, even in these places where it is most abundant, it predominantly occurs in disturbed habitats and is only occasionally reported from more natural habitats such as prairies or woodlands (Voss 1985, Minnesota DNR 2006, Wisconsin State Herbarium 2006). However, it is apparently increasing in woodlands in Michigan (Voss 1985).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: Approximately 38 ecoregions are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Predominantly occurs on dry, sandy or gravelly soils in disturbed, open habitats such as roadsides, railroad rights-of-way, waste places, pastures, and agricultural fields; also (secondarily) in partially open disturbed habitats such as old fields and forest edges (Muenscher 1955, Voss 1985, Reichman 1988, NPWRC and USGS 1997, Sedivec and Barker 1998, Cranston et al. 2002, Stevens County Noxious Weed Control Board 2006, Wisconsin State Herbarium 2006). Also occurs on creek banks and lake shores (Voss 1985, Wisconsin State Herbarium 2006). Much less frequently found in more natural habitats - these include natural grasslands (e.g. prairies, meadows, and bracken grassland), open woods, marshes, and rock outcrops (Wisconsin State Herbarium 2006). Apparently increasing in woodland habitats in Michigan (Voss 1985).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Spreading throughout much of eastern North America and becoming more locally common in at least Missouri and Michigan (Voss 1985, Teneglia 2006).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

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COMMENTS: Based on areas currently occupied, may be able to spread into some parts of California.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Possesses no biological adaptations for long-distance dispersal, but occurs in agricultural fields and has been noted as a potential seed contaminant (USDA ARS 2005).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Becoming more common in Missouri (Teneglia 2006), increasing in the rangelands of Minnesota and North Dakota (Sedivec and Barker 1998), and increasing in Michigan woodlands (Voss 1985).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: Most abundant in disturbed habitats (Wisconsin State Herbarium 2006). Does not pose a threat to intact native grasslands (Egler 1983, Minnesota DNR 2006). Can displace native species, but only in places where vegetation is sparse such as dry prairies and sand blowouts (Minnesota DNR 2006). It can also be abundant in the early stages of prairie restorations, but declines as natives become established (White et al. 1993, Minnesota DNR 2006).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Also established in Canada, but only found in habitats comparable to those it has invaded in the U.S. (Scoggan 1978).

16. REPRODUCTIVE CHARACTERISTICS

C - LOW SIGNIFICANCE

COMMENTS: Reproduces by seed only (Muenscher 1955). It is capable of producing > 1000 seeds per plant, but only under optimal circumstances (Reichman 1988). It has a very flexible life history, occurring as an annual, a biennial, or a perennial (Stevens County Noxious Weed Control Board 2006).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

C - LOW SIGNIFICANCE

COMMENTS: Small infestations can be controlled by hand-pulling or hoeing out plants (Muenscher 1955). Mowing may be effective (Minnesota DNR 2006), but must be done prior to seed production (Cranston et al. 2002, Larimer County Weed Control District 2006). Herbicides including 2,4-D, dicamba, or glyphosate also are effective when applied in the spring or fall, although retreatment is often necessary (Cranston et al. 2002, Larimer County Weed Control District 2006).

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18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS: If herbicide control is used, retreatment is often necessary (Larimer County Weed Control District 2006).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: Hand-pulling should have minimal impacts. Spraying of herbicide could possibly be timed to coincide with dormancy of some native species (Larimer County Weed Control District 2006), but some impacts will likely occur.

20. ACCESSIBILITY OF INVADED AREAS

D - INSIGNIFICANT

COMMENTS: The great majority of occurrences are in easily accessible locations such roadsides, railroad rights-of-way, waste places, pastures, and agricultural fields.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Bidens aristosa

ELEMENT NATIONAL ID: 242675
SCIENTIFIC NAME: *Bidens aristosa*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-07
EVALUATOR: Gravuer, K.

CALCULATED I-RANK: Low/Insignificant
I-RANK: Low

I-RANK ADJUSTMENT JUSTIFICATION:
Numerical I-Rank range very strongly skewed towards Low.

I-RANK REASONS SUMMARY:
Bidens aristosa (incl. *B. polylepis*) is an herbaceous species native to the midwestern United States that has invaded nearly all U.S. states east of its native range (with the exception of VT and FL). It predominantly invades wet, open habitats, including marshes, wet meadows, stream banks, ditches, fields, pastures, waste places, old fields, and roadsides. It appears to have its greatest impact on native biodiversity in the mid-Atlantic states (particularly NJ, MD, and DE), where it has been noted to invade natural areas and threaten native species. Impacts in New England and the southeast appear to be less significant. It is exhibiting substantial local spread in the mid-Atlantic (notably PA, MD, WV, and NJ). Management by mowing, hand-pulling, or general-purpose herbicide is straightforward.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low

OTHER CONSIDERATIONS:
Note: taxon assessed here includes *Bidens polylepis* material, which is included in *Bidens aristosa* by Kartesz (1999), but is often treated separately by other authors.

NATIVE AND NON-NATIVE IN NATION
NATIVE RANGE: Native to the midwestern United States, including NE, CO, KS, OK, TX, IA, MO, AR, LA, IL, IN, OH, MI, KY, TN, MS, and AL (Kartesz 1999, USDA ARS 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

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S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Occurs in marshes and wet meadows; stream banks and ditches; fields, pastures, and waste places; and old fields and roadsides; also rarely found in swamps, bogs, and open bottomlands (Small 1933, Fernald 1950, Muenscher 1955, Massey 1961, Radford, Ahles, and Bell 1968, Strausbaugh and Core 1978, Cronquist 1980, Hough 1983, Seymour 1989, Gleason and Cronquist 1991, Rhoads and Block 2000, Young 2003, MDDNR 2004, USDA Forest Service 2006).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

D - INSIGNIFICANT

COMMENTS: No reports of impacts on ecosystem processes or system-wide parameters were found. Therefore, assume impacts insignificant.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

COMMENTS: This is an herbaceous species that predominantly invades habitats already dominated by herbaceous vegetation. However, density and/or cover changes may occur upon invasion. In Maryland, it is often found in monocultures displacing native community structure (Environmental Systems Analysis, Inc., no date). It is also considered invasive in natural habitats in Delaware and New Jersey (DENHP 2003, Young 2003, NJDEP 2004), and other sources have noted that it spreads to displace native plant species (USDA Forest Service 2006) and is known to cause substantial impacts (Falck and Garske 2002). Research conducted in its native range (Lousiana) suggests that the plant is an aggressive colonizer, but declines as succession proceeds (Vidrine et al. 2001).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: In Maryland, this species is often found in monocultures displacing native community structure (Environmental Systems Analysis, Inc., no date). It is also considered invasive in natural habitats in Delaware and New Jersey (DENHP 2003, Young 2003, NJDEP 2004), and other sources have noted that it spreads to displace native plant species (USDA Forest Service 2006) and is known to cause substantial impacts (Falck and Garske 2002).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not significant.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: This species has invaded some ecologically significant areas in Delaware (Delaware Nature Society 2005). In Maryland, it has been designated as a serious threat to natural areas (MDDNR 2004). It is also invasive in natural habitats in New Jersey (NJDEP 2004). Given the habitats known to be invaded, it is likely that the species occasionally threatens high-quality occurrences of marsh, wet meadow, and/or riparian communities in these states.

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SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: The non-native range includes WV, MD, DE, PA, NJ, NY, CT, RI, MA, NH, ME, VA, NC, SC, and GA (USDA ARS 2005, Fernald 1950, Gleason and Cronquist 1991, Seymour 1989, Rhoads and Block 2000, Rhoads and Klein 1993, Hough 1983, Weldy and Werier 2005, Strausbaugh and Core 1978, Weakley 2006). Approximately 20% of available US area is invaded (after excluding area covered by native range).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C - LOW SIGNIFICANCE

COMMENTS: This species has been designated as invasive in natural areas in NJ, MD and DE (DENHP 2003, Young 2003, NJDEP 2004, MDDNR 2004, Environmental Systems Analysis, Inc., no date). It appears to have lesser impacts in New England and the southeast.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: Approximately 30% of available ecoregions are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Occurs in marshes and wet meadows; stream banks and ditches; fields, pastures, and waste places; and old fields and roadsides; also rarely found in swamps, bogs, and open bottomlands (Small 1933, Fernald 1950, Muenscher 1955, Massey 1961, Radford, Ahles, and Bell 1968, Strausbaugh and Core 1978, Cronquist 1980, Hough 1983, Seymour 1989, Gleason and Cronquist 1991, Rhoads and Block 2000, Young 2003, MDDNR 2004, USDA Forest Service 2006). Usually occurs in wetlands, but occasionally found in non-wetlands. Seems to prefer more open habitats but can tolerate some shading.

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Spreading rapidly in at least PA, MD, WV, and NJ (Strausbaugh and Core 1978, Hough 1983, Rhoads and Klein 1993, MDDNR 2004). However, the potential non-native range of the species is limited by the ocean to the east and its native range to the west; in a generalized sense, much of the area between these two limits is already occupied.

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11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Assumed potential for spread into VT.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Available for limited sale on the internet. Also, fruits have barbed spines which can cling to human clothing or animal fur, potentially facilitating occasional long-distance transport (USDA Forest Service 2006).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Spreading rapidly in at least PA, MD, WV, and NJ (Strausbaugh and Core 1978, Hough 1983, Rhoads and Klein 1993, MDDNR 2004).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: Apparently able to invade natural areas in NJ, MD and DE (DENHP 2003, Young 2003, NJDEP 2004, MDDNR 2004, Environmental Systems Analysis, Inc., no date). However, on observing the species closely in New Jersey, Egler (1983) noted that volunteer seedlings continue to appear [on bare soil] each year. A few seedlings sometimes appear in adjacent Unmown Herbland, but plants extremely small, and not reproducing themselves the following year. Therefore, the species does not appear capable of regularly establishing in undisturbed vegetation.

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Naturalized in at least Canada (Ontario), Finland, and Japan (Kartesz 1999, Randall 2002). In Canada, it appears to invade similar habitats (Scoggen 1978).

16. REPRODUCTIVE CHARACTERISTICS

C - LOW SIGNIFICANCE

COMMENTS: Has been noted to reseed prolifically (Aitken et al. 2002), but does not appear to possess any other aggressive reproductive characteristics.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

C - LOW SIGNIFICANCE

COMMENTS: Mowing, hand-pulling, or treatment with any of several readily available general use herbicides (e.g. glyphosate, dicaba, or picloram) can achieve effective control (Muenscher 1955, USDA Forest Service 2006).

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18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS: No mention of need for re-treatment was found in the literature, so assumed that substantial follow-up control was not necessary.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Effects of mowing or hand-pulling would likely be minimal, but herbicide treatment may reduce native species abundance somewhat.

20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: Does not invade inherently inaccessible habitats, but because there is some horticultural use of this species, at least a few infestations are likely to be located on private land.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Calamagrostis epigeios

ELEMENT NATIONAL ID: 249343
SCIENTIFIC NAME: *Calamagrostis epigeios*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-21
EVALUATOR: Tomaino, A.

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:
Currently known from scattered locations in 11 states but sold as an ornamental and planted for erosion control and revegetation. Occurs in a variety of habitats including sandy woods, salt-marshes, fields, waste places, disturbed woods, roadsides, moist lowland, river bank, forest and grassland. Very little information was found about its impacts on native species habitats in the U.S. It has high ecological impacts in some situations in its native range in Europe, particularly in sandy soils. Control can be accomplished with herbicides.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Low

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Europe, temperate Asia, India, Pakistan, and eastern and southern Africa (USDA 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Established outside cultivation in the U.S. (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Occurs in disturbed woods, roadsides, and waste ground in Pennsylvania (Rhoads and Block 2000).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

B/C - MODERATE/LOW SIGNIFICANCE

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COMMENTS: Information on impacts in other countries was found in the literature but no information on impacts in the U.S. was found; assumption is that there may be unreported impacts in the U.S. In the Netherlands, *Calamagrostis epigeios* is a problematic native; in coastal dune grasslands where nutrients have become more available due in part to acid rain, it has increased in abundance and contributes to a positive feedback-loop in which higher litter input and increased exudation of hydrogen ions, futher enlarges the P and N availability and the dominance of high-productive competitive species such as *Calamagrostis epigeios* (Koen et al. 2005).

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Perennial with culms 1 to 1.5 meters tall and extensively creeping rhizomes (Hitchcock 1951). Information on impacts in other countries was found in the literature but no information on impacts in the U.S. was found; assumption is that there may be unreported impacts in the U.S. In the Netherlands, *Calamagrostis epigeios* is a problematic native; it is described as a coarse, highly productive grass that dominates and has high litter output (Koen et al. 2005).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B - MODERATE SIGNIFICANCE

COMMENTS: Information on impacts in other countries was found in the literature but no information on impacts in the U.S. was found; assumption is that there may be unreported impacts in the U.S. In the Netherlands, *Calamagrostis epigeios* is a problematic native; in coastal dune grasslands it has increased in abundance and out-competes the characteristic dune grassland species (Koen et al. 2005). In Hungary, *Calamagrostis epigeios* is described as a dangerous native that shows invasive tendancies (Mihály and Demeter 2003).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not high or moderate.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Sandy woods and salt-marshes (Gleason and Cronquist 1991), moist lowland area (Voss 1972), bank of a river in moist sand and forest and grassland habitat (IPAW 2003) may be of conservation significance but apparently it is not often threatening elements of conservation significance.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Established in a few very scattered counties in 11 states from Masaschusetts to Pennsylvania, Michigan, to Iowa, and Kansas, North Dakota and Wyoming (J. Kartesz, unpublished data).

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7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: No mention of negative impacts on biodiversity in the U.S. found in the literature; assumption is that impacts occur in <50% of the species' current generalized range. In Wisconsin, described as spreading elewhere in a similar ecoregion but unknown if it will become a serious invader of native plant communities (IPAW 2003).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

C - LOW SIGNIFICANCE

COMMENTS: Inferred from distribution as currently understood (J. Kartesz, unpublished data; TNC 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: In the northeastern U.S., sandy woods, salt-marshes, fields, and waste places (Gleason and Cronquist 1991). In Pennsylvania, disturbed woods, roadsides, and waste ground (Rhoads and Block 2000). In Michigan, a moist lowland area (Voss 1972). In Illinois, a strip mine (Mohlenbrock 1986). In Wisconsin, on the bank of a river in moist sand (Wisconsin State Herbaria 2005) and in forest and grassland habitat (IPAW 2003).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: It is still available for sale. Occurs in disturbed areas (Rhoads and Block 2000) ; assumption is that disturbed areas are not declining and therefore this species' total range is not declining.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

A - HIGH SIGNIFICANCE

COMMENTS: Inferred from USDA (1990) and J. Kartesz, unpublished data.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Sold on the internet as an ornamental grass (Bluestem Nursery 2006). Planted as an ornamental, for erosion control, and revegetation (USDA 2005).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Occurs in disturbed areas (Rhoads and Block 2000); assumption is that disturbed areas are not decreasing or remaining stable and therefore this species' local range is not decreasing or remaining stable.

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14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: No mention of invasion of undisturbed habitats found in the literature; assumption is that it rarely or seldom invades undisturbed habitats.

15. SIMILAR HABITATS INVADED ELSEWHERE

B - MODERATE SIGNIFICANCE

COMMENTS: In Ontario, it is exotic and occurs near highways and on mine tailings (Dore and McNeill 1980). Other habitats in Canada include, pastures, old fields, railway lines, roadsides, and disturbed areas (Darbyshire 2003). In the Netherlands, *Calamagrostis epigeios* is a problematic native; in coastal dune grasslands it has increased in abundance and out-competes the characteristic dune grassland species (Koen et al. 2005). In Hungary, *Calamagrostis epigeios* is described as a dangerous native that shows invasive tendancies (Mihály and Demeter 2003).

16. REPRODUCTIVE CHARACTERISTICS

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Perennial with extensively creeping rhizomes (Hitchcock 1951). Densely colonial by rhizomes (Gleason and Cronquist 1991). Rapid spreader in sandy soil, slower in heavy soil (Bluestem Nursery 2006). The species has at least one aggressive characteristic.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B - MODERATE SIGNIFICANCE

COMMENTS: In Britain, described as well controlled by a forest herbicide treatment (McCavish 1980). In Wisconsin, categorized as having the greatest potential for being controlled cost effectively using integrated pest management techniques (Falck and Garske 2002).

18. MINIMUM TIME COMMITMENT

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: No mention of control requiring more than 10 years found in the literature; assumption is that control requires less than 10 years.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: In Britain, the forest herbicide treatment did cause damage to other species if applied during the active growing period (McCavish 1980).

20. ACCESSIBILITY OF INVADED AREAS

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Planted as an ornamental and for erosion control (USDA 2005); assumption is, at least in some areas, accessibility may be a problem.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Carduus crispus

ELEMENT NATIONAL ID: 216398
SCIENTIFIC NAME: *Carduus crispus*
COMMON NAME:
I-RANK REVIEW DATE: 2006-05-25
EVALUATOR: G. Davis

I-RANK: Insignificant

I-RANK REASONS SUMMARY:
Although many thistles can be extremely invasive, the available information does not indicate Carduus crispus as a strong threat to natural areas. It does colonize waste areas and roadsides but there are no reports of it taking over intact natural communities. While it has been reported over a wide area in the northeastern and midwestern U.S., reports are sporatic and described as being mostly near larger ports.

SUBRANK I - ECOLOGICAL IMPACT:	Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Insignificant

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Europe and Asia (USDA, ARS 2006).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Occurs on roadsides and waste places; sparingly introduced in the northeastern U.S., chiefly near larger ports (Gleason and Cronquist 1991).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Carduus crispus occurs in disturbed areas and has naturalized around large ports; rare (Weakley 2006 draft).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No impacts on ecosystem processes indicated in literature.

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2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

D - INSIGNIFICANT

COMMENTS: No indication that Carduus crispus alters the herbaceous layer where it colonizes.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No indication that Carduus crispus dominates or reduces recruitment of other species where it colonizes.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No particular species mentioned as disproportionately impacted by Carduus crispus.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Primarily invades waste places and roadsides (Gleason and Cronquist 1991).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Occurs sparingly in the midwestern (North Dakota and Minnesota, south to Arkansas) and northeastern U.S. (New England south to Virgina, west to Ohio) (Kartesz 1999, Gleason and Cronquist 1997).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: According to available county data, occurs in only a few, dispersed counties throughout its generalized range (USDA, NRCS 2006). As part of a West Virginia Dept. of Agriculture exotic weed survey, the species was found in only nine counties in West Virginia, all in heavily disturbed areas (e.g., near railroads, old parking lots, and roadsides) (Harmon, pers. comm. 2006).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

C - LOW SIGNIFICANCE

COMMENTS: According to available county data, occurrences are located in approximately 10 ecoregions.

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

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COMMENTS: Colonizes roadsides and wasteplaces. In West Virginia it was found in one plot (out of 2661) by Elizabeth Beyers in a river scour community on the Shenandoah River adjacent to a railroad - the plot had other exotics and erosion; it was also found by Jim Vanderhorst in a grazed limestone area, a habitat which often grades into limestone glades that have weeds (Harmon, pers. comm. 2006). No information was found to suggest it invades other types of habitat or intact natural areas.

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: No information to suggest that range is increasing rapidly or decreasing.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Since Carduus crispus does not occupy a large portion of its generalized range it is assumed that it has potential to occupy more.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Other similar thistles produce large amounts of seed (up to 10,000) which are wind dispersed which can allow for movement over long distances (Wisconsin Department of Natural Resources 2004).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Carduus crispus was found in West Virginia in 1930 and since then has only been found in nine counties, mostly in eastern WV into a couple of highland counties, plus a couple of counties in the north-central and southeastern parts of the state (Harmon, pers. comm. 2006). There is no indication that this species is spreading rapidly in other areas where it occurs, but is also probably not decreasing.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Carduus crispus is described as a species of roadsides and waste places, chiefly near large ports (Gleason & Cronquist 1991) and has not been described as one that invades intact communities.

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: No indication that Carduus crispus invades anything other than disturbed areas such as waste places.

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16. REPRODUCTIVE CHARACTERISTICS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Other Carduus species can produce up to 10,000 seeds which can remain viable in the soil for up to 10 years (Wisconsin Department of Natural Resources 2004), but biological information specifically about Carduus crispus was not found.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: Controlling other Carduus species requires manual removal before flowering occurs such as mowing or individual plant removal twice per year (Wisconsin Department of Natural Resources 2004) and it is assumed that C. crispus could be controlled using similar techniques; however, given that there is no evidence that C. crispus reaches high density in intact natural areas, it may not be necessary to control it at all.

18. MINIMUM TIME COMMITMENT

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS:

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS:

20. ACCESSIBILITY OF INVADED AREAS

D - INSIGNIFICANT

COMMENTS:

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Invasive Species Assessment Protocol:
U.S. National Assessments

Cirsium palustre

ELEMENT NATIONAL ID: 208470
SCIENTIFIC NAME: *Cirsium palustre*
COMMON NAME:
I-RANK REVIEW DATE: 2005-12-29
EVALUATOR: Gravuer, K.

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:

Cirsium palustre is well-established in northern Michigan and northern Wisconsin and established in a more scattered manner in New Hampshire, New York, Massachusetts, and Maine. It invades a wide variety of wetland and moist upland habitats, including wet meadows/marshes, shrub wetlands, swamps, floodplain forests, bogs/fens, coastal grasslands, forest edge/old fields, roadsides/ditches, mid- and late-successional forests, and lakeshores/beaches. It is capable of invading mature, undisturbed vegetation and forming tall, dense colonies. These abilities combined with the presence of rare species in many invaded habitats constitute the primary threat posed by this species. It is increasing in abundance in the Great Lakes region and appears to be of greater concern to managers there than to those in New England. It prefers moist ground and climates with long, cold winters, so its potential U.S. range may not be much larger than its current range. Management is complicated by the species' strong resprouting abilities, but is usually successful after a few years of persistence.

SUBRANK I - ECOLOGICAL IMPACT:	Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Low

NON-NATIVE THROUGHOUT NATION

NATIVE RANGE: Native to Europe and Siberia, including Denmark, Faroe Islands, Finland, Ireland, Norway, Sweden, United Kingdom, Austria, Belgium, Czechoslovakia, Germany, Hungary, Netherlands, Poland, Switzerland, Belarus, Estonia, Latvia, Lithuania, Moldova, Russian Federation (European part, Eastern Siberia, Western Siberia), Ukraine, Albania, Italy, Romania, Yugoslavia, France, Portugal, and Spain (GRIN 2001).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

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S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Invades a number of wetland habitats, including wet meadows/marshes, shrub wetlands, swamps, floodplain forests, and bogs/fens. Also invades moist upland areas, including coastal grasslands, forest edge/old fields, roadsides/ditches, and mid- and late-successional forests. Invades lakeshores and beaches as well (Mehrhoff et al. 2003, Wisconsin State Herbarium 2005).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

D - INSIGNIFICANT

COMMENTS: Apparently present in New England since at least 1902 and in the Great Lakes region since at least 1934 (Voss 1996, Mehrhoff et al. 2003). Nonetheless, no reports of impacts on ecosystem processes or system-wide parameters were found. Therefore, assume impacts insignificant.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

COMMENTS: Plants can grow greater than 2m tall (Nordin 2002), which may allow them to overtop native species when they invade herbaceous habitats such as wet meadows. They also tend to form dense ungainly colonies (Voss 1996), which may result in increased vegetation density.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C - LOW SIGNIFICANCE

COMMENTS: Forms tall, dense colonies which can displace native species (Voss 1996, WFP 2004, GLIFWC 2005). It has even been noted to compete with tree seedlings (WFP 2004). Because the plants are extremely spiny, they are unpalatable to deer and other wildlife (GLIFWC 2005), which may impact wildlife use of habitats.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Competes directly with and probably displaces the native swamp thistle, *Cirsium muticum* (Voss 1996, GLIFWC 2005). In British Columbia, it has been implicated in the degradation of sedge (*Carex* spp.) meadows that are important habitat for grizzly bears (Polster 2002); however, this is not a major concern in the invaded U.S. areas.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B - MODERATE SIGNIFICANCE

COMMENTS: Apparently threatens a number of rare wetland species, as Voss (1996) notes that its large spiny rosettes and densely prickly stems appear out of place next to *Orchis rotundifolia* and other rarities. Several communities it invades, such as bogs and fens, are also of conservation significance, and its ability to invade undisturbed vegetation suggests that it may pose a threat to high-quality examples of these.

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SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Well-established on the upper peninsula of Michigan; also fairly common in the northern lower peninsula and in northern Wisconsin (Voss 1996). Established in a more scattered manner in New Hampshire, Massachusetts, and New York (Kartesz 1999). Recently discovered in Maine (Mehrhoff et al. 2003).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B - MODERATE SIGNIFICANCE

COMMENTS: Professionals in the Great Lakes area (Michigan and Wisconsin) consider the species problematic (e.g. Voss 1996, GLIFWC 2005, Wisconsin Department of Natural Resources 2005). Although it is tracked by the Invasive Plant Atlas of New England, it does not appear to be as problematic in the northeast. For example, Mehrhoff et al. (2003) state invasive in upper Midwest, known from New Hampshire.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

C - LOW SIGNIFICANCE

COMMENTS: Approximately 5-10 ecoregions are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Invades a number of wetland habitats, including wet meadows/marshes, shrub wetlands, swamps, floodplain forests, and bogs/fens. Also invades moist upland areas, including coastal grasslands, forest edge/old fields, roadsides/ditches, and mid- and late-successional forests. Invades lakeshores and beaches as well (Mehrhoff et al. 2003, Wisconsin State Herbarium 2005). Often seems to first establish in disturbed habitats (e.g. roadsides), then move out from these sites into less disturbed natural areas (Voss 1996, GLIFWC 2005). Requires moist soil but, while acidic soils are apparently preferred, it can grow in a range of moist soils, including coarse gravel (Nordin 2002, WFP 2004, Wisconsin Department of Natural Resources 2005). While sunny or lightly shaded areas seem to be preferred, it is sufficiently shade-tolerant to invade nearly closed-canopy forest (GLIFWC 2005).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Voss (1996) believes it to be spreading south in Michigan. Potentially spreading north in New England, as it was recently discovered in Maine (Mehrhoff et al. 2003); suspected transport by logging equipment (Nordin 2002) may facilitate spread in this direction. Also noted to be spreading aggressively in British Columbia (GLIFWC 2005), suggesting the potential for establishment in the Pacific northwest states.

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11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: This species prefers moist to wet ground and is adapted to climates with long, cold winters (GLIFWC 2005). Therefore, the climate in much of the U.S. may be too warm and/or dry for the species to succeed. Nevertheless, potential spread into at least Minnesota, Vermont, and additional areas of Maine seems highly likely.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Wind is the primary mechanism of dispersal (Mehrhoff et al. 2003, GLIFWC 2005). In British Columbia, there is some evidence that logging equipment has transported seeds to new areas (Nordin 2002); this could potentially occur in areas of the U.S. where active logging is occurring. This species may also be transported by agricultural machinery (Nordin 2002) and has been noted as a potential seed contaminant (GRIN 2001).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B - MODERATE SIGNIFICANCE

COMMENTS: Local abundance and range are increasing in Michigan and Wisconsin (Voss 1996, GLIFWC 2005). One source noted that it has become locally abundant in the northeastern US (GLIFWC 2005). Apparently spreading rapidly in British Columbia (Nordin 2002, Darbyshire 2003) and potentially spreading at a slower rate in eastern Canada (Nordin 2002), both of which could result in new U.S. infestations.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: A number of sources described this species as capable of invading undisturbed, minimally managed, or late successional habitats (Voss 1996, Mehrhoff et al. 2003, GLIFWC 2005). It often seems to first establish in disturbed habitats (e.g. roadsides), then move out from these sites into less disturbed natural areas (Voss 1996, GLIFWC 2005). This may occur for a number of reasons, including a greater likelihood of wind dispersal to areas without thick vegetation (Nordin 2002), facilitation of dispersal by human implements such as logging equipment, agricultural machinery, and vehicles (Nordin 2002), and/or greater ease of establishment in disturbed sites.

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Also established in at least Canada and New Zealand (Kartesz 1999, Randall 2002). Invaded habitats in these countries include meadows, marshes, bogs, ditches, roadsides, riverbeds, pasture, swampy land, forest margins, coastal gravels, and waste land (Webb et al. 1988, Darbyshire 2003). However, the range of habitats already invaded in the U.S. is sufficiently broad that there do not appear to be habitats invaded elsewhere that are not already occupied in the U.S.

16. REPRODUCTIVE CHARACTERISTICS

C - LOW SIGNIFICANCE

COMMENTS: Reproduces entirely be seed, producing up to 2000 seeds per plant in the second year of growth (Nordin 2002, GLIFWC 2005). Some resprouting occurs after cutting or mowing (GLIFWC 2005).

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SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: This species may be somewhat more difficult to eradicate than other roadside weeds, as Voss (1996) noted that the typical program of roadside spraying and mowing employed in Michigan had failed to eradicate populations. For smaller infestations, manual control methods can be successful. Hand-pulling or digging out the rosettes is likely to be successful if sufficient time and labor are available (Nordin 2002, GLIFWC 2005, Wisconsin Department of Natural Resources 2005). Stems can also be cut near the ground before flowering occurs, but this must be done at least twice per season because of resprouting (GLIFWC 2005). For larger infestations, herbicides may be necessary. An herbicide specific for broad-leaved species may minimize collateral damage in grass-dominated ecosystems (Nordin 2002). If glyphosate is required, collateral damage can be minimized by cutting stems near ground level, then spraying a small amount of solution into the cut hollow stems (GLIFWC 2005). For heavily infested areas, biological control may offer the best chance for success. Unfortunately, no effective control agents for this species have yet been found (Nordin 2002). Regardless of the control program selected, yearly monitoring and treatment are probably necessary for several years or more (GLIFWC 2005).

18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS: The seedbank longevity is typically 3-12 months, but some seeds may survive for 2-3 years (Peat and Fitter 2005). Also, plants have a strong tendency to resprout when cut, so manual control methods may need to be repeated for several years before successful control is achieved (GLIFWC 2005).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: The necessity of cutting several times per season because of resprouting may result in more trampling damage to native species than in cases where one cut per season is sufficient. If use of glyphosate is necessary, this could also result in some damage to natives.

20. ACCESSIBILITY OF INVADED AREAS

B - MODERATE SIGNIFICANCE

COMMENTS: In Michigan, the species has spread to a substantial number of shores and remoter wetlands (Voss 1996), which could be difficult to access.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Cuscuta epilinum

ELEMENT NATIONAL ID: 214735
SCIENTIFIC NAME: *Cuscuta epilinum*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-03
EVALUATOR: K. Maybury

I-RANK: Insignificant

I-RANK REASONS SUMMARY:
As this species has established in the U.S. but is not believed to occur in native species habitats, it *de facto* represents an insignificant threat to natural biodiversity here. It is injurious to cultivated flax and therefore a weed of economic concern.

SUBRANK I - ECOLOGICAL IMPACT:	Not Ranked
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Not Ranked
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Not Ranked
SUBRANK IV - MANAGEMENT DIFFICULTY:	Not Ranked

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Europe (Gleason and Cronquist 1991).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS:

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Unknown

COMMENTS: Based on vouchered specimens, this species has been reported very sporadically and primarily/exclusively on flax, presumably in cultivated fields. There is one collection from the 1890s on a flax plant in Ohio (Cooperrider 1995), two collections from two counties in New York (Weldy and Werier 2005), a single collection from 1863 in Pennsylvania (Rhoads and Klein 1995), and one from eastern Washington in 1923 (St. John 1963). The actual distribution is undoubtedly greater than the vouchered specimens would suggest (Fernald [1950] noted that this species was "very injurious to cult. flax") but there is no indication that this species has ever escaped other than in cultivated flax fields and thus it is uncertain if it is truely present in native species habitats in the U.S.

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

COMMENTS:

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

COMMENTS:

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

COMMENTS:

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

COMMENTS:

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

COMMENTS:

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

COMMENTS:

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

COMMENTS:

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

COMMENTS:

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

COMMENTS:

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SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

COMMENTS:

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

COMMENTS:

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

COMMENTS:

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

COMMENTS:

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

COMMENTS:

15. SIMILAR HABITATS INVADED ELSEWHERE

COMMENTS:

16. REPRODUCTIVE CHARACTERISTICS

COMMENTS:

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

COMMENTS:

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18. MINIMUM TIME COMMITMENT

COMMENTS:

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

COMMENTS:

20. ACCESSIBILITY OF INVADED AREAS

COMMENTS:

REFERENCES:

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Invasive Species Assessment Protocol:
U.S. National Assessments

Cuscuta europaea

ELEMENT NATIONAL ID: 218283
SCIENTIFIC NAME: *Cuscuta europaea*
COMMON NAME:
I-RANK REVIEW DATE: 2006-03-30
EVALUATOR: K. Maybury

I-RANK: Insignificant

I-RANK REASONS SUMMARY:
This species is thus far only documented as established in the U.S. in Maine, where it is local and rare. Given its extremly wide native range, it may have great potential for spreading in North America. However, *Cuscuta* species in general are economic weeds, causing great damage to a variety of crops in agricultural settings but generally without major impacts in high quality natural areas. Therefore, while the spread of this species beyond its current range (e.g., via contaminated crop seed from Europe or Asia) may be of great concern, the species may not have the potential for significant impacts on native biodiversity.

SUBRANK I - ECOLOGICAL IMPACT:	Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Insignificant
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Medium

OTHER CONSIDERATIONS:
A serious agricultural weed within its native range in Europe (Lanini and Kogan 2005).

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Europe

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Haines and Vining (1998); J. Kartesz, unpublished 2006 draft distribution data.

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Found in hedgerows (Haines and Vining 1998), presumably with native species present.

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No evidence of changes in ecosystem processes.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

D - INSIGNIFICANT

COMMENTS: Inferred.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Inferred.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

B - MODERATE SIGNIFICANCE

COMMENTS: Plants in the genus *Cuscuta* are obligate stem and leaf parasites, living entirely on the host plant (Lanini and Kogan 2005).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

D - INSIGNIFICANT

COMMENTS: Verified escaped and naturalized in the U.S. only in "hedgerows" in Maine and considered "very rare" there (Haines and Vining 1998).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

D - INSIGNIFICANT

COMMENTS: Only verified as escaped and naturalized in Maine (J. Kartesz, unpublished 2006 draft data).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Adventive locally; very rare in Maine (Haines and Vining 1998).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS:

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9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

D - INSIGNIFICANT

COMMENTS:

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

U - UNKNOWN

COMMENTS:

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

A - HIGH SIGNIFICANCE

COMMENTS: In the Old World this species is extremly widespread from northern Europe to North Africa (Algeria) and to eastern Asia (USDA, ARS; not dated; Fang and Staples, 1995). In China found in a variety of habitats (open grassy localities, streamsides, etc.) and on a variety of hosts (Asteraceae, Fabaceae, Chenopodiaceae, and others) at 800-3100 m. (Fang and Staples 1995). *Cuscuta europaea* is clearly tolerant to a wide variety of climatic and soil conditions and there is no obvious reason why this species could not spread nearly throughout the U.S.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Per Lanini and Kogan (2005): dodder seeds are transmitted by humans via mud on shoes and tires (also very often via contaminated seed once established in agricultural croplands); the seeds can also survive passage through the digestive tracts of many domestic animals and thus can be spread by grazing.

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

U - UNKNOWN

COMMENTS:

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: Apparently not now established in any undisturbed areas. Dodder species in general are most problematic in agricultural croplands, rather than in undisturbed natural situations (e.g., Czarapata 2005).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Naturalized "occasionally" in South America (Fang and Staples 1995).

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16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: Dodders in general exhibit 2 characteristics typical of invasive plants: 1. They grow fairly rapidly to reproductive maturity, producing viable seeds in 60-65 days (Lanini and Kogan 2005); 2. They have seeds that remain viable in soil for 10-30 years, depending on the species (Lanini and Kogan 2005).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Most of the literature on dodders addresses control in agricultural settings, and indicates that complete control is very difficult after establishment. In more natural settings, if control is needed there, the selective herbicides recomended in the agricultural literature may not be appropriate and thus management could be even more difficult.

18. MINIMUM TIME COMMITMENT

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: In agricultural settings, control requires an integrated approach over many years (Lanini and Kogan 2005).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: In agricultural situations, dodders are very difficult to selectively manage once established on crop plants, with control often involving killing or severely damaging the host plant to prevent spread (Lanini and Kogan 2005); presumably the same would be true of native host plants in natural situations.

20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: Inferred. As dodders are known to be economically damaging, most areas---even private lands---would presumably be accessible for control.

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USDA, ARS, National Genetic Resources Program. No date. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov2/cgi-bin/npgs/html/taxon.pl?409853. (Accessed 2006).

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Invasive Species Assessment Protocol:
U.S. National Assessments

Cuscuta suaveolens

ELEMENT NATIONAL ID: 218284
SCIENTIFIC NAME: *Cuscuta suaveolens*
COMMON NAME:
I-RANK REVIEW DATE: 2006-03-31
EVALUATOR: K. Maybury

CALCULATED I-RANK: Low/Insignificant
I-RANK: Insignificant

I-RANK ADJUSTMENT JUSTIFICATION:
The level of managment difficulty here described (& that went into the I-rank) reflects managment in agricultural situations, which is challenging. However, it is not clear that management in more natural situations would be needed.

I-RANK REASONS SUMMARY:
This is a species that primarily invades croplands. The current U.S. distribution is widespread but very spotty. Impacts on native biodiversity are presumed minimal.

SUBRANK I - ECOLOGICAL IMPACT:	Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Medium

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: South America (Brazil, Argentina, Chile, Uruguay (USDA, ARS; no date).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS:

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes
COMMENTS: Presumably.

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No evidence of significant alterations.

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2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

D - INSIGNIFICANT

COMMENTS: Inferred.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Inferred.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

B - MODERATE SIGNIFICANCE

COMMENTS: Plants in the genus *Cuscuta* are obligate stem and leaf parasites, living entirely on the host plant (Lanini and Kogan 2005).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

D - INSIGNIFICANT

COMMENTS: Primarily a weed of alfalfa crops (Abrams 1951, Correll and Johnston 1970, Great Plains Flora Association 1986, Lanini and Kogan 2005).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Scattered distribution including Ohio, Maryland, Alabama, Texas, New Mexico, California, South Dakota (J. Kartesz, unpublished 2006 draft distribution data) and Oklahoma (Oklahoma State University, no date).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Extremely scattered in most parts of the generalized range (perhaps more widespread in Texas and nearby?) and primarly confined to agricultural areas so impacts on native plants and animals are presumed minimal.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

C - LOW SIGNIFICANCE

COMMENTS:

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS:

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SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

U - UNKNOWN

COMMENTS:

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

B - MODERATE SIGNIFICANCE

COMMENTS: *Cuscuta suaveolens* is found worldwide (Lanini and Kogan 2005) and is clearly tolerant to a wide variety of climatic and soil conditions. There is no obvious reason why this species could not spread nearly throughout the U.S.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Per Lanini and Kogan (2005): dodder seeds are transmitted by humans via contaminated crop seed as well as via shoes and tires. Contaminated alfalfa seeds have allowed this species to become widely distributed (Abrams 1951, Correll and Johnston 1970). The seeds can also survive passage through the digestive tracts of many domestic animals and thus can be spread by grazing (Lanini and Kogan 2005).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

U - UNKNOWN

COMMENTS:

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: Primarily invades in agricultural settings.

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Found worldwide, but primarily attacking alfalfa (Lanini and Kogan 2005).

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: Dodders in general exhibit 2 characteristics typical of invasive plants: 1. They grow fairly rapidly to reproductive maturity, producing viable seeds in 60-65 days (Lanini and Kogan 2005); 2. They have seeds that remain viable in soil for 10-30 years, depending on the species (Lanini and Kogan 2005).

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SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Most of the literature on dodders addresses control in agricultural settings, and indicates that complete control is very difficult after establishment. In more natural settings, if control is needed there, the selective herbicides recomended in the agricultural literature may not be appropriate and thus management could be even more difficult.

18. MINIMUM TIME COMMITMENT

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: In agricultural settings, control requires an integrated approach over many years (Lanini and Kogan 2005).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: In agricultural situations, dodders are very difficult to selectively manage once established on crop plants, with control often involving killing or severely damaging the host plant to prevent spread (Lanini and Kogan 2005); presumably the same would be true of native host plants in natural situations.

20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: Inferred. As dodders are known to be economically damaging, most areas---even private lands---would presumably be accessible for control.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Cynanchum louiseae

ELEMENT NATIONAL ID: 208889
SCIENTIFIC NAME: *Cynanchum louiseae*
COMMON NAME: Black Swallow-wort
I-RANK REVIEW DATE: 2006-06-22
EVALUATOR: J. Cordeiro

I-RANK: High

I-RANK REASONS SUMMARY:
Large, monospecific stands can form in open, fully-exposed areas. In brushy areas, these vines can over-top and smother shrubs, forming the dominant cover. Under forested canopies, plants of shorter stature can comprise the dominant cover in the herbaceous understory layer. The twining and sprawling habit contributes to effective contribution with pre-existing vegetation, and frequently results in large monocultures. This species has become particularly invasive in coastal areas of New England, the Connecticut River valley, and the lower Hudson River region. Adverse effects to native species (including federally endangered species) have been documented and the species has moderate invasiveness potential and is readily capable of long-distance dispersal. Management difficulty is high and time frame for management moderate with control measures having moderate effects on native species.

SUBRANK I - ECOLOGICAL IMPACT:	High/Medium
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	High

OTHER CONSIDERATIONS:
The taxonomy of *Vincetoxicum/ Cynanchum* has been used inconsistently. Some recognize *Vincetoxicum nigrum*, *Vincetoxicum hirundinaria*, and *Vincetoxicum rossicum* as introduced in to North America. Some group *V. rossicum* with *V. hirundinaria*. Different scientific names have been used. Kartesz (1994) treats *V. nigrum* as *Cynanchum louiseae*, *V. rossicum* as *Cynanchum rossicum*, and *V. hirundinaria* as *Cinanchum vincetoxicum* (see Sheeley and Raynal, 1996). This has made evaluating spread of the genus difficult. For the purpose of this assessment, *Cynanchum* (= *Vincetoxicum*) *nigrum* is considered synonymous with *Cynanthum* (= *Vincetoxicum*) *louiseae* and *Cynanchum* (= *Vincetoxicum*) *hirundinaria* is considered synonymous with *Cynanchum* (= *Vincetoxicum*) *vincetoxicum* (per DiTommaso et al., 2005).

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: This species is native to western European Mediterranean regions (Lawlor, 2001). Tewksbury et al. (2002) list native distribution as southwestern Europe in France, Italy, Portugal, and Spain.

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SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species has been established as a non-native in the United States for over 150 years in both disturbed and undistrubed upland natural areas (Lawlor, 2001).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: This species has been established as a non-native in the United States for over 150 years in both disturbed and undistrubed upland natural areas (Lawlor, 2001).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

B - MODERATE SIGNIFICANCE

COMMENTS: Ecosystem scale modification appears obvious but impacts have not yet been studied (DiTommaso et al., 2005; Lawlor, 2001). However, when invading open or brushy areas, appears to cause ecosystem-wide reduction in light availability for co-occurring species.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B - MODERATE SIGNIFICANCE

COMMENTS: Large, monospecific stands can form in open, fully-exposed areas. In brushy areas, these vines can over-top and smother shrubs, forming the dominant cover. Under forested canopies, plants of shorter stature can comprise the dominant cover in the herbaceous understory layer (Lawlor, 2001; Sheeley and Raynal, 1996). The twining and sprawling habit contributes to effective contribution with pre-existing vegetation, and frequently results in large monocultures (DiTommaso et al., 2005; Massachusetts Invasive Plant Advisory Group, 2005).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B - MODERATE SIGNIFICANCE

COMMENTS: This species can form dense stands that displace desirable native species and, although community dynamics studies have not been carried out, presence large mono-specific stands suggest they can suppress other plant species via competition for soil moisture and nutrients, light, other environmental factors, or via alleopathy (DiTommaso et al., 2005; Lawlor, 2001). It is known to outcompete native wildflowers and young trees (Czarapata, 2005).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Because this species adversely affects monarch butterfly (*Danaus plexippus*) populations as monarchs oviposit on black swallow-wort rather than on native *Asclepias* species (milkweeds) and eggs experience high mortality levels when they do (Casagrande and Dacey, 2001; Haribal and Renwick, 1998), it can be inferred that other native insects that use milkweed plants as hosts might also be negatively affected by using black swallow-wort instead (Tewksbury et al., 2002). Roots of *Cynanchum vincetoxicum* are considered poisionous to humans and several mammals and the same is likely true for other species in the subgenus *Vincetoxicum* (DiTommaso et al., 2005).

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5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

A - HIGH SIGNIFICANCE

COMMENTS: Occurrence of stands of this species are threatening the survival of rare and threatened native species, such as Jessop's milkvetch (*Astragalus robbinsii*) on ice scoured banks of the Connecticut River in Vermont (DiTommaso et al., 2005; Lawlor, 2001). The closely related *Vincetoxicum rossicum* was also observed overgrowing the federally listed Hart's tongue fern (*Phyllitis scolopendrium*) at Split Rock, near Onadaga, New York (Lawlor, 2001); and is also threatening the only New England population of *Asclepias viridiflora* in Connecticut (state endangered) (Tewksbury et al., 2002; Haribal and Renwick, 1998). This species also adversely affects monarch butterfly (*Danaus plexippus*) populations as monarchs oviposit on black swallow-wort rather than on native *Asclepias* species (milkweeds) and eggs experience high mortality levels when they do (Casagrande and Dacey, 2001; Haribal and Renwick, 1998). Further, they may pose a greater threat to monarch butterflies by reducing host plant availability through competetive displacement (DiTommaso et al., 2005).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: North American herbarium records date to 1854 in Massachusetts with collections also from New York, Michigan, Ohio, Rhode Island, Vermont, Pennsylvania, Illinois, Missouri, Connecticut, Maine, Maryland, New Jersey, New Hampshire, Indiana, and Wisconsin (Sheeley and Raynal, 1996) and recently in Kansas, Kentucky, Nebraska, and California (USDA, 1999). Tewksbury et al. (2002) cite North American distribution as extending west from the Atlantic coast to southeastern Ontario and south to southern Pennsylvania and Missouri with a record from California.

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B - MODERATE SIGNIFICANCE

COMMENTS: Although considered an invasive plant throughout the United States, it has become particularly invasive in coastal areas of New England, the Connecticut River valley, and the lower Hudson River region (Lawlor, 2001).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: It is conservatively estimated that over 25 ecoregions (disjunct in California) have been invaded by *Cyanchum louiseae* in the United States (Cordeiro, pers. obs., April 2006, based on TNC, 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

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COMMENTS: Plants thrive in sunny open areas, shrub habitats and hedges, as well as under fully shaded forest canopies and is found in a wide range of upland habitats and is primarily a species of woods and moist sunny places (though it tolerates a wide range of light intensities) (Lawlor, 2001; Tewksbury et al., 2002; Uva et al., 1997). Ecologically a generalist, tolerating a wide range of light intensities, soil conditions, and habitats. It is generally an upland species, but rivers and streams that experience spring flood scouring, such as flood plain ravines along Lake Ontario and the banks of the Connecticut River near Windsor, Vermont, have been extensively invaded (DiTommaso et al., 2005).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: *Cynanchum louiseae* appears to be rapidly expanding its range in North America and there is no evidence theat it is near to reaching maxiumum geographic or ecological distribution; future growth is expected (DiTommaso et al., 2005). Much like in Europe (Fournier, 1977 cited in Lawlor, 2001), this species has spread across the United States over the past 150 years beginning in New England. The natural spread of most exotic *Vincetoxicum* species (not *V. hirundinaria*, though) appears to be slower, however, than other exotic plant species that colonize new sites aggressively by sexual and vegetative means. Once established, however, *Vincetoxicum* species may persist for decades serving as source populations for further spread; with populations in Illinois and New York sustained for over 70 years since establishment (Sheeley and Raynal, 1996).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: *Cynanchum louiseae* appears to be rapidly expanding its range in North America and there is no evidence theat it is near to reaching maxiumum geographic or ecological distribution; future growth is expected (DiTommaso et al., 2005). This is evident by the recent disjunct invasion in areas of California far removed from the eastern and northeastern center of its distribution in the United States. It has also become locally abundant in several areas in Wisconsin recently (Czarapata, 2005). It is particularly invasive in the northeast where it occupies all the New England states (Mehrhoff et al., 2003).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Seeds are wind-dispersed, bearing the tuft of hairs like a parachute for long-distance dispersal. Observations indicate a large proportion of seeds ramains close to the parent plant, but many small, satellite populations are often found downwind of large seed source populations (Lawlor, 2001; Czarapata, 2005). Human land management activities may also contribute to dispersal (harvesting, hay making) as this species is listed as a cultivated ornamental in the United States, sometimes incorrectly under the name *Cynanchum nigrum* (DiTommaso et al., 2005).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B - MODERATE SIGNIFICANCE

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COMMENTS: Although the species has been present in New England for over 150 years, it has expanded recently in Kansas, Kentucky, Nebraska, and California (USDA, 2006). Tewksbury et al. (2002) cite North American distribution as extending west from the Atlantic coast to southeastern Ontario and south to southern Pennsylvania and Missouri with a record from California. It has also become locally abundant in several areas in Wisconsin recently (Czarapata, 2005); as well as in New England (Mehrhoff et al., 2003).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: This species is listed as a "potential problem species" in Czarapata (2005). This species is associated with disturbances, particularly anthropogenic disturbances such as highway, rail, utility and other transportation corridors, limestone quarries, abandoned pastures and old fields, Christmas tree plantations, nursery crops, and other perennial crops (DiTommaso et al., 2005; Lawlor, 2001). Rivers and streams experincing spring flood scouring or areas subject to hydrologic extremes are also vulnerable to invasion (Lawlor, 2001). However, once established, the plant will readily move into nearby, less disturbed habitats.

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Habitat in native western Mediterranean region is slopes, copses, bushy places, and stoney, dry areas from sea level to 500 meters (DiTommaso et al., 2005; Fournier, 1977 cited in Lawlor, 2001).

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: Reproduction is by seed (Uva et al., 1997) or by spreading rhizomes, and shoots from the root crown of the parent plant (Czarapata, 2005). Black swallow-wort blooms June through September and is capable of self-pollination but is also pollinated by insects (Lumer and Yost, 1995; Uva et al., 1997). Fruit ripens late July in sunny locations and throughout August in shadier locations with seed production highest in full sun (2090 seeds per square meter per plant). Seeds in the genus *Vincetoxicum* (= *Cynanchum*) are also polyembryonic (more than 1 embryo per seed) and seed germination is bimodal with germination of some seeds in the fall and others in the following spring and plants can set fruits with viable seeds without a pollen vector (Lumer and Yost, 1995; Sheeley and Raynal, 1996; Czarapata, 2005). Seed bank dynamics are unknown. The confirmation of underground rhizomes suggests clonal vegetative reproductive capacity in this species and plants readily resprout after destruction of the aboveground shoot (Lawlor, 2001; Lumer and Yost, 1995). Seeds do not require either dormancy or stratification to germinate so in New York, seeds from early-maturing fruite may germinate and become established the same year before the first frost, whereas seeds from late-maturing fruits overwinter and germinate in the spring (Lumer and Yost, 1995).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A - HIGH SIGNIFICANCE

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COMMENTS: Prevention of new infestations is the best management method as this species is already widely distributed in the northeastern U.S., upper midwest and adjacent Canada and seeds are readily dispersed by wind. Eraciation of isolated plants and small patches is possible with persistence and an early detection system, but large scale infestations will require persistent effort and continuous follow-up monitoring to control (Lawlor, 2001). Mowing and hand-pulling are only effective if the extensive and deep root crowns are removed and completely destroyed to prevent resprouting. Response to herbicides varies by site and site condition. In treating whole plants or tall stems, glyphosate can be used in denegraded patches with little desirable vegetation; triclopyr ester is better in sites with desirable grasses to be conserved. In cut-stem applications, glyphosate was superior to all triclopyr amine concentrations (Lawlor, 2000 cited in Lawlor, 2001). In all cases, repeated follow up herbicide treatments are necessary. Fire alone is ineffective (Czarapata, 2005) but may be useful after herbicide control to control seedlings. Grazing is of mixed utility. Prolonged flooding is effective but negatively impacts native species (Lawlor, 2001). There are few to no native pests, diseases or other natural controls in North America (Lawlor, 2001; Sheeley and Raynal, 1996; Tewksbury et al., 2002), but there are several potential biological control agents associated with the related *Vincetoxicum hirundinaria* in Europe (see Tewksbury et al., 2002 for discussion).
In Europe, *Cynanchum vincetoxicum* is very widespread and common and several associated herbivorous insects (mostly plant specialists due to the poisionous nature of this plant) are known including the leaf eating Chrysomelidae, *Chrysochus asclepiadeus* and *Chrysomella aurichalcea* ssp. *bohemic*; the weevil *Otiorhynchus pinastri*; and three dipteran species *Euphranta connexa*, *Contarinia vincetoxici*, and *Contarinia asclepiadis* feeding on reproductive plant parts. In Sweden, the moth, *Abrostola asclepiadis*, was found to be monophagous on *C. vincetoxicum* but only consumed a very small percantage of foliage. The lygus bugs, *Lygaeus equestris* and *Tropidothorax leucopterus* are reported to feed on seeds of *C. vincetoxicum* with effect on seed production relatively minimal. Species of *Cynanchum*, especially *C. vincetoxicum*, are imprtant alternate hosts for the widespread European rust fungus, *Cronartium flaccidum* (and *Cronartium asclepiadeum*) which can cause significant reductions of foliar biomass (for more information see DiTomasso et al., 2005).

18. MINIMUM TIME COMMITMENT

B - MODERATE SIGNIFICANCE

COMMENTS: Prevention of new infestations is the best management method as this species is already widely distributed in the northeastern U.S., upper midwest and adjacent Canada and seeds are readily dispersed by wind. Eraciation of isolated plants and small patches is possible with persistence and an early detection system, but large scale infestations will require persistent effort and continuous follow-up monitoring to control (Lawlor, 2001). If herbicides are to be used (see Lawlor, 2000 cited in Lawlor, 2001) repeated treatments are necessary. Because management requires and integrated approach and resprouting regularly occurs, yearly monitoring and treatment following initial control is necessary for assessments of survival and seedling establishment (Lawlor, 2001).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B - MODERATE SIGNIFICANCE

COMMENTS: There are few to no native pests, diseases or other natural controls in North America (Lawlor, 2001; Sheeley and Raynal, 1996; Tewksbury et al., 2002), but there are several potential biological control agents associated with the related *Vincetoxicum hirundinaria* in Europe (see Tewksbury et al., 2002 for discussion). Also see "general management difficulty" for information on control of various *Cynanchum* species in Europe.

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20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: As this species frequently occurs on private land (often downwind from an invasion point), some access issues will arise and cooperation with landownders for management will be necessary (Lawlor, 2001).

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Invasive Species Assessment Protocol:
U.S. National Assessments

Cynanchum vincetoxicum

ELEMENT NATIONAL ID: 236271
SCIENTIFIC NAME: *Cynanchum vincetoxicum*
COMMON NAME: White Swallow-wort
I-RANK REVIEW DATE: 2006-06-27
EVALUATOR: J. Cordeiro, rev. K. Gravuer

I-RANK: Low

I-RANK REASONS SUMMARY:
Most of the impact of this species is anecdotal based on confirmed impacts of the related *Cynanchum louiseae*. Although it is a widespread pest species across Europe, the species has only invaded a few select areas in the United States and does not appear to be spreading. Control measures have not been tested in the U.S. but various control measures, including biological control with limited impact on native species, have been utilized in Europe.

SUBRANK I - ECOLOGICAL IMPACT:	Medium
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Insignificant
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low

OTHER CONSIDERATIONS:
The taxonomy of *Vincetoxicum/ Cynanchum* has been used inconsistently. Some recognize *Vincetoxicum nigrum*, *Vincetoxicum hirundinaria*, and *Vincetoxicum rossicum* as introduced in to North America. Some group *V. rossicum* with *V. hirundinaria*. Different scientific names have been used. Kartesz (1994) treats *V. nigrum* as *Cynanchum louiseae*, *V. rossicum* as *Cynanchum rossicum*, and *V. hirundinaria* as *Cinanchum vincetoxicum* (see Sheeley and Raynal, 1996). This has made evaluating spread of the genus difficult. For the purpose of this assessment, *Cynanchum* (= *Vincetoxicum*) *nigrum* is considered synonymous with *Cynanthum* (= *Vincetoxicum*) *louiseae* and *Cynanchum* (= *Vincetoxicum*) *hirundinaria* is considered synonymous with *Cynanchum* (= *Vincetoxicum*) *vincetoxicum* (per DiTommaso et al., 2005).

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Native range for the nominal subspecies Vincetoxicum hirundiana hirundiana includes all of Europe except Portugal and Spain (Tewksbury et al., 2002).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS: This species occurs only sparsely in the northeast and Sheeley and Raynal (1996) suggest that it is not well established in North America; escaping very infrequently from cultivation.

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S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: This species occurs only sparsely in the northeast and Sheeley and Raynal (1996) suggest that it is not well established in North America; escaping very infrequently from cultivation.

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

B - MODERATE SIGNIFICANCE

COMMENTS: Ecosystem scale modification appears obvious but impacts have not yet been studied (DiTommaso et al., 2005; Lawlor, 2001). However, when invading open or brushy areas, appears to cause ecosystem-wide reduction in light availability for co-occurring species.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B - MODERATE SIGNIFICANCE

COMMENTS: Large, monospecific stands can form in open, fully-esposed areas. In brushy areas, these vines can over-top and smother shrubs, forming the dominant cover. Under forested canopies, plants of shorter stature can comprise the dominant cover in the herbaceous understory layer (Lawlor, 2001; Sheeley and Raynal, 1996).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B - MODERATE SIGNIFICANCE

COMMENTS: This species can form dense stands that displace desirable native species and, although community dynamics studies have not been carried out, presence large mono-specific stands suggest they can suppress other plant species via competition for soil moisture and nutrients, light, other environmental factors, or via alleopathy (DiTommaso et al., 2005; Lawlor, 2001).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Roots of *Cynanchum vincetoxicum* are considered poisionous to humans and several mammals and the same is likely true for other species in the subgenus *Vincetoxicum* (DiTommaso et al., 2005). Because the related species, *Cynanchum louiseae*, adversely affects monarch butterfly (*Danaus plexippus*) populations as monarchs oviposit on black swallow-wort rather than on native *Asclepias* species (milkweeds) and eggs experience high mortality levels when they do (Casagrande and Dacey, 2001; Haribal and Renwick, 1998), it can be inferred that other native insects that use milkweed plants as hosts might also be negatively affected by using black swallow-wort instead (Tewksbury et al., 2002).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C - LOW SIGNIFICANCE

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COMMENTS: The closely related *Vincetoxicum rossicum* was observed overgrowing the federally listed Hart's tongue fern (*Phyllitis scolopendrium*) at Split Rock, near Onadaga, New York (Lawlor, 2001); and is also threatening the only New England population of *Asclepias viridiflora* in Connecticut (state endangered) (Tewksbury et al., 2002; Haribal and Renwick, 1998). *Cynanchum louiseae* also adversely affects monarch butterfly (*Danaus plexippus*) populations as monarchs oviposit on black swallow-wort rather than on native *Asclepias* species (milkweeds) and eggs experience high mortality levels when they do (Casagrande and Dacey, 2001; Haribal and Renwick, 1998). Further, they may pose a greater threat to monarch butterflies by reducing host plant availability through competetive displacement (DiTommaso et al., 2005).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

D - INSIGNIFICANT

COMMENTS: This species was first recorded in North America in 1908 and existing records are known only from New York (5 counties in central part of state), Michigan (one site), and Montreal near Niagara Falls (Sheeley and Raynal, 1996; Tewksbury et al., 2002; USDA, 2006).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C - LOW SIGNIFICANCE

COMMENTS: This species occurs only sparsely in the northeast and Sheeley and Raynal (1996) suggest that it is not well established in North America; escaping very infrequently from cultivation.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

D - INSIGNIFICANT

COMMENTS: It is conservatively estimated that only 3 or 4 ecoregions have been invaded by *Cyanchum vincetoxicum* in the United States (Cordeiro, pers. obs., April 2006, based on TNC, 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: In Europe, plants thrive in sunny open areas, shrub habitats and hedges, as well as under fully shaded forest canopies and is found in a wide range of upland habitats and is primarily a species of woods and moist sunny places (though it tolerates a wide range of light intensities) (Lawlor, 2001; Tewksbury et al., 2002), but in the U.S. it has only invaded a few sites, all of them experiencing some form of accidental release from cultivation (Sheeley and Raynal, 1996).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

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COMMENTS: Because earliest introductions in New York date to 1908 and this species has succeeed in invading only one other U.S. state in almost 100 years, coupled with its widespread distribution and invasive success in Europe, it appears this species has not been a very successful invader with little increase in range and little or no spread outward from original introduction points, although it does persist once established (Sheeley and Raynal, 1996). Occasional escapes are rare and in most cases do not persist in North America (DiTommaso et al., 2005). This pattern is in contrast to most exotic *Vincetoxicum* species which colonize new sites aggressively by sexual and vegetative means. Once established, however, *Vincetoxicum* species may persist for decades serving as source populations for further spread; with populations in Illinois and New York sustained for over 70 years since establishment (Sheeley and Raynal, 1996).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

A - HIGH SIGNIFICANCE

COMMENTS: Because earliest introductions in New York date to 1908 and this species has succeeded in invading only one other U.S. state in almost 100 years, coupled with its widespread distribution and invasive success in Europe, it appears this species has not been a very successful invader with little increase in range and little or no spread outward from original introduction points, although it does persist once established (Sheeley and Raynal, 1996).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Like other species of *Vincetoxicum*, seeds are wind-dispersed, bearing the tuft of hairs like a parachute for long-distance dispersal. Observations of *Vincetoxicum nigrum* indicate a large proportion of seeds ramains close to the parent plant, but many small, satellite populations are often found downwind of large seed source populations (Lawlor, 2001). Human land management activities may also contribute to dispersal (harvesting, hay making) as *Vincetoxicum hirundinaria* is an infrequent escape from cultivation (Sheeley and Raynal, 1996).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

D - INSIGNIFICANT

COMMENTS: Because earliest introductions in New York date to 1908 and this species has succeeed in invading only one other U.S. state in almost 100 years, coupled with its widespread distribution and invasive success in Europe, it appears this species has not been a very successful invader with little increase in range and little or no spread outward from original introduction points, although it does persist once established (Sheeley and Raynal, 1996).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Although other *Vincetoxicum* species (*V. nigrum*, *V. rossicum*) have been successful at invading areas of the U.S. and are associated with disturbances, particularly anthropogenic disturbances such as highway, rail, utility and other transportation corridors, limestone quarries, abandoned pastures and old fields, Christmas tree plantations, nursery crops, and other perennial crops (Lawlor, 2001), this species has been largely unsuccessful with no well-established colonies in North America (Sheeley and Raynal, 1996). Although hybridization is rare, *Cynanchum rossicum* has been purported to hybridize with *Cynanchum vincetoxicum* (see DiTommaso et al., 2005) but such hybridization is unlikely in North America since *C. vincetoxicum* is rarely cultivated and occasional escapes are not known to persist except in a few instances.

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15. SIMILAR HABITATS INVADED ELSEWHERE

A - HIGH SIGNIFICANCE

COMMENTS: Habitat in native western Mediterranean region is slopes, copses and stoney, dry areas from sea level to 500 meters (Fournier, 1977 cited in Lawlor, 2001). In Europe, this species was used economically in post-World War I as a fiber plant for linen (Lawlor, 2001). Unlike in the U.S., this species is a widespread pest weed across Europe n sunny open areas, shrub habitats and hedges, as well as under fully shaded forest canopies and is found in a wide range of upland habitats and is primarily a species of woods and moist sunny places (though it tolerates a wide range of light intensities); and various control measures have been devised to keep it in check (Tewksbury et al., 2002).

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: Reproductive characteristics are anecdotal and based on the related black swallow-wort. Black swallow-wort blooms June through September and is capable of self-pollination but is also pollinated by insects (Lumer and Yost, 1995). Fruite repens late July in sunny locations and throughout August in shadier locations with seed production highest in full sun (2090 seeds per square meter per plant). Seeds also polyembryonic (more than 1 embryo per seed) and seed germination is bimodal with germination of some seeds in the fall and others in the following spring and platns can set fruits with viable seeds without a pollen vector (Lumer and Yost, 1995; Sheeley and Raynal, 1996). At least some populations of *Cynanchum vincetoxicum* are known to be self-compatible (DiTommaso et al., 2005). Seed bank dynamics are unknown. The confirmation of underground rhizomes suggests clonal vegetative reproductive capacity in this species and plants readily resprout after destruction of the aboveground shoot (Lawlor, 2001; Lumer and Yost, 1995). Seeds do not require either dormancy or stratification to germinate so in New York, seeds from early-maturing fruite may germinate and become established the same year before the first frost, whereas seeds from late-maturing fruits overwinter and germinate in the spring (Lumer and Yost, 1995).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

C - LOW SIGNIFICANCE

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COMMENTS: So long as this species remains as only a few isolated releases from cultivation (escapes often do not persist), control should involve prevention of further accidental releases and containment of the few existing occurrences. New, small invasions can be eliminated by hand pulling the entire plant (see below). Biological controls have been very successful in Europe (see Tewksbury et al., 2002).
In Europe, *Cynanchum vincetoxicum* is very widespread and common and several associated herbivorous insects (mostly plant specialists due to the poisionous nature of this plant) are known including the leaf eating Chrysomelidae, *Chrysochus asclepiadeus* and *Chrysomella aurichalcea* ssp. *bohemic*; the weevil *Otiorhynchus pinastri*; and three dipteran species *Euphranta connexa*, *Contarinia vincetoxici*, and *Contarinia asclepiadis* feeding on reproductive plant parts. In Sweden, the moth, *Abrostola asclepiadis*, was found to be monophagous on *C. vincetoxicum* but only consumed a very small percantage of foliage. The lygus bugs, *Lygaeus equestris* and *Tropidothorax leucopterus* are reported to feed on seeds of *C. vincetoxicum* with effect on seed production relatively minimal. Species of *Cynanchum*, especially *C. vincetoxicum*, are imprtant alternate hosts for the widespread European rust fungus, *Cronartium flaccidum* (and *Cronartium asclepiadeum*) which can cause significant reductions of foliar biomass (for more information see DiTomasso et al., 2005). Information that follows is in reference to the much more invasive *Vincetoxicum nigrum* and *V. rossicum*. Mowing and hand-pulling are only effective if the extensive and deep root crowns are removed and completely destroyed to prevent resprouting. Response to herbicides varies by site and site condition. In treating whole plants or tall stems, glyphosate can be used in denegraded patches with little desirable vegetation; triclopyr ester is better in sites with desirable grasses to be conserved. In cut-stem applications, glyphosate was superior to all triclopyr amine concentrations (Lawlor, 2000 cited in Lawlor, 2001). In all cases, repeated follow up herbicide treatments are necessary. Fire alone is ineffective but may be useful after herbicide control to control seedlings. Grazing is of mixed utility. Prolonged flooding is effective but negatively impacts native species (Lawlor, 2001). There are few to no native pests, diseases or other natural controls in North America (Lawlor, 2001; Sheeley and Raynal, 1996; Tewksbury et al., 2002), but there are several potential biological control agents associated with *Vincetoxicum hirundinaria* in Europe (see Tewksbury et al., 2002 for discussion).

18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS: Prevention of new infestations is the best management method as this species is already widely distributed in the northeastern U.S., upper midwest and adjacent Canada and seeds are readily dispersed by wind. Eraciation of isolated plants and small patches is possible with persistence and an early detection system, but large scale infestations will require persistent effort and continuous follow-up monitoring to control (Lawlor, 2001). If herbicides are to be used (see Lawlor, 2000 cited in Lawlor, 2001) repeated treatments are necessary. Because management requires and integrated approach and resprouting regularly occurs, yearly monitoring and treatment following initial control is necessary for assessments of survival and seedling establishment (Lawlor, 2001).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

COMMENTS: There are few to no native pests, diseases or other natural controls in North America (Lawlor, 2001; Sheeley and Raynal, 1996; Tewksbury et al., 2002), but there are several potential biological control agents associated with the related *Vincetoxicum hirundinaria* in Europe (see Tewksbury et al., 2002 for discussion). Also see "general management difficulty" for information on control of various *Cynanchum* species in Europe. Because all current U.S. populations are small, control measures can be adequately developed that should have minimal impacts on native species.

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20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: This species is very rare as an invasive in North America but should it spread to private land (often downwind from an invasion point), some access issues will arise and cooperation with landownders for management will be necessary (Lawlor, 2001).

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Invasive Species Assessment Protocol:
U.S. National Assessments

Digitaria sanguinalis

ELEMENT NATIONAL ID: 214989
SCIENTIFIC NAME: *Digitaria sanguinalis*
COMMON NAME:
I-RANK REVIEW DATE: 2006-06-15
EVALUATOR: Tomaino, A.

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:
Digitaria sanguinalis is widespread and occurs throughout the contiguous U.S., with the exception of Florida. It is a serious weed of lawns and gardens. In native species habitats, is occurs primarily in waste areas, old fields, borders, and roadsides. Where it occurs in more natural habitats such as prairies and dunes, it seems to be restricted to freshly disturbed areas. It has been found to produce root exudates that inhibit its own seedlings, as well as the seedlings of other early invading species; it is one of the first species to dissappear in old field succession. Digitaria sanguinalis does posess some aggressive reproductive characteristics. A single plant may produce up to 188,000 seeds and stems often root at the lower nodes. However, it appears to have few negative impacts on biodiversity.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low/Insignificant

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Southern and Eastern Europe, North Africa, and Temperate Asia (USDA 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Established outside cultivation in the U.S. (FNA 2003). The native indicator in Kartesz (1999) is an error (J. Kartesz pers. comm., 2006).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: In Arizona, it occurs along streams, ditch banks, roadsides, and washes (Parker 1972).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No mention of changes in abiotic ecosystem processes or system-wide parameters found in the literature; assumption is that any alterations are not high or moderate.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

COMMENTS: Annual grass with culms 20-70 cm, often decumbent (FNA 2003).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C - LOW SIGNIFICANCE

COMMENTS: Has a C4 photosynthetic pathway, which makes it tolerant of hot, dry conditions and very competitive during the summer (Danneberger 1993 cited by Kime tal. 2002). Produces root exudates that inhibit its own seedlings as well as the seedlings of other early invading species; Due to this sensitivity, it is one of the first species to dissappear in old field succession (Parenti and Rice 1969). In disturbed Indiana dunes, this species filled in gaps left by removal of other exotic grasses and had a high % cover but was replaced by planted natives within two years (Ghoi and Pavlovic 1998). This species does cause alteration in community composition but since it also inhibits itself, its impacts are interpreted as low since they aren't continuing long-term.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not significant.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: In Missouri prairie lands, it is an obligate ruderal that is restricted to newly exposed soils or heavily compacted sites such as along roadsides and parking areas (Ladd and Churchwell 1999). In disturbed Indiana dunes, this species filled in gaps left by removal of other exotic grasses but was replaced by planted natives within two years (Ghoi and Pavlovic 1998). In Long Island prairie, it occurs in areas that are disturbed by vehicle traffic and dumping (Stalter and Lamont 1986). In New Jersey, it occurs on the back of coastal dunes (Hough 1983). At least some of these communities are probably of conservation significance but this species seems to be restricted to freshly disturbed areas; assumption is that it is not often or occasionally threatening elements of conservation significance.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Established throughout the contiguous U.S., with the exception of Florida (Kartesz 1999; J. Kartesz, unpublished data).

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7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C - LOW SIGNIFICANCE

COMMENTS: In Missouri prairie lands, it is an obligate ruderal that is restricted to newly exposed soils or heavily compacted sites such as along roadsides and parking areas (Ladd and Churchwell 1999). On Indiana dune ridges, it invaded after other exotic grasses were removed but was a poor competitor with planted natives and was replaced by them within two years (Choi and Pavlovic 1998). In Long Island prairie, it occurs in areas that are disturbed by vehicle traffic and dumping (Stalter and Lamont 1986).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: Inferred from distribution as currently understood (J. Kartesz, unpublished data; TNC 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Occurs in disturbed areas of prairies (Ladd and Churchwell 1999; Stalter and Lamont 1987). Occurs in disturbed areas of sand dunes (Choi and Pavlovic 1998). Occurs along streams, ditch banks, and washes (Parker 1972). Also occurs in waste ground, fields, borders, roadsides, gardens, and lawns (FNA 2003; Baldwin et al. 2006; Weakley 2006; Kartesz 1988; Hitchcock 1951).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: Already very widespread throughout the region (Kartesz 1999; J. Kartesz, unpublished data). Potential for further expansion is probably limited by its biology.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

D - INSIGNIFICANT

COMMENTS: Inferred from USDA (1990) and J. Kartesz, unpublished data.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: May contaminate and be spread via seed crops because it grows alongside agricultural fields (Peters 2005). One of the most significant weeds turfgrass (Kim et al. 2002).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

C - LOW SIGNIFICANCE

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COMMENTS: Already quite widespread (J. Kartesz, unpublished data); assumption is that local range expansion and abundance is not moderate or rapid.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: In Missouri prairie lands, it is an obligate ruderal that is restricted to newly exposed soils or heavily compacted sites such as along roadsides and parking areas (Ladd and Churchwell 1999). On Indiana dune ridges, it invaded after other exotic grasses were removed but was a poor competitor with planted natives and was replaced by them within two years (Choi and Pavlovic 1998). In Long Island prairie, it occurs in areas that are disturbed by vehicle traffic and dumping (Stalter and Lamont 1986).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Occurs in waste ground of fields gardens, and lawns throughout much of the world (FNA 2003). An introduced invasive in Australia, New Zealand, and Guam (PIER 2005). A dominant invading species on disturbed Korean sand dunes (Kim 2005). An invasive exotic in Lithuania (Gudzinskas 2004). Occurs in Canada (Kartesz 1999). In British Columbia, occurs in mesic to dry lawns, fields, roadsides and waste areas.

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: A single plant may produce up to 188,000 seeds (Peters and Dunn 1971 cited by Kim et al. 2002). It reproduces by seeds and also by stems spreading at the base and rooting at the lower joints (Parker 1972). It is an annual (FNA 2003).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

C - LOW SIGNIFICANCE

COMMENTS: Chemical herbicides and/or mowing are used to control this species in the borders of agricultural fields (Peters 2005). Because this species disappears early in old field succession (Parenti and Rice 1969), management may rarely be needed in more natural areas.

18. MINIMUM TIME COMMITMENT

D - INSIGNIFICANT

COMMENTS: Produces root exudates that inhibit its own seedlings as well as the seedlings of other early invading species (Parenti and Rice 1969). It is an annual (FNA 2003).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: A number of herbicides can control *Digitaria sanguinalis* but they may impact native herbaceous and woody vegetation (Judge et al. 2005).

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20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: A significant weed of agricultural and horticultual crops, especially turfgrass (Kim et al. 2002). A troublesome weed in lawns and cultivated ground (Hitchcock 1951). Classified as a noxious weed in Nevada and New Hampshire (J. Kartesz, unpublished data). Assumption is accessibility problems are not severe or substantial.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Dipsacus fullonum

ELEMENT NATIONAL ID: 217301
SCIENTIFIC NAME: *Dipsacus fullonum*
COMMON NAME:
I-RANK REVIEW DATE: 2006-06-13
EVALUATOR: Fellows, M., rev. K. Gravuer

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:
Dipsacus fullonum is known from throughout most of the US, primarily from roadside habitats. It can also invade natural areas, in habitats such as grasslands, savannas, forest edges, riparian habitats and wet meadows. This species can form large, often dense monocultures that significantly alter the composition and structure of native communities. Recently noted to be spreading rapidly throughout much of its invaded range, which may be linked to the expansion of the interstate highway system, an important long-distance dispersal corridor.

SUBRANK I - ECOLOGICAL IMPACT:	Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Low

OTHER CONSIDERATIONS:
Hybridizes with *Dipsacus laciniatus* (Gleason and Cronquist 1991). Discussion of synonymy from Rector et al. (2006): There has been some confusion over the synonomy of teasel species. Common teasel has frequently been called *D. sylvestris* (Huds.) rather than *D. fullonum*, particularly in the North American literature. In addition, those who refer to common teasel as *D. sylvestris* have sometimes used *D. fullonum* as the name for cultivated (or "Fuller's") teasel, which is otherwise known as *D. sativus*. A detailed discussion of this taxonomic issue by Ferguson and Brizicky (1965) concluded that the most appropriate name for common teasel is *D. fullonum*. The Weed Science Society of America refers to common teasel as *D. fullonum*, cutleaf teasel as *D. laciniatus*, and cultivated teasel as *D. sativus* (WSSA, 2005), and we use this nomenclature.

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Temperate Asia, northern Africa and Europe (Weber 2003).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS: This species is a non-native that has established outside cultivation (Kartesz 1999).

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S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Occurs in grasslands, savannas, forest edges, riparian habitats and wet meadows (Weber 2003), as well as waste places and roadsides (Strausbaugh and Core 1978). Established at the Indiana Dunes National Lakeshore (APRS 2001).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

D - INSIGNIFICANT

COMMENTS: This species has probably been present in North America since the 1700s (Smith 2004). Despite being present for over 200 years and widespread, no reports of impacts on ecosystem processes or system-wide parameters were found. Therefore, assume impacts insignificant.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B - MODERATE SIGNIFICANCE

COMMENTS: Dense leaves shade out other vegetation (Weber 2003).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B - MODERATE SIGNIFICANCE

COMMENTS: Can form monospecific colonies (Weber 2003; Smith 2004).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C - LOW SIGNIFICANCE

COMMENTS: In a limestone fen in Warren County, New Jersey, *Dipsacus* species have eliminated the habitat for several state listed endangered plant species including spreading globe flower (*Trollius laxus*) and sessile water speedwell (*Veronica catenata*) (Snyder and Kaufman 2004).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B - MODERATE SIGNIFICANCE

COMMENTS: Known from roadsides, meadows, high quality prairies, savannas, steppes, sedge meadows, waste areas, and disturbed sites (Strausbaugh and Core 1978; Smith 2004).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Occurs throughout the US, with the exception of the southeast (Texas to Florida) and the northern mid-west (North Dakota and Minnesota) (Kartesz 1999). Occurrence by county is sporadic (NRCS 2004), but over a very great area, so it is inferred that the range is greater than 1/3 of the U.S.

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7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Appears to be of concern in the Great Lakes/upper Midwest states (WI, MI, IL) (Glass 1990, Czarapata 2005), the Pacific coast states (Swearingen 2006), MO (Smith 2004), and NJ (Snyder and Kaufman 2004). Although most populations are found in disturbed areas, it appears to be invading more natural habitats in at least these states.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Inferrred from current range (Kartesz 1999; NRCS 2004) and the TNC Ecoregion map (2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Waste places and roadsides (Strausbaugh and Core 1978), grasslands, savannas, forest edges, riparian habitats and wet meadows (Weber 2003).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: *Dipsacus fullonum* has been rapidly spreading west and south in the last 20-30 years (Smith 2004) and it is inferred that expansion will continue.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Inferred from current range (Kartesz 1999; NRCS 2004).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Seeds dispersed by water in the native habitat (Weber 2003). Seeds are probably dispersed by vehicles traveling on the interstates (Smith 2004).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Quickly spreads in prairies and savannas (Smith 2004).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: Can germinate in vegetated areas, but under narrow conditions (APRS 2001).

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15. SIMILAR HABITATS INVADED ELSEWHERE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Known from similar habitats in Canada (Kartesz 1999), southern Africa, South America, Australia and New Zealand (Weber 2003). In Australia, it also invades saline and subsaline wetlands (Victoria Department of Primary Industries 2006), to which it does not yet appear to have spread in the US.

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: Large number of seeds (Weber 2003). It may resprout from roots or stumps (APRS 2001).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Prevention of seed production either by cutting or herbicides (Weber 2003). It may resprout (APRS 2001), so repeated treatments may be needed. Effective control is acheivable, though there is greater success if control is initiated before a serious infestion occurs (Smith 2004).

18. MINIMUM TIME COMMITMENT

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Repeat control treatments will be needed, as young plants are cryptic. But there does not appear to be a long-lived seed bank (APRS 2001) or only up to 2 years (Smith 2004). Control may take up to 6 years (Smith 2004).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Digging up large roots may impact native plants and foliar herbicides must be used with care (Smith 2004).

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Most populations are found in disturbed areas, which should be accessible. However, the limited horticultural use of this species may mean that a few populations are located on private lands.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Dipsacus laciniatus

ELEMENT NATIONAL ID: 224383
SCIENTIFIC NAME: *Dipsacus laciniatus*
COMMON NAME:
I-RANK REVIEW DATE: 2006-06-12
EVALUATOR: Gravuer, K.

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:

Dipsacus laciniatus is a Eurasian monocarpic perennial that is established in the mid-Atlantic states, the Great Lakes states, the central Midwest, and at one location in Oregon. It is apparently somewhat rare and scattered in the mid-Atlantic and Midwestern states and more common in the Great Lakes states. Although it most commonly occurs in open, disturbed habitats, it also invades high-quality prairies, savannas, wet meadows, and woodland openings. This species can form large, often dense monocultures that significantly alter the composition and structure of these native communities. This species has been established in the US at least since the late 1800s, but had recently been noted to be spreading rapidly throughout much of its invaded range. Some sources link this recent rapid spread to the expansion of the interstate highway system, an important long-distance dispersal corridor. Management can be achieved through mechanical or chemical means, but often takes several years and is complicated by this species' ability to resprout.

SUBRANK I - ECOLOGICAL IMPACT:	Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Low

OTHER CONSIDERATIONS:

Hybridizes with *Dipsacus fullonum* (Gleason and Cronquist 1991).

NON-NATIVE THROUGHOUT NATION

NATIVE RANGE: Native to Europe and temperate Asia, including Austria, Czechoslovakia, Germany, Hungary, Poland, Switzerland, Moldova, Ukraine (including Krym), Albania, Bulgaria, Greece, Italy, Romania, Yugoslavia, France, Iran, northern Iraq, Israel, Lebanon, Syria, Turkey, Armenia, Azerbaijan, Georgia, Russian Federation (Ciscaucasia), Kyrgyzstan, Tajikistan, and Turkmenistan (USDA-ARS 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

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S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Most commonly occurs in open, disturbed habitats (e.g. waste places, cemeteries, pastures), roadsides, and railroads. However, it also invades high-quality prairies and other unmanaged grasslands; savannas; woodland openings; wet meadows, seeps, and limestone fens; and riparian meadows (Glass 1990, Voss 1996, OHDNAP 2001, Gremaud and Smith 2002, IPAW 2003, Weber 2003, Smith 2004, Snyder and Kaufman 2004, WIDNR 2004, Czarapata 2005, Wisconsin State Herbarium 2006, Hilty 2006).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

D - INSIGNIFICANT

COMMENTS: This species has been established in North America since at least the late 1800s and probably earlier (Seymour 1989, Voss 1996). Despite being present for over 100 years, no reports of impacts on ecosystem processes or system-wide parameters were found. Therefore, assume impacts insignificant.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B - MODERATE SIGNIFICANCE

COMMENTS: This species has been noted to form large, often dense monocultures that exclude native vegetation (Glass 1990, Gremaud and Smith 2002, IPAW 2003, Weber 2003, Smith 2004, WIDNR 2004, Czarapata 2005, Tenaglia 2006). These monocultures are likely to be different in cover and/or density compared to the replaced native stand. In addition, this species can be quite tall (2-3 m), such that monocultures may be taller than the replaced native stand as well. In New Jersey, Snyder and Kaufman (2004) note that "teasels significantly alter the structure of rare natural plant communities".

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B - MODERATE SIGNIFICANCE

COMMENTS: Several sources noted that this species is capable of replacing native vegetation (Glass 1990, Gremaud and Smith 2002, Weber 2003, Smith 2004, Snyder and Kaufman 2004, WIDNR 2004, Czarapata 2005, Tenaglia 2006). Its large rosette leaves are thought to aid it in preventing native species from persisting or establishing (Snyder and Kaufman 2004). This species is thought to be even more aggressive than its more widespread congener, *D. fullonum*.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C - LOW SIGNIFICANCE

COMMENTS: In a limestone fen in Warren County, New Jersey, *Dipsacus* species have eliminated the habitat for several state listed endangered plant species including spreading globe flower (*Trollius laxus*) and sessile water speedwell (*Veronica catenata*) (Snyder and Kaufman 2004).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B - MODERATE SIGNIFICANCE

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COMMENTS: Although it is most often found in disturbed habitats, this species also threatens high-quality examples of prairie communities, as well as savannas and wet meadows (Glass 1990, Weber 2003, Smith 2004, Snyder and Kaufman 2004, WIDNR 2004, Czarapata 2005, Hilty 2006). It has been noted as a severe threat to several Midwestern natural areas (Glass 1990, Smith 2004, Czarapata 2005). In a limestone fen in Warren County, New Jersey, *Dipsacus* species have eliminated the habitat for several state listed endangered plant species including spreading globe flower (*Trollius laxus*) and sessile water speedwell (*Veronica catenata*) (Snyder and Kaufman 2004).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Occurs in the mid-Atlantic states (north to NY and MA, south to VA and KY), the Great Lakes states, and the central Midwest (IA, MO, NE, KS, and around Denver, CO) (Kartesz 1999). Also found at one location in Oregon (Rice 2006). It is apparently somewhat rare and scattered in the mid-Atlantic and Midwestern states (Great Plains Flora Association 1986, Gleason and Cronquist 1991) and more common in the Great Lakes states (Czarapata 2005, Hilty 2006).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Appears to be of greatest concern in the Great Lakes/upper Midwest states (WI, MI, IL) (Glass 1990, Czarapata 2005, Swearingen 2006, Wisconsin State Herbarium 2006) and well as in MO (Smith 2004) and NJ (Snyder and Kaufman 2004). Although most populations are found in disturbed areas, it appears to be invading more natural habitats in at least these states.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: Approximately 21 ecoregions are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: This species has a strong preference for open (full sun) conditions and can grow in a variety of soil moisture regimes (wet to dry), but strongly prefers mesic, fertile soils (Glass 1990, OHDNAP 2001, WIDNR 2004, Czarapata 2005, Hilty 2006, Whitinger 2006). Apparently, it also has some tolerance of saline conditions (OHDNAP 2001). Most commonly occurs in open, disturbed habitats (e.g. waste places, cemeteries, pastures), roadsides, and railroads. However, it also invades high-quality prairies and other unmanaged grasslands; savannas; woodland openings; wet meadows, seeps, and limestone fens; and riparian meadows (Glass 1990, Voss 1996, OHDNAP 2001, Gremaud and Smith 2002, IPAW 2003, Weber 2003, Smith 2004, Snyder and Kaufman 2004, WIDNR 2004, Czarapata 2005, Wisconsin State Herbarium 2006, Hilty 2006).

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SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This species is spreading westward; it was recently detected it the Denver area in Colorado (Weber and Wittman 1996) and in Jackson County, Oregon (Rice 2006). A number of sources also noted rapid spread in the recent past (Czarapata 2005, Rector et al. 2006; MI: Voss 1996; WI: IPAW 2003, WIDNR 2004; MO: Gremaud and Smith 2002, Tenaglia 2006; IL: Hilty 2006). It is thought that construction of the interstate highway system has aided the rapid spread of this species (Glass 1990, Smith 2004), which has been established in the United States for some time (at least since the late 1800s; Seymour 1989, Voss 1996) but has apparently only recently begun to spread rapidly.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: This species is hardy to USDA zone 5a (Whitinger 2006). Based on the areas it already occupies, a significant climatically suitable area of the US remains available for invasion.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Most seeds fall near the parent plant (Glass 1990, Smith 2004, WIDNR 2004, Rector et al. 2006), although the potential for water dispersal of seeds has frequently been noted (Glass 1990, Weber 2003, Smith 2004, WIDNR 2004, Rector et al. 2006). The interstate highway system is thought to be associated with increased opportunity for long-distance dispersal of this species. It flourishes along highway rights-of-way, where the creation of wind corridors and the presence of mowing management both serve to significantly increase long-distance dispersal opportunities (Gremaud and Smith 2002, Musser and Parrish 2002, Snyder and Kaufman 2004, WIDNR 2004, Parrish et al. 2005). This species is also occasionally sold as a horticultural plant, and is particularly frequent in dried flower arrangements, which afford it establishment opportunities in cemetery areas (Gremaud and Smith 2002, Snyder and Kaufman 2004, WIDNR 2004, Czarapata 2005, USDA-ARS 2005).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A - HIGH SIGNIFICANCE

COMMENTS: A number of sources noted rapid local spread and increase in the recent past (Glass 1990, Smith 2004, Czarapata 2005, Rector et al. 2006; MI: Voss 1996; WI: IPAW 2003, WIDNR 2004; MO: Gremaud and Smith 2002, Tenaglia 2006; IL: Hilty 2006). This species has been established in the United States for some time (at least since the late 1800s; Seymour 1989, Voss 1996) but has apparently only recently begun to spread rapidly.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Although it is most often found in disturbed habitats and seems to require full sun, this species can apparently invade mature stands of open vegetation, such as high-quality prairies and sedge meadows (WIDNR 2004, Czarapata 2005, Hilty 2006). It has also shown its ability to displace the anthropogenic analogues of these habitats, such as thick fescue stands (Gremaud and Smith 2002).

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15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Also established in Ontario, Canada (Kartesz 1999), where it appears to invade similar habitats (Scoggan 1978).

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: A single plant is capable of producing 2000-3000 seeds (Glass 1990, OHDNAP 2001, Smith 2004, Snyder and Kaufman 2004, Czarapata 2005). Seeds remain viable in the soil for at least 2 years (Glass 1990, OHDNAP 2001, Smith 2004, WIDNR 2004, Czarapata 2005). In addition, immature seed heads are capable of producing viable seed (Glass 1990, WIDNR 2004). Plants will resprout when cut, except if cutting is done just after plants begin to flower (Glass 1990, Smith 2004).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: The Invasive Plant Association of Wisconsin (IPAW) regards this species as relatively difficult to control (IPAW 2003). Mechanical control is recommended in natural areas. In small stands, rosettes can be dug up, although plants often resprout if the root is not completely removed and damage to the surrounding area can occur if plants are large. Stalks can also be cut once flowering has begun, but before seed set. Because seeds can develop on immature heads, however, the cut stalks need to be removed from the area. Also, cutting of flowering stems may need to be repeated for several years to achieve effective control. Mowing is not an effective control, and in fact often increases the size of patches (Parrish et al. 2005). If mechanical control is not feasible, foliar application of herbicides can be used. Because rosettes of this species are green in early spring and late fall when many native plants are dormant, herbicide control during these times will minimize damage to native species. Also, dicot-selective herbicides (e.g. Triclopyr) are effective, which reduces damage to native monocots. As with mechanical control, however, herbicide applications over several years are required to manage an established population. Periodic prescribed burning may be helpful in conjunction with mechanical and/or chemical control (Glass 1990, Weber 2003, Smith 2004, WIDNR 2004, Czarapata 2005). No biocontrol agents are currently in use, but these are being researched (Rector et al. 2006).

18. MINIMUM TIME COMMITMENT

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Several years (up to 5-6) of treatment may be necessary to totally eradicate this species from a natural community, regardless of whether mechanical or chemical treatment is chosen (Glass 1990, Gremaud and Smith 2002, Smith 2004, WIDNR 2004, Czarapata 2005).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

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COMMENTS: If rosettes are dug up, damage to the surrounding area can occur if plants are large. If flowering stems are cut, native species of similar height may also be cut in the process. If herbicides are used, non-target damage may occur, though this can be minimized by spraying during the dormant season and/or using a dicot-specific herbicide (Glass 1990, Weber 2003, Smith 2004, WIDNR 2004, Czarapata 2005).

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Most populations are found in disturbed areas, which should be accessible. However, the limited horticultural use of this species may mean that a few populations are located on private lands.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Duchesnea indica

ELEMENT NATIONAL ID: 226498
SCIENTIFIC NAME: *Duchesnea indica*
COMMON NAME:
I-RANK REVIEW DATE: 2005-12-27
EVALUATOR: Gravuer, K.

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:

An herbaceous perennial ground cover species native to Asia, *Duchesnea indica* has become well-established in the mid-Atlantic and southeastern states, with scattered establishment to the north and west of this area as well as in the west coast states. It is commercially available as a ground cover for landscaping and sometimes escapes into native habitats. It predominantly invades disturbed open areas, but is shade-tolerant and is also frequently found in woodland and woodland edges, and is rarely found in more intact habitats such as rockhouses and native prairies. Impacts include formation of a dense ground cover, which can be especially problematic for small native perennials. Management by pulling or herbicide is relatively straightforward.

SUBRANK I - ECOLOGICAL IMPACT:	Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low

NON-NATIVE THROUGHOUT NATION

NATIVE RANGE: Native to temperate and tropical Asia, including Afghanistan, China (Liaoning), Taiwan, Japan, Korea, Bhutan, India, Nepal, Pakistan, Laos, Thailand, Vietnam, Indonesia (Java, Lesser Sunda Islands), and the Philippines (GRIN 2001).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Predominantly invades disturbed, open areas, including waste places, fields, pastures, lawns, and roadsides (Correll and Johnston 1970, Gleason and Cronquist 1991, Weakley 2005). Also invades woodlands, often in alluvial situations, as well as woodland edges and old fields (Hough 1983, Rhoads and Block 2000). Single sources listed additional habitats, including prairies (Steyermark 1963), rockhouses (Knouse 2005), and seepage areas/marshes (Correll and Johnston 1970).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

D - INSIGNIFICANT

COMMENTS: No reports of impacts on ecosystem processes or system-wide parameters were found, and none are suggested given the invaded habitats and the form and behavior of the species. Therefore, assume impacts insignificant.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

COMMENTS: Can form a ground cover that has greater density than that formed by native ground cover species (e.g. *Fragaria* sp.; Weigelt et al. 2004). An increase in ground cover density may impact successional processes.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C - LOW SIGNIFICANCE

COMMENTS: A number of sources noted that this species can overrun or drown out smaller perennials (Plants for a Future 2001, Saylor 2003, Moore and Dolan 2005). It was described as an aggressively spreading ground cover (Saylor 2003, Hilty 2005) that can from a dense carpet (Weigelt et al. 2004). A dense, pervasive ground cover may impact successional processes.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: In Germany, it was felt that this species exhibited the potential risk of replacing the native *Fragaria*, based on its vigorous growth and rapid spread (Weigelt et al. 2004). Potentially, the species could also threaten *Fragaria* species native to the U.S.; however, no published reports were found to confirm this.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C - LOW SIGNIFICANCE

COMMENTS: The majority of sources indicated that this species is found in disturbed, open areas. However, according to Knouse (2005), in Ohio this species often becomes a significant problem in rockhouses (shallow caves) and other marginal habitats where it may crowd out more desirable native species. Rockhouse habitats often harbor rare taxa.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

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COMMENTS: Appears best established in the mid-Atlantic and southeastern states, from PA west to IL and e. TX, south to n. FL. Also scattered establishment to the north in NY, CT, MI, and WI, as well as to the west in IA, MO, NE, KS, OK, and w. TX. Scattered establishment in the west coast states as well, throughout WA, OR, and CA. Generalized range includes approximately 30-50% of the region of interest (Kartesz 1999).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: One focus of impact for this species appears to be the mid-Atlantic states and states immediately to the west (OH, KY, IN) (Thompson 1999, Knouse 2005, MDNR 2004, Moore and Dolan 2005, NJDEP 2004, Swearingen 2005). In addition, it has been listed as invasive in the central southwest/gulf coast region and appears to be widespread there. In the upper Midwest, the plains states, and the Pacific northwest, establishment appears scattered and impacts minimal (e.g. Wisconsin State Herbarium 2005).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Approximately 30-40 ecoregions are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: This species prefers moist, well-drained soil in partial shade, although it can also grow in full sun or full shade (Faucon 2005, Hilty 2005, Whitinger 2005). Predominantly invades disturbed, open areas, including waste places, fields, pastures, lawns, and roadsides (Correll and Johnston 1970, Gleason and Cronquist 1991, Weakley 2005). Also invades woodlands, often in alluvial situations, as well as woodland edges and old fields (Hough 1983, Rhoads and Block 2000). Single sources listed additional habitats, including prairies (Steyermark 1963), rockhouses (Knouse 2005), and seepage areas/marshes (Correll and Johnston 1970).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Range apparently undergoing some expansion (NWF 2005), but rapid expansion was not mentioned by any of the sources consulted.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Apparently hardy between zones 5 and 10 (Saylor 2003). Lack of cold tolerance will probably therefore restrict this species from spreading to MN, ND, SD, MT, ID, and WY, while the southern parts of FL, AZ, and CA may be too warm. While western states such as UT and CO appear at least somewhat suitable in terms of temperature, the climate over much of these areas may be too arid for this species to flourish, as it prefers moist soil. There appears to be potential for local expansion in some of the states where it currently exhibits scattered establishment, however.

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12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This species is relatively available commercially, predominantly for use as a ground cover, although it is also used for bed edging, hanging baskets, and pots (Saylor 2003, Whitinger 2005). Birds are thought to disperse the seeds (Knouse 2005).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Suspected to be undergoing local spread in IL (Hilty 2005) and appears to be doing the same in IN, where occurrence in only 4 counties was reported in 1940 but is nearly ubiquitous currently (Deam 1940, Moore and Dolan 2005). Also suspected to be spreading generally (NWF 2005).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: Appears to invade relatively intact woodland habitats, although these sometimes have naturally open canopies (Hough 1983, Rhoads and Block 2000). However, the species is also known to be shade-tolerant (e.g. Faucon 2005). Possession of runners probably also enables the species to spread into less-disturbed areas from footholds in more easily-invaded environments.

15. SIMILAR HABITATS INVADED ELSEWHERE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Widely naturalized outside the United States, including Canada, Mexico, Argentina, Bolivia, Colombia, Ecuador, Peru, Chile, parts of Europe, New Zealand, Australia, and South Africa (Kartesz 1999, Randall 2002). Appears to invade mostly similar habitats.

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: This species reproduces by both seeds and stolons (Muenscher 1955, Thompson 1999), which spread quickly and may root at the nodes (Plants for a Future 2001). Fragments appear capable of establishing new plants, but it is unclear how often fragmentation and fragment dispersal occurs. This species is also tolerant of mowing (Hilty 2005).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

C - LOW SIGNIFICANCE

COMMENTS: Control does not appear particularly difficult. Mechanical control appears to be the preferred method, although this must be accomplished by pulling or raking since the species is low-growing and tolerant of mowing (Muenscher 1955, Hilty 2005). Mechanical control will be most successful with small plants on moist soils. Alternatively, plants can be spot-treated with a broad-leaf herbicide (Thompson 1999).

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18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS: If all crowns are not removed during the first treatment, follow-up will be required (Thompson 1999).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Damage from pulling or raking should be relatively minor, but if the infestation is large and a general broad-leaf herbicide is required, impacts will be more significant.

20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: The invaded habitats do not appear to pose major access problems. However, the fact that many infestations start as garden escapes may mean that some target areas are privately-owned.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Elymus repens

ELEMENT NATIONAL ID: 220337
SCIENTIFIC NAME: *Elymus repens*
COMMON NAME: Creeping Wild Rye
I-RANK REVIEW DATE: 2006-06-27
EVALUATOR: J. Cordeiro, rev. K. Gravuer

I-RANK: High/Medium

I-RANK REASONS SUMMARY:
This species is widespread occurring in nearly every U.S. state but local expansion is still occurring particularly in the western states. Negative impacts are significant as this species has the potential to form dense, monospecific stands, and aggressive rhizomes can outcompete native grasses suppressing growth and reproductive vigor. The species has moderate invasive capability into native habitats and is difficult, costly, and time consuming to control, often negatively affecting native species during management efforts.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Medium

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Elymus repens is native to Eurasia (temperate Europe and Central Asia: Afghanistan, India, Pakistan), but can be found in parts of South America (Argentina and Chile) and in Australia, New Zealand, and Indonesia (Batcher, 2002).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: The species is widely distributed as an invasive across North America and is especially invasive in grass prairie and/or wetlands of western North America (Batcher, 2002).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: The species is widely distributed as an invasive across North America and is especially invasive in grass prairie and/or wetlands of western North America (Batcher, 2002).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C - LOW SIGNIFICANCE

COMMENTS: Quackgrass consumes soil moisture and key nutrients (N, P, K) which it removes from the soil during the growing season with possible potential to change ecosystem dynamics (Batcher, 2002).

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B - MODERATE SIGNIFICANCE

COMMENTS: Dense occurrences can exclude the regeneration of native woody species where it forms dense stands (Batcher, 2002).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: *Elymus repens* can form extensive rhizomes that enable it to compete strongly with native grasses and forbs in prairies and grasslands. Once established, it can outcompete and exclude native vegetation resulting in loss of overall biodiversity. As a cool-season grass that can photosynthesize and grow during early spring before other grasses, *E. repens* can suppress species that grow during the later, warmer part of the growing season (Batcher, 2002). Quackgrass has been listed among the 10 most frequently listed in a recently compiled database of noxious weeds in the United States and Canada (Skinner et al., 2000).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C - LOW SIGNIFICANCE

COMMENTS: *Elymus repens* has been shown to produce ethylacetate extracts (phototoxins) exuded from shoots and roots which may be allelopathic and can suppress growth or reproductive vigor of competing plant species (Batcher, 2002).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Habitat includes natural terrestrial grassland communities, mixed-grass prairies, open woodlands, wet prairies and riparian corridors (Batcher, 2002; Czarapata, 2005).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: This species is found in every state in the U.S. and in Canada from Newfoundland to British Columbia and North to the Yukon (Werner and Rioux, 1977). Quackgrass has been listed among the most frequently listed in a recently compiled database of noxious weeds in the United States and Canada (Skinner et al., 2000).

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7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This species is considered invasive throughout North America but particularly so in western North America where it invades wet meadows, wetland borders and other low-lying wet areas of grasslands and prairies (Batcher, 2002). Quackgrass has been listed among the most frequently listed in a recently compiled database of noxious weeds in the United States and Canada (Skinner et al., 2000).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: It is conservatively estimated that over the vast majority of ecoregions have been invaded by *Elymus repens* in the United States (Cordeiro, pers. obs., April 2006, based on TNC, 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Habitat includes natural terrestrial grassland communities as well as in agricultural fields in temperate North America. It is found primarily in open areas with moderate to high nutrient levels. Such areas may include mixed-grass prairies and open woodlands, as well as wet prairies or riparian corridors (Batcher, 2002; Czarapata, 2005).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: Already established throughout most of the US and restricted from the southeastern states where not yet established by low tolerance of hot summers. This species is considered invasive throughout North America but particularly so in western North America where it invades wet meadows, wetland borders and other low-lying wet areas of grasslands and prairies (Batcher, 2002). Quackgrass has been listed among the most frequently listed in a recently compiled database of noxious weeds in the United States and Canada (Skinner et al., 2000).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: This species is found in every state in the U.S. and in Canada from Newfoundland to British Columbia and North to the Yukon (Werner and Rioux, 1977). Quackgrass has been listed among the most frequently listed in a recently compiled database of noxious weeds in the United States and Canada (Skinner et al., 2000). Potential is still high for expansion into native grassland areas that have not yet been impacted, but total range cannot expand much beyond where it already occurs because it is so widespread.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B - MODERATE SIGNIFICANCE

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COMMENTS: Seed dispersal mechanisms are largely unknown but the species is wind-pollinated and may also, therefore, be wind dispersed (Werner and Rioux, 1977). It has been spread anthropogenically through planting for nutrient reclamation from sewage effluent sprayed on fields and planting to revegetate mine tailings in Nova Scotia (not in U.S.). (Werner and Rioux, 1977). Also, many hybrid crosses have been developed and planted for livestock (Batcher, 2002).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: This species is considered invasive throughout North America but particularly so in western North America where it invades wet meadows, wetland borders and other low-lying wet areas of grasslands and prairies (Batcher, 2002).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: This species is listed as an "invasive plant of lesser concern" in Czarapata (2005). The species is early successional (giving it an advantage as a colonizer over native grasses), has vigorous vegetative reproduction, and is tolerant of a variety of soil types, including saline conditions, but is intolerant of shade (moderately adaptable) (Batcher, 2002; Czarapata, 2005). Although it is found primarily in open areas with moderate to high nutrient levels (often agricultural), such areas may include mixed-grass prairies and open woodlands, as well as wet prairies or riparian corridors (Batcher, 2002).

15. SIMILAR HABITATS INVADED ELSEWHERE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS:

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: This species spreads by both seeds and extensively creeping rhizomes and its long running rootstocks extend through the soil and send up numerous shoots, forming a loose but tough sod. It is wind pollinated and self-sterile with seed production generally at 25 to 40 per plant but ranging from 15 up to 400 seeds per culm. Alternating temperatures are required for germination (diurnal) and there is no after-ripening period. Seeds may remain dormant in soil for 2 to 3 years (Czarapata, 2005 cites 4 years) and can remain viable after passage through the domestic systems of domestic animals (Batcher, 2002). Vegetative reproduction is more important than seed reproduction (Werner and Rioux, 1977).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/B - HIGH/MODERATE SIGNIFICANCE

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COMMENTS: This species is notoriously one of the most difficult weeds to control especially in cultivated fields. Because it is an early successional species, declines in abundance may occur with time with no active management as a grassland matures but as yet there have been no large abundance decreases or eradications with passive management. Contrary to what might be expected, cutting to manage reed beds has been found to result in a more diverse fauna than for unmanaged reed beds, except in the case with *Elymus repens* which seems to benefit from passive management in the United Kingdom (Cowie et al., 1992). In natural areas or wildlands, the application of selective herbicides (see Batcher, 2002, and Ivany, 2002, for herbicide summaries) can reduce populations of desirable native grasses but success for restoration of large scale infestations is probably low to moderately low unless the infested area is tilled, treated with herbicide, and reseeded (Batcher, 2002). Zero tillage herbicide application was found to be ineffective in reducing *E. repens* significantly (Harker and O'Sullivan, 1993). Burning alone has also met with little success (Batcher, 2002) and has even caused a doubling in both cover and frequency following burning (Stohlgren et al., 1999; Rice, 2005). Becker (1989 cited in Rice, 2005) found that the optimal timing for repeat burning (over five years) to suppress Kentucky bluegrass did not reduce quackgrass (*Agropyron repens*) canopy cover in southwest Minnesota because of the relatively later tiller elongation of the quackgrass. May burns producing ground surface temperatures of 248 to 617°F (120 to 325°C) were conducted in Kentucky bluegrass and quackgrass-dominated residential acquisitions at the Indiana Dunes National Lakeshore (Choi and Pavlovic, 1994). The burns did not decrease the targets on these exotic-grass-dominated sites.

18. MINIMUM TIME COMMITMENT

B - MODERATE SIGNIFICANCE

COMMENTS: This species is notoriously one of the most difficult weeds to control especially in cultivated fields. Although no method is adequately successful at controlling this species, herbicide application in combination with tilling or burning on a biennial schedule over several years may reduce abundance (Batcher, 2002; Ivany, 2002).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B - MODERATE SIGNIFICANCE

COMMENTS: In managing formerly arable land that has been abandoned to natural grassland establishment, sowing a seed mixture (as opposed to letting grasses naturally grow) has been found to significantly reduce abundance and number of naturally colonizing grassy weed species, including *Elymus repens* in Scotland (Lawson et al., 2004). In natural areas or wildlands, the application of selective herbicides can reduce populations of desirable native grasses but success for restoration of large scale infestations is probably low to moderately low unless the infested area is tilled, treated with herbicide, and reseeded (Batcher, 2002). Unfortunately, tillage or burning is likely not an option in conservation areas or areas with species of conservation concern, and application of herbicides alone has been largely unsuccessful. Potential for control exists, but has not been explored, through fungal pathogens as quickgrass is infected by crown rust (*Puccinia coronata*) throughout North America, as well as in its native range in Eurasia (Torchin and Mitchell, 2004).

20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: As this species frequently occurs on private land, particularly grasslands, some access issues will arise and cooperation with landownders for management will be necessary.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Emex spinosa

ELEMENT NATIONAL ID: 244866
SCIENTIFIC NAME: *Emex spinosa*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-18
EVALUATOR: Oliver, L.

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:

Emex spinosa, Spiny Threecornerjack, is similar to *E. australis*, the latter being a major crop weed in Australia. *E. spinosa* is known from only a few states in the US, including New Jersey, Massachusetts, Florida, Texas, California and Hawaii. It is unclear whether this species is still present in New Jersey and Florida. It is of most concern in southern California where it is spreading locally in areas where it's never been documented before. It is encroaching on the habitat of at least 2 endangered species, *Lotus nattallianus* and the California Least tern. In other states, this species occurs in waste places, and in California it occurs in naturally disturbed places, like beaches and other coastal habitats. Unfortunately, this species does have very spiny seeds which stick easily to shoes, feathers, fur, vehicles tires, so it is easily transported. This species is controlled in Hawaii by an introduced weevil. While this species isn't causing enormous damage to natural habitats currently, it does appear to be spreading, at least locally, and should be monitored.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Insignificant
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	Unknown

NON-NATIVE THROUGHOUT NATION

NATIVE RANGE: Emex spinosa is native to Africa (Macronesia and North Africa), western Asia, and parts of Europe (Greece, Italy, France, Portugal and Spain) (GRIN).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: The Spiny threecornerjack is established as a non-native in the United States in California, Hawaii and Texas. It has also been reported in Florida, New Jersey and Massachusetts, however, it isn't clear if the species is extant in those states. Kartesz (1999) reports E. spinosa from CA, TX, HI, NJ, and MA.

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Most of the places where this species occurs in the United States are disturbed waste places, however, in California this species has been documented to invade coastal and dune habitats (CAL-IPC 2006, Brusati and DiTomaso 2003).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

U - UNKNOWN

COMMENTS: It is unknown what effects on abiotic processes this species has. Considering that it is known mainly from waste places in Hawaii (Buriscati and diTomaso 2003) and in naturally disturbed habitats, such as beaches, in California (CAL-IPC 2006, Buriscati and diTomaso 2003) it may have little or insignifcant effects on natural ecosystem processes.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

COMMENTS: *Emex spinosa* influences the structure of one vegetation layer, the herb layer.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: While only documented for one location as such, this species has carpeted an area in Lichty Mesa, California and if left unchecked it will it will crowd all other species (Buriscati and diTomaso 2003). While this is only one location in the United States, it does demonstrate the potential this species has to infiltrate and spread in beach and coastal habitats.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No information was found indicating that this species significantly impacts one native species more than any other native species.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B - MODERATE SIGNIFICANCE

COMMENTS: *Emex spinosa* has been reported to reduce the population size of the rare *Lotus nuttallianus* and further, it has also impacted the nesting sites of the California least tern (Brusati and DiTomaso 2003).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

D - INSIGNIFICANT

COMMENTS: This species is known from only a small area in the United States. It is known from one collection in Florida (Garland 2004), one instance in New Jersey (Synder and Kaufman 2004), Hawaii (Kartesz 1999), several locations in southern California (CAL-IPC 2006) and Texas (Kartesz 1999).

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7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

D - INSIGNIFICANT

COMMENTS: The area where this species is negatively impacting biodiversity is small, and in only southern California (CAL-IPC 2006, Brusati and DiTomaso 2003) at present. It shoud be mentioned, however, that this species does appear to be aggressively in a few locations in southern California (Brusati and DiTomaso 2003).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

D - INSIGNIFICANT

COMMENTS: The Spiny threecornerjack is known mainly from the South Coast physiographic province in California (Hickman et al. 1993). It isn't clear which other biogeographic units this species occurs in in Texas, which is the only other state where is species may be extant. In Hawaii, this species is known from disturbed areas (Brusati and DiTomaso 2003).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: The Spiny threecornerjack occurs in coastal and beach habitats and also in grasslands (CAL-IPC 2006, Federal Noxious Weeds Disseminules of the U.S.).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: The range of this species in the United States at present (2006), is not broad, occurring in only a few states and within those states in only a few locations. This species does seem to be expanding in southern California where it is documented from Orange Co. (Brusati and DiTomaso 2003), San Diego (Brusati and DiTomaso 2003 and the NY Botanical Garden Online Herbarium), and Riverside Co. (NY Botanical Garden Online Herbarium).
Further, it should be noted that while this species may not be showing a drastic invasion in the United States, it is hypothesized that global warming may be influencing species with a similar attributes to spread into countries where they have not been recorded previously. There have been reports of range extensions of Meditteranean thermophilous plants, such as *E. spinosa*, which normally occur in North Africa, into Corsica where they were not known previously (Mytilini 2000).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: *E. spinosa,* or Spiny threecornerjack, is presently known from waste places, beach, coastal and grassland communities (Federal Noxious Weed Disseminules of the U.S., CAL-IPC 2006).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B - MODERATE SIGNIFICANCE

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COMMENTS: The seeds of this species are transported by wind, animals and human activities, including adhereing to vehicle tires (APHIS). More specifically, in California it is noted that this species might be spread by border patrol activities (dirt smoothing) and it is also noted that the 'spiny seeds stick to anything' including fur and feathers (Brusati and DiTomaso 2003). It is likely that this non-native could spread throughout the range of the California Least Tern given that *E. spinosa* has dominated the nesting sites of this bird in Mission Bay, CA.

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A - HIGH SIGNIFICANCE

COMMENTS: In southern California this species is spreading rapidly in localized areas. In Lichty Mesa, CA it is reported that this species was absent as of 2003, however, currently it is prevalent in endangered plant habitat and if left unchecked it crowds all other species. It is spreading along trails and then into undisturbed areas as well. Finally, it is also spreading rapidly in Mission Bay, CA (Brusati and DiTomaso 2003).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: This species is spreading into endangered species habitat and into undisturbed places in southern California (Brusati and DiTomaso (2003).

15. SIMILAR HABITATS INVADED ELSEWHERE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: This species is a known problem in southern Australia, but specifically which habitats it occurs in isn't clear. The other species of *Emex* which is quite problematic in Australia, '*australis*' is rapidly spreading and competes with crops and pasture (Yeoh and Scott 2006).

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: *Emex spinosa* and *E. australis*, can remain dormant in the soil for up to 7 years (Yeoh and Scott 2006). This species also blooms througout the year (Flora North America vol. 5).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: It is known that a biological control program was set into place to manage against this species in Hawaii. A weevil, *Perapion antiquum,* was used and was considered 'highly successful in controlling *Emex* in Hawaii' (Yeoh and Scott 2006). It isn't clear how expensive or how much effort was required to implement this control.

18. MINIMUM TIME COMMITMENT

U - UNKNOWN

COMMENTS:

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19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

U - UNKNOWN

COMMENTS:

20. ACCESSIBILITY OF INVADED AREAS

U - UNKNOWN

COMMENTS:

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Federal Noxious Weed Disseminules of the U.S. Emex spinosa (L.) Campdera. Accessed online at: http://www.lucidcentral.org/keys/v3/FNW/#.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Epilobium hirsutum

ELEMENT NATIONAL ID: 241263
SCIENTIFIC NAME: *Epilobium hirsutum*
COMMON NAME:
I-RANK REVIEW DATE: 2005-10-17
EVALUATOR: Gravuer, K.

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:
Epilobium hirsutum is a perennial herb that invades predominantly open, wet habitats. It is rhizomatous and has been noted to form dense monocultures which can replace native species, but its presence does not have significant effects on ecosystem processes or structure. It currently has a disjunct range in the US, with both the northeast and the Pacific northwest invaded. Future spread seems likely, as new populations can be established from ornamental plantings and the species is increasingly being used as a horticultural substitute for purple loosestrife (*Lythrum salicaria*). Also, the species' extensive native range suggests broad environmental tolerances. Management can be achieved with herbicides suitable for aquatic environments, but the persistent seedbank may require a long-term effort.

SUBRANK I - ECOLOGICAL IMPACT:	Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Low

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Native to Europe, Asia, and Africa.
Africa: Algeria, Egypt, Libya, Morocco, Tunisia, Chad, Sudan, Kenya, Tanzania, Uganda, Burundi, Rwanda, Zaire, Angola, Zambia, Lesotho, South Africa (Cape Province, Natal, Orange Free State, Transvaal), Cape Verde.
Asia: Afghanistan, Iran, Iraq, Israel, Jordan, Lebanon, Syria, Turkey, Armenia, Azerbaijan, Georgia, Russian Federation (Ciscaucasia, Dagestan, Western Siberia), Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Mongolia, China (Anhui, Gansu, Guangdong, Guizhou, Hebei, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Nei Monggol, Ningxia [s.], Shaanxi, Shandong, Shanxi, Sichuan, Xinjiang, Xizang, Yunnan, Zhejiang), Japan (Honshu), Korea, Nepal, Pakistan .
Europe: Denmark, Finland, Ireland, Norway, Sweden, United Kingdom, Austria, Belgium, Czechoslovakia, Germany, Hungary, Netherlands, Poland, Switzerland, Belarus, Estonia, Latvia, Lithuania, Russian Federation (European part), Ukraine [incl. Krym], Albania, Bulgaria, Greece [incl. Crete], Italy [incl. Sardinia, Sicily], Romania, Yugoslavia, France [incl. Corsica], Portugal, Spain [incl. Baleares, Canary Islands]. (GRIN 2001)

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SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Hairy willow-herb invades riparian areas, upland open habitats, upland partially open habitats (e.g. woodland edges), and herbaceous wetlands (Muenscher 1955, Washington State Noxious Weed Control Board 2003, Czarapata 2005, Wisconsin State Herbarium 2005).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C - LOW SIGNIFICANCE

COMMENTS: This species has been noted to form dense monotypic stands in wetland areas that can replace native species (Mehrhoff et al. 2003, Washington State Noxious Weed Control Board 2003, Czarapata 2005). If these stands differ from native populations in terms of density or vegetative cover, there is the potential for alteration of the wetland's hydrologic regime (WDOE 2003, Washington State Noxious Weed Control Board 2003).

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

COMMENTS: Predominantly invades areas already dominated by herbaceous species. However, the noted density of the stands it forms (Mehrhoff et al. 2003, Washington State Noxious Weed Control Board 2003, Czarapata 2005) may increase the density of these herbaceous communities.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B - MODERATE SIGNIFICANCE

COMMENTS: This species has been noted to form dense monotypic stands in wetland areas that can replace native species (Mehrhoff et al. 2003, Washington State Noxious Weed Control Board 2003, Czarapata 2005). It competes well with cattails (Czarapata 2005).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Although monocultures were noted to have negative impacts generally, no disproportionate impacts on particular native species were mentioned in the literature. The species with which *E. hirsutum* was reported to compete most strongly was purple loosestrife (*Lythrum salicaria*), another exotic plant (Czarapata 2005).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

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COMMENTS: The undisturbed wet meadow habitat invaded by this species is uncommon over at least some of its invaded range (e.g. Rhode Island, Miller and Golet 2000). It is also known to be problematic on at least one site owned by The Nature Conservancy (Richter 2000).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Well-established in the northeastern US, extending south to West Virginia and Kentucky and west to Illinois and Wisconsin (Kartesz 1999). Also established in Washington and Oregon since at least the 1960s. In Washington, infestations have been found in several disjunct counties and are suspected in many cases to be escapes from garden plantings (Washington State Noxious Weed Control Board 2003). Total generalized range occupies approximately 20% of continental US.

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B - MODERATE SIGNIFICANCE

COMMENTS: Hairy willow-herb has been declared a wetland/aquatic noxious weed in WA (Washington State Noxious Weed Control Board 2003). It is also considered ecologically invasive in WI (Wisconsin State Herbarium 2005, Swearingen 2005). It also appears to have negative impacts in at least some parts of New England (Mehrhoff et al. 2003, Novick 2003).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: Approximately 21 ecoregions are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Hairy willow-herb prefers open, wetland to semi-aquatic habitats. It invades riparian areas (ditches, stream banks, swales, lakeshores, and ponds), upland open habitats (pastures, waste lands, and gardens), upland partially open habitats (open woods, edges, and roadsides), and herbaceous wetlands (wet meadows) (Muenscher 1955, Washington State Noxious Weed Control Board 2003, Czarapata 2005, Wisconsin State Herbarium 2005).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: The first records of this species are from the northeastern seaboard in the mid-1800s (Mehrhoff et al. 2003). Since that time, the species has spread inland. Some sources believe that the westward spread of this front continues today (Washington State Noxious Weed Control Board 2003). In addition, the species was collected in the Pacific northwest for the first time in 1965 and appears to be spreading in WA (Washington State Noxious Weed Control Board 2003, King County Noxious Weed Control Program 2005).

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11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: The extensive native range of this species (GRIN 2001) suggests that most of the US could potentially be occupied. When reliant on its own dispersal mechanisms, the species does not appear to spread extremely rapidly; it was established in the northeast 1829 but has not yet spread much beyond that region by biological means. However, it can establish new foci when planted in new regions as a garden ornamental (WDOE 2003).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This species is occasionally sold as a garden ornamental. The Pacific northwest populations, first detected in the 1960s, are believed to have originated from ornamental plantings (WDOE 2003, Washington State Noxious Weed Control Board 2003). Sales could potentially increase in the near future, as gardeners reportedly consider this species a substitute for purple loosestrife (WDOE 2003), which is considered to be noxious in many states (Kartesz 1999). It also has wind-dispersed seeds (Shamsi and Whitehead 1974, Mehrhoff et al. 2003, Czarapata 2005).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B - MODERATE SIGNIFICANCE

COMMENTS: The best recent documentation of local range expansion comes from Washington state, where the species was first found in one county in 1965 and has since been reported from at least four others (Rice 2005, King County Noxious Weed Control Program 2005). One cause of this expansion could be increased sales of the plant as an ornamental, as gardeners reportedly consider this species a substitute for purple loosestrife (WDOE 2003). Spread from ornamental plantings is also believed to be resulting in local increase in the northeastern US (Czarapata 2005).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Although it is most often found in open, disturbed areas, this species is clearly capable of spreading into undisturbed wet meadows (Washington State Noxious Weed Control Board 2003).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Hairy willow-herb is also established in Canada and Australia. In both countries, it appears to invade similar habitats to those invaded in the US (Scoggan 1978, Weiss 1998). In its native range, the species occurs in neutral to alkaline fen habitats (Shamsi and Whitehead 1974), but no reports of invasion of similar habitats in the US were found.

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

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COMMENTS: Hairy willow-herb strongly exhibits the following invasive characteristics: it reproduces both vegetatively and by seed (Mehrhoff et al. 2003, Czarapata 2005), it has seeds that remain viable in the soil for three or more years (Blomqvist et al. 2004), it has quickly spreading rhizomes (Washington State Noxious Weed Control Board 2003), and it resprouts readily when cut (Washington State Noxious Weed Control Board 2003).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Herbicide treatment with aquatic-suitable glyphosate (Rodeo) appears to afford the greatest management success. Herbicide can be applied to bundles of cut stems (Czarapata 2005). However, even with this method, regrowth from rootstocks may still occur and increase the resources needed to achieve effective control (Washington State Noxious Weed Control Board 2003). Mowing may prevent the addition of new seeds to the seed bank (Muenscher 1955), but regrowth can be a major issue with this method, as any stems intact to the first node can resprout (Washington State Noxious Weed Control Board 2003).

18. MINIMUM TIME COMMITMENT

B - MODERATE SIGNIFICANCE

COMMENTS: The seed bank of this species generally lasts at least 5 years (Blomqvist et al. 2004). However, it does respond to herbicide treatment, so repeated follow-up should be able to achieve control once the seed bank has been exhausted.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Because the recommended control method is to spray colonies with herbicide, some impacts on co-occurring native species appear unavoidable (Washington State Noxious Weed Control Board 2003). However, impacts can be reduced by bundling and tying stems, cutting above the string, and applying the herbicide to the bundle of cut stems, thus reducing the area sprayed (Czarapata 2005).

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Most of the invaded habitats should be relatively accessible. However, the ability of the plant to grow in semi-aquatic environments (Mehrhoff et al. 2003) may create some access problems, and its establishment via escape from ornamental plantings may lead to some populations being found on private lands.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Epipactis helleborine

ELEMENT NATIONAL ID: 193657
SCIENTIFIC NAME: *Epipactis helleborine*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-26
EVALUATOR: Tomaino, A.

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:
Frequent in the northeast and upper midwest and scattered elsewhere through the U.S. Often occurs in small numbers but aggressive in some areas, particularly in limestone bedrock areas near the Great Lakes. Elsewhere, apparently having relatively low impacts on biodiversity. Its spread due to transplantation and long distance seed dispersal will probably continue. Plants can be hand-pulled. Some individuals may emerge very infrequently. May be confused with native orchids.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Europe (Gleason and Cronquist 1991).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Established outside cultivation in the U.S. (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Moist to dry, rocky, shaded, deciduous to mixed woods, cedar swamps and forested stream margins, often in disturbed places (FNA 2002).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No mention of changes in abiotic ecosystem processes or system-wide parameters found in the literature; assumption is that any alterations are not high or moderate.

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2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: An herbaceous perennial, 25-80 cm tall (FNA 2002). In natural communities, usually occurs in small numbers (White et al. 1993). However, also described as aggressive and common in many different soil conditions and habitats (Luer 1975).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: In natural communities, usually occurs in small numbers (White et al. 1993). However, also described as aggressive and common in many different soil conditions and habitats (Luer 1975).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not high or moderate.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Habitats where it occurs include cedar swamps, forested stream margins, (FNA 2002), rich deciduous woods, hemlock-hardwoods, thickets on dunes (Voss 1972), beech forests (Wisconsin State Herbaria 2005), white-cedar- yellow birch - hemlock forest, mountain forests (Schmidt 2003), and limestone bluff cedar-pine forests (Sorenson and Popp 2006). These communities are likely to be of conservation significance.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Widespread in Pennsylvania north through New England and also widespread in Michigan, eastern Wisconsin, and in the northern portions of Illinois, Indiana, and Ohio near the Great Lakes. Also known in the coastal mountains of California and in the San Francisco Bay area (FNA 2002; J. Kartesz, unpublished data). Otherwise, in scattered counties in the east as far south as Arkansas and northern Georgia, and in a few sites in western states including Washington, Oregon, Montana, Colorado, and New Mexico (FNA 2002; J. Kartesz, unpublished data).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: In the upper midwest, abundant in areas near the Great Lakes with limestone bedrock but not a significant problem in most of the region (Czarapata 2003). In Vermont, occurs in more than one-half of limestone bluff cedar-pine forests but is considered to be relatively "naturalized and not invasive" compared to other exotics in these communities (Sorenson and Popp 2006).

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8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: Inferred from distribution as currently understood (J. Kartesz, unpublished data; TNC 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Moist to dry, rocky, shaded, deciduous to mixed woods, cedar swamps and forested stream margins, often in disturbed places such as lawns and cracks in concrete sidewalks (FNA 2002). In the Upper Midwest, forests with clay soils, woodlands, thickets, and disturbed areas (Czarapata 2005). In Michigan, rich deciduous woods, hemlock-hardwoods, mixed woods, thickets on dunes (Voss 1972). In Wisconsin, beech forests (Wisconsin State Herbaria 2005). In Michigan and Wisconsin, white-cedar- yellow birch - hemlock forest (Schmidt 2003). In Vermont, occurs in limestone bluff cedar-pine forests (Sorenson and Popp 2006). In Pennsylvania, roadsides and forest edges (Rhoads and Block 2000). Along roadsides and in woods (Gleason and Cronquist 1991). Shady woods and disturbed areas including refuse dumps (Luer 1975). In Virginia, North Carolina, and Georgia, in mountain forests (Weakley 2006). In California, dry slopes and roadcuts (Baldwin et al. 2006). In Colorado, a sandstone alcove (Weber and Wittmann 1996).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: From its history of spread in North America to date, it is a very aggressive plant and we can expect to see further spreading (Soper and Murray 1985).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Inferred from USDA (1990) and J. Kartesz, unpublished data.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Seed is exceedingly small, almost microscopic (Soper and Murray 1985). Prevailing southwesterly winds may have carried seed a distance of 100 miles (Drew and Giles 1951 cited by Soper and Murray 1985). It has been transplanted to (and escaped from) gardens across the continent (Luer 1975). Dispersal may also occur as seeds are carried by water and accidentally as a result of movement of soil (Soper and Murray 1985). Not found to be sold on the internet currently.

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: From its history of spread in North America to date, it is a very aggressive plant and we can expect to see further spreading (Soper and Murray 1985).

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14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: Does not pose a major threat to well-established native plant communities (Czarapata 2003). Often associated with some disturbance of the woods where it grows (Voss 1972). However, also described as aggressive and common in many different soil conditions and habitats (Luer 1975).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: In Canada, spreading rapidly in woods, ravines, and alluvia near settled areas (Scoggon 1978). In Ontario, occurs in white-cedar - yellow birch - hemlock forest (Schmidt 2003). In Ontario, abundant in limestone areas but also scattered in acidic areas (Brunton 1986).

16. REPRODUCTIVE CHARACTERISTICS

C - LOW SIGNIFICANCE

COMMENTS: Reproduction is primarily by seed; root elongation with formation of new flowering stems is a possibility for very local increase and slow spread of populations (Soper and Murray 1985). A study in a park in Quebec found that in a 20-year period, 62% of Epipactis helleborine plants emerged only once (Light and MacConaill 2006). Strong exhibition of aggressive reproductive characteristics not found in the literature.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Can be hand-pulled (Czarapata 2005).

18. MINIMUM TIME COMMITMENT

A - HIGH SIGNIFICANCE

COMMENTS: A study in a park in Quebec found that in a 20-year period, 62% of Epipactis helleborine plants emerged only once (Light and MacConaill 2006).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Hand-pulling would presumeably have minor impacts.

20. ACCESSIBILITY OF INVADED AREAS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Assumption is that accessibility problems are not severe or substantial but at least in some areas accessibility may be a problem.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Euphorbia cyparissias

ELEMENT NATIONAL ID: 210757
SCIENTIFIC NAME: *Euphorbia cyparissias*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-26
EVALUATOR: Tomaino, A. (2004), rev. A. Tomaino

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:
Widespread and locally common in the northeastern and north-central states; less frequent in the Pacific Northwest and southern states. Spreads and becomes a weed in disturbed areas. Apparently, *Euphorbia cyparissias* often occurs in disturbed areas such as old fields, rights-of-way, and pastures. However, on Long Island, New York, *Euphorbia cyparissias* has invaded a rare grassland community which is habitat for a federally endangered plant. More information is needed about the extent of its impacts on biodiversity. Planted as an ornamental and sold on the internet, so has the ability to disperse long distances. Reproduces mostly by creeping roots, and in some areas also by seed. Three cytotypes are known. Individual tetraploid plants may produce 30-900 or more seeds. Seeds remain viable in the soil for 1 to 5 years. Management is difficult in natural areas.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Medium

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Native to Europe and Turkey (GRIN 2001).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Established outside cultivation in the U.S. (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Dry gravelly or sandy fields, pastures, roadsides, cemetaries, and waste places (Muenscher 1955).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No mention of changes in abiotic ecosystem processes or system-wide parameters found in the literature; assumption is that any alterations are not significant.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B - MODERATE SIGNIFICANCE

COMMENTS: A herbaceous to semi-woody perennial that is 15-30 cm tall (Mehrhoff et al. 2003). It is invading the Hempstead Plains Grassland, Long Island, New York and increased substantially over a three year period and reached cover levels of 25-75% (Jordan 2002).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B - MODERATE SIGNIFICANCE

COMMENTS: Easily spreading and becoming a weed in disturbed areas (Voss 1985). A highly successful competitor in Colorado State and at Indiana Dunes National Lakeshore (APRS Implementation Team 2001). *Euphorbia cyparissias* overgrows other species (Jordan and Jacobs, not dated).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: *Euphorbia cyparissias* is having negative impacts on the best population of the federally endangered *Agalinis acuta* at the Hempstead Plains Grassland, Long Island New York; management is necessary to keep it from being overgrown (Jordan and Jacobs, not dated). However, the impacts of *Euphorbia cyparissias* on *Agalinis acuta* do not seem to be unusually disproportionate.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: On Long Island, New York, *Euphorbia cyparissias* occurs in the Hempstead Plains Grassland which is a rare community and habitat for the federally endangered *Agalinis acuta* (Jordan 2002, Jordan and Jacobs, not dated).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Established in most states across the U.S. except for Hawaii, Alaska, and the southernmost states (Kartesz 1999). Widespread and locally common in the northeastern and north-central states; less frequent in the Pacific Northwest (Muenscher 1955). See the subnational distribution data in these sources: Baldwin et al. 2004, Rice 2004, Weber et al. 2004, Wisconsin State Herbarium 2004, Iverson et al. 1999, Weldy et al. 2002, Mehrhoff et al. 2003, University of Tennessee Herbarium 2002, Rayner et al. 2000, J. Kartesz, unpublished data.

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7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: *Euphorbia cyparissias* is having negative impacts on the best population of the federally endangered *Agalinis acuta* at the Hempstead Plains Grassland, Long Island New York (Jordan and Jacobs, not dated). Little other mention of negative impacts on biodiversity found in the literature; assumption is that impacts occur in 5-50% of the species' current generalized range.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: Approximately 14-34 units, inferred from TNC (2001), Kartesz (1999), Baldwin et al. 2004, Rice 2004, Weber et al. 2004, Wisconsin State Herbarium 2004, Iverson et al. 1999, Weldy et al. 2002, Mehrhoff et al. 2003, University of Tennessee Herbarium 2002, Rayner et al. 2000.

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: In New England, *Euphorbia cyparissias* occurs in old fields, right-of-ways, pasture, and other disturbed areas (Mehrhoff et al. 2003). On Long Island, New York, *E. cyparissias* occurs near the periphery of native grassland (Jordan 2002). In Michigan, occurs in clearings, fields, roadsides, railroads, old homesites, old homesites, and cemeteries (Voss 1985).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Easily spreading and becoming a weed in disturbed areas (Voss 1985). It is available for sale on the internet. Occurs in disturbed areas; assumption is that disturbed areas are not declining and therefore this species' total range is not declining.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Inferred from USDA (1990) and Kartesz (1999), 30-90% of its potential generalized range in the U.S. is currently occupied.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Seeds are dispersed by ants Stahevitch et al. 1988). Planted as an ornamental (Stahevitch et al. 1988). For sale on the internet.

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13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Easily spreading and becoming a weed in disturbed areas (Voss 1985). Occurs in disturbed areas; assumption is that disturbed areas are not decreasing or remaining stable and therefore this species' local range is not decreasing or remaining stable.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: Easily spreading and becoming a weed in disturbed areas (Voss 1985). On Long Island, New York, *E. cyparissias* occurs near the periphery of native grassland (Jordan 2002).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: In Canada, *Euphorbia cyparissias* occurs in disturbed communities on sandy substrates and also on limestone; most sites are dry but occasionally plants grow along wet ditches (Stahevitch et al. 1988). These are habitats it has already invaded in the region of interest.

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: Reproduces mostly by creeping roots, in some areas also by seed (Muenscher 1955). Three cytotypes are known; the fertile tetraploid is the most weedy and has abundant seed set and more shoots than sterile diploids (Stahevitch et al. 1988). At Indiana Dunes National Lakeshore, seeds remain viable in the soil for 1 to 5 years (APRS Implementation Team 2001). Individual tetraploid plants may produce 30-900 or more seeds (Stahevitch et al. 1988).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A - HIGH SIGNIFICANCE

COMMENTS: Prevent seed production by mowing as soon as the first blossoms appear; close pasturing with sheep will gradually decrease *Euphorbia cyparissias* (Muenscher 1955). On Long Island, New York, *E. cyparissias* was not controlled by mowing, herbicide, or fire (Jordan 2002). On Long Island, "We may be able to control *E. cyparissias* well enough by wick application to keep *A. acuta* from being overgrown but only if we keep at it forever (Jordan and Jacobs, not dated). Two insect species were successful at reducing *E. cyparissias* in Rhode Island pastures (Faubert and Casagrande, not dated).

18. MINIMUM TIME COMMITMENT

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: At Indiana Dunes National Lakeshore, seeds remain viable in the soil for 1 to 5 years (APRS Implementation Team 2001). On Long Island, "We may be able to control *E. cyparissias* well enough by wick application to keep *A. acuta* from being overgrown but only if we keep at it forever (Jordan, not dated).

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19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Herbicide spray application kills everything growing beneath *Euphorbia cyparissias* (Jordan and Jacobs, not dated).

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: An agricultural pest because it is potentially toxic to horses and cattle (Mehrhoff et al 2003). Classified as a noxious weed in Colorado (Kartesz 1999). Infestations are not known to be in extreme or remote habitats. Assumption is that accessibility problems are not severe or substantial.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Frangula alnus

ELEMENT NATIONAL ID: 233616
SCIENTIFIC NAME: *Frangula alnus*
COMMON NAME: Glossy False Buckthorn
I-RANK REVIEW DATE: 2006-06-22
EVALUATOR: J. Cordeiro

I-RANK: High/Medium

I-RANK REASONS SUMMARY:
Buckthorns rapidly form dense, even-edged thickets followed by lateral crown thread which continues until branches touch adjacent shrubs forming continuous canopy and creating dense shade that eliminates native tree seedlings, saplings, and groundlayer species. Heavy infestations decrease the total cover and alter the species dominance of the herbaceous layer in riparian savanna. Other woody species experience negative effects on growth and seedling establishment. Although fairly widespread in the United States, particularly the eastern half, the species continues to spread into open and semi-open woodlands, but also into some upland woodlands. Management difficulty is moderate, though rapid, with limited effects on native species.

SUBRANK I - ECOLOGICAL IMPACT:	High/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: This species is native to North Africa, Asia, and Europe, except Iceland (Converse, 2001).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: In North America, this species occurs from Nova Scotia to Manitoba, south to Minnesota, Illinois, New Jersey, and Tennessee (Converse, 2001). It was introduced as an ornamental in the Midwest as early as 1849 (Czarapata, 2005).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Although this species was probably introduced to North America before 1800 it did not become widespread and naturalized until the early 1900s (Converse, 2001). It was introduced as an ornamental in the Midwest as early as 1849 and is now well established and spreading rapidly (Czarapata, 2005).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

U - UNKNOWN

COMMENTS:

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Buckthorns rapidly form dense, even-edged thickets followed by lateral crown thread which continues until branches touch adjacent shrubs (Massachusetts Invasive Plant Advisory Group, 2005). Large leaves and continuous canopy create dense shade (Converse, 2001) that eliminates native tree seedlings, saplings, and groundlayer species (Czarapata, 2005). Godwin (1936) found a mixed sedge area in the United Kingdom colonized by seedlings became continuous shrub carr in about 20 years and Godwin et al. (1974) found the same area 40 years later to still be a continuous consolidation of shrub carr but with far fewer and much larger individual crowns than were previously present. Invasion of glossy buckthorn decreases the total cover and alters the species dominance of the herbaceous layer in riparian savanna in the Allegheny National Forest, western Pennsylvania (Possessky et al., 2000; Krock and Williams, 2002).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A - HIGH SIGNIFICANCE

COMMENTS: Invasion of glossy buckthorn decreases the total cover and alters the species dominance of the herbaceous layer in riparian savanna in the Allegheny National Forest, western Pennsylvania (Possessky et al., 2000; Krock and Williams, 2002). In Wicket Fen in the United Kingdom, dense thickets of this species altered herbaceous understory composition (Godwin et al., 1974). Frappier et al. (2003) found buckthorn basal area was inversely associated with tree seedling number, percent total herb cover, and ground-level species richness in several southeastern New Hampshire forests. In a subsequent study in the same area, Frappier et al. (2004), through direct experimental manupulation, demonstrated that >90% of buckthorn cover inhibits tree species first-year seedling recruitment with equal impact to all first-year tree species seedlings regenerating in the two stands manipulated for the experiment.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

A - HIGH SIGNIFICANCE

COMMENTS: Buckthorn affects the survival of co-occurring species. Other woody plants such as *Viburnum opulus* (European) and *Betula permula* may be replaced or are unable to invade buckthorn thickets (Godwin, 1936). Frappier et al. (2003) found buckthorn basal area was inversely associated with tree seedling number, percent total herb cover, and ground-level species richness in several southeastern New Hampshire forests. In a subsequent study in the same area, Frappier et al. (2004), through direct experimental manupulation, demonstrated that >90% of buckthorn cover inhibits tree species first-year seedling recruitment with equal impact to all first-year tree species seedlings regenerating in the two stands manipulated for the experiment. All parts of the plant are poisonous to humans if ingested and the plants are an alternate host for the fungus that causes oak rust (Randall and Marinelli, 1996).

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5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

U - UNKNOWN

COMMENTS:

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: In North America, this species occurs from Nova Scotia to Manitoba, south to Minnesota, Illinois, New Jersey, and Tennessee (Converse, 2001).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B - MODERATE SIGNIFICANCE

COMMENTS: Frappier et al. (2003; 2004) conclude that it is likely that this species will "continue increasing in pine forests in the northeastern U.S. for the foreseeable future". Although common buckthorn is more widespread, glossy buckthorn is particularly aggressive in wet areas (Czarapata, 2005).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: It is conservatively estimated that all ecoregions in the northeastern United States and the majority of the ecoregions east of the Mississippi River, as well as several west of the Mississippi to the Rocky Mountains, have been invaded by *Frangula alnus* in the United States (Cordeiro, pers. obs. May 2006 based on TNC, 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Habitat typically includes wetter, less shaded, and more acidic soils than the related *Rhamnus cathartica* including alder thickets and calcareous wetlands. Wetlands include wet prairies, marshes, calcareous fens, sedge meadows, sphagnum bogs, and tamarack swamps. Heath-oak woods, pine, and spruce woods frequently have this species in the understory (Converse, 2001). Glossy buckthorn typically inhabits wetter, less shaded sites than common buckthorn. It grows in soils of any texture. Habitats include alder thickets and calcareous or limestone-influenced wetlands.

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: The range of this species will likely continue to expand in North America, as the species is becoming abundant in open and semi-open wetlands and some upland woodlands (Catling and Porebski, 1994; Frappier et al., 2003).

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11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

B - MODERATE SIGNIFICANCE

COMMENTS: The range of this species will likely continue to expand in North America, as the species is becoming abundant in open and semi-open wetlands and some upland woodlands (Catling and Porebski, 1994; Frappier et al., 2003). Although common buckthorn is more widespread, glossy buckthorn is particularly aggressive in wet areas (Czarapata, 2005).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Fruit is effectively dispersed usually by starlings, blackbirds, woodducks, elk, mice, cedar waxwings, robins, and blue jays (Converse, 2001; Catling and Porebski, 1994; Godwin, 1936; Hampe, 2005). It appears, based on recent rangewide expansion, that American invasive populations are seed dispersed by migratory birds, as well, much like temperate European populations (which make up the bulk of the native range, have the greatest genetic variability, have expanded greatly, and have high seed exchange) unlike disjunct European populations (Iberian peninsula and Anatolia) which are dispersed by short-ranging native birds (hence populations have distinct gentotypes, declined recently, are isolated, and have narrow seed exchange over short distances) (Hampe, 2005; Hampe and Bairlein, 2000; Hampe et al., 2003). Few bird species readily tolerate the anthranquinones (emodin) present especially in immature fruit, preventing premature dispersal; although the related *Rhamnus cathartica* likely disperses farther and more frequently because this species retains fruit into or throughout the winter whereas fruits of *Rhamnus frangula* more rapidly falls to the ground following ripening (Godwin, 1936). Although the importance of water dispersal is not known, fresh fruit of *Rhamnus frangula* floats 19 days, and dry seed floats one week (Ridley, 1930 cited in Converse, 2001). Horticultural distribution increases seed sources for dispersal significantly as this species is known from two cultivar forms, 'Asplenifolia' (fernless buckthorn) and 'Columnaris' (tallhedge buckthorn).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B - MODERATE SIGNIFICANCE

COMMENTS: The range of this species will likely continue to expand in North America, as the species is becoming abundant in open and semi-open wetlands and some upland woodlands (Catling and Porebski, 1994; Frappier et al., 2003). New Jersey has recently experienced a rapid population explosion in the northern part of the state (Snyder and Kaufman, 2004).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: This species is listed as an "invasive plant of major concern" in Czarapata (2005). Buckthorns are capable of invading open, native areas, as well as disturbed areas, but as plants mature, they show less shade tolerance where seedlings may continue to establish but show little growth under adult plants (Converse, 2001; Godwin, 1936). Adults may be temporarily suppressed by canopy species. Typically, buckthorns initially became widespread in North America where various disturbances (drainage, lack of fire, wetland grazing and cutting, etc.) created ideal habitat for seedling recruitment and maintenance of sexually mature adults; but naturalized habitats can also be invaded if they are similar to indigenous habitats (little shade, open, grassy, somewhat wet, though in the drier parts of wetlands) (Converse, 2001).

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15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: In the United States, this species most often invades wetlands that are comparable to European wetland habitats (Converse, 2001). There are genetically and morphologically distinct populations, including a distinct subspecies in the southern Iberian peninsula in Spain (the trailing edge of southern distribution in Europe), that are considered small, isolated, and progressively declining, and hence not invasive, but bordering on imperiled (Hampe, 2005; Hampe and Bairlein, 2000; Hampe et al., 2003).

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: Buckthorns generally have long growing seasons with fruits throughout (Massachusetts Invasive Species Advisory Group, 2005), rapid growth rate, and resprout vigorously following top removal. Production is abundant (Godwin, 1936), ranging between 430 and 1804 fruit per ganet in one study (Medan, 1994 cited in Frappier et al., 2004). Natural reproduction is primarily sexual with asexual means either absent or insignificant. Plants reach seed bearing age quickly and plants bloom in late May through September, after leaf expansion; although flowers can blossom on a current season's growth (Converse, 2001; Godwin, 1936). Germination varies because seeds have either embryo or seed coat dormancy or require stratification and scarification (Godwin, 1936).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B - MODERATE SIGNIFICANCE

COMMENTS: Adult plants are persistent and plants vigorously resprout after top removal. Repeated cutting (as well as girdling at the plant base followed with flame application) reduced plant vigor and mowing maintains open areas by preventing seedling establishment (Godwin, 1936). Seedlings of small plants can be hand removed but is only recommended for very small invasions as it may induce colonization by new seedlings (Converse, 2001; Randall and Marinelli, 1996). Most fire treatments are not effective as vigorous resprouting usually follows top kill (Godwin et al., 1974). "Underplanting" disturbed woods with native woody species is potentially effective to prevent primary invasion, or re-invasion. Some chemical treatments with application guidelines and advantages and disadvantages are summarized in Dziuk (1998) and Converse (2001). An ongoing study of herbicide treatments at Seney National Wildlife Refuge in Michigan (Cornwall et al., 2005) indicates spraying and sponge application of herbicides are to some degree effective in management so long as repeated visits and treatment follow-ups are practiced for a few years. Frappier et al. (2004) suggest initial control efforts must be followed in the second year with some effective, yet non-damaging, technique for destroying the resulting increase in buckthorn seedlings following first year buckthorn plant removal (suggest follow up of 1-2 years).

18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

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COMMENTS: Frappier et al. (2004) suggest initial control efforts must be followed in the second year with some effective, yet non-damaging, technique for destroying the resulting increase in buckthorn seedlings following first year buckthorn plant removal (suggest follow up of 1-2 years). An ongoing study of herbicide treatments at Seney National Wildlife Refuge in Michigan (Cornwall et al., 2005) indicates spraying and sponge application of herbicides are to some degree effective in management so long as repeated visits and treatment follow-ups are practiced for a few years.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B - MODERATE SIGNIFICANCE

COMMENTS: Cutting and mowing is clearly detrimental to native species but girdling (at the base followed by a five second flame application) has been shown to be successful and does not affect sensitive wetlands (D. Reed, Southeast WI Regional Planning Commission, pers. comm. to C.K. Converse, 1983, cited in Converse, 2001). Fire is highly detrimental to native vegetation and is not effective at removal anyway. Some chemicals have less effect on native plants (see Converse, 2001; Dziuk, 1998): glyphosate without surfactant is effective in anaerobic conditions; Picloram + 2,4-D does not damage surrounding plants only if very carefully applied in a point targeted manner, but is a major groundwater contaminent and persists in the environment;. This species is an alternate host for the oak rust fungus (*Puccina coronata*) (Godwin, 1936; Frappier et al., 2004) which causes significant die-back in buckthorn. Control using oak rust has been successful in Europe and should be explored for the United States. Because many North American insects do not feed on buckthorn (likely because of emodin intolerance), host-specific insects of the Rhamnaceae may serve to control buckthorn (Malicky et al., 1970 cited in Converse, 2001) but futher testing will be necessary before release approval in North America is granted; probably between 2007 and 2010 (Czarapata, 2005). In wetlands with artificially lowered water tables, restoring water to its previous levels will often kill glossy buckthorn in the area (Czarapata, 2005). Chemical control can be applied in fall to trunks when most native plants are dormant (Czarapata, 2005).

20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: As this species frequently occurs on private land, particularly grasslands, some access issues will arise and cooperation with landownders for management will be necessary.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Galega officinalis

ELEMENT NATIONAL ID: 224299
SCIENTIFIC NAME: *Galega officinalis*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-10
EVALUATOR: Gravuer, K.

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:
Galega officinalis has a limited and scattered distribution in the United States, due in part to the discovery of its toxicity to livestock and consequent designation as a federal noxious weed. It is currently subject to eradication or control efforts nearly everywhere it is known to occur. The largest infestation is in Cache County, UT; other establishment sites include King County, WA and a few scattered counties in PA and NY. A few collections have also been made from ME, MA, CT, MD, NE, and CO, but there is doubt that these populations persist. Invaded habitats include moist open grasslands, roadsides, cropland, stream banks, and marshes/wet meadows. Where well-established, the species can form monocultures and dense thickets in wetland communities, reducing food and nesting materials for wildlife. The Utah infestation has proven difficult and costly to eradicate, in part because seeds remain viable in the soil for 5-10 years. However, selective herbicides can achieve reasonably efficient control at less-entrenched sites.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Low/Insignificant
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Low

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Eurasia, including France, Spain, Austria, Czechoslovakia, Germany, Hungary, Poland, Albania, Bulgaria, Greece, Italy, Romania, Yugoslavia, northern Algeria, Morocco, Turkey, and northern Pakistan (USDA ARS 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

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COMMENTS: Invaded habitats include moist open grasslands (pastures, fields, meadows, and waste places), roadsides, cropland (e.g. alfalfa fields), stream banks (incl. irrigation waterways, canals, ditches), and marshes (Cronquist et al. 1989, Rhoads and Klein 1993, Evans 1996, Klugh 1998, Washington State Noxious Weed Control Board 2003, Welsh et al. 2003, Scher 2004, King County Noxious Weed Control Program 2005, Bugwood Network et al. 2006, WVDA 2006, Whitinger 2006).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

D - INSIGNIFICANT

COMMENTS: This species was introduced to North America in 1891 (Washington State Noxious Weed Control Board 2003). Despite being present for over 100 years, no reports of impacts on ecosystem processes or system-wide parameters were found. Therefore, assume impacts insignificant.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

COMMENTS: Can form monocultures and dense thickets in wetland communities (Washington State Noxious Weed Control Board 2003, Bugwood Network et al. 2006). However, the wetland communities it invades appear to be already largely dominated by herbaceous species, so impacts on community structure are probably limited to changes in density or cover of the existing herbaceous layer.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Can form monocultures and dense thickets in wetland communities (Washington State Noxious Weed Control Board 2003, Bugwood Network et al. 2006). Wildlife dependent on these communities are then impacted by reductions in food and nesting materials (King County Noxious Weed Control Program 2005).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not significant. The species is known to be poisonous to livestock but herbivorous wildlife appear to largely avoid it (Klugh 1998).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Detailed descriptions of the species' behavior in Utah, Pennsylvania, and Washington (Evan 1996, Klugh 1998, Washington State Noxious Weed Control Board 2003, King County Noxious Weed Control Program 2005) suggest that it invades both disturbed (roadsides, crop fields, irrigation ditches) and less-disturbed (marshes, wet meadows) habitats where it becomes established. Some of the less-disturbed habitats may feature high-quality community examples.

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SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

D - INSIGNIFICANT

COMMENTS: This species has a limited and scattered distribution in the United States. This is in part due to the discovery of its toxic effects on livestock and consequent designation as a federally listed noxious weed (USDA ARS 2005). The species is currently subject to eradication or control efforts in nearly every place it is known to occur (Evan 1996, Klugh 1998, Washington State Noxious Weed Control Board 2003, King County Noxious Weed Control Program 2005). The largest infestation is located in Cache County, Utah, where 38,000 acres (60 square miles) are infested to varying degrees (Evans 1996). Control efforts were begun at this site in 1976 but have still not succeeded in completely eradicating the plant (Washington State Noxious Weed Control Board 2003). There are also a few infested sites in King county, Washington, which are also subject to active control with the goal of eradication from Washington (King County Noxious Weed Control Program 2005). It is established in several scattered counties in Pennsylvania (Rhoads and Klein 1993), with at least the Philadelphia County (Morris Arboretum) infestation subject to active control (Klugh 1998). It has also been collected from several scattered counties in New York, with at least the Bronx infestations persisting currently (2004 collection listed in Weldy and Werier 2005); control status of these infestations is unknown. A few collections have also been made from Maine, Massachusetts, Connecticut, Maryland, Nebraska, and Colorado (Kartesz 1999, Rydberg 1932, Seymour 1989), but there is some doubt that these populations are persistent (Lasseigne 2003).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Detailed descriptions of the species' behavior in Utah, Pennsylvania, and Washington (Evan 1996, Klugh 1998, Washington State Noxious Weed Control Board 2003, King County Noxious Weed Control Program 2005) suggest that it invades both disturbed (roadsides, crop fields, irrigation ditches) and less-disturbed (marshes, wet meadows) habitats where it becomes established. The percentage of infested area covered by the less-disturbed habitats was assumed to be between 5 and 50%.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

C - LOW SIGNIFICANCE

COMMENTS: The species' widely scattered establishment sites appear to be located in distinct ecoregions (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Prefers full sun but will tolerate light shade; prefers moist to wet soil. Habitats include moist open grasslands (pastures, fields, meadows, and waste places), roadsides, cropland (e.g. alfalfa fields), stream banks and their man-made counterparts (e.g. irrigation waterways, canals, ditches), and marshes. In King county, WA, associated species include *Phalaris arundinacea*, *Spirea*, *Rubus* spp., and *Lythrum salicaria* (Cronquist et al. 1989, Rhoads and Klein 1993, Evans 1996, Klugh 1998, Washington State Noxious Weed Control Board 2003, Welsh et al. 2003, Scher 2004, King County Noxious Weed Control Program 2005, Bugwood Network et al. 2006, WVDA 2006, Whitinger 2006).

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SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: Most known populations are currently subject to eradication or control efforts (e.g. Evan 1996, Klugh 1998, Washington State Noxious Weed Control Board 2003, King County Noxious Weed Control Program 2005), and a number of states where the plant has not yet been detected have nonetheless listed it as a noxious weed, with the goal of preventing establishment. However, the species has been used in the past for both ornamental and medicinal purposes and does still have some limited internet availability (Washington State Noxious Weed Control Board 2003), suggesting the potential for the establishment of additional populations escaped from cultivation (WVDA 2006).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

A - HIGH SIGNIFICANCE

COMMENTS: The species is thought to have a wide temperature tolerance (USDA hardiness zones 3a - 9b, Whitinger 2006) and has established in both arid (UT) and less arid (WA, PA) areas of the country; therefore, it appears as if most of the U.S. would be suitable for establishment.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Apparently, it is occasionally found for sale as an ornamental plant from nurseries and is also found for sale over the Internet as a medicinal herb (Cronquist et al. 1989, Washington State Noxious Weed Control Board 2003). Additional more local dispersal mechanisms include water (apparently, the pods of the plant are buoyant for a short time, Klugh 1998), farm machinery, contaminated seed, animal manure and contaminated soil (Evans 1996, Washington State Noxious Weed Control Board 2003).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

D - INSIGNIFICANT

COMMENTS: Most known populations are currently subject to eradication or control efforts (e.g. Evan 1996, Klugh 1998, Washington State Noxious Weed Control Board 2003, King County Noxious Weed Control Program 2005). Descriptions of local spread behavior have ranged from slow-spreading (Evans 1996) to spreading vigorously (50 ft. in a year) (Stokes 1964), so it appears that the potential for populations to expand rapidly once established may vary considerably with local conditions.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Detailed descriptions of the species' behavior in Utah, Pennsylvania, and Washington (Evan 1996, Klugh 1998, Washington State Noxious Weed Control Board 2003, King County Noxious Weed Control Program 2005) suggest that it invades both disturbed (roadsides, crop fields, irrigation ditches) and less-disturbed (marshes, wet meadows) habitats where it becomes established. It appears to often access the less-disturbed habitats via the disturbed habitats, e.g. at the Morris Arboretum in Pennsylvania, where it moved from a roadside to a streamside to a wet meadow (Stokes 1964, Klugh 1998).

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15. SIMILAR HABITATS INVADED ELSEWHERE

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Also collected from the wild in Canada (though questionably persistent there), New Zealand, Peru, Argentina, Chile, Ecuador, and Britain (Kartesz 1999, Plants for a Future 2001, Randall 2002, Lasseigne 2003). In New Zealand, it invades riverbeds and swampland (Webb et al. 1988), which do not appear to be invaded to an appreciable extent in the U.S. In Britain, it appears to invade scrub and woods (Plants for a Future 2001), which also do not appear to be invaded to an appreciable extent in the U.S.

16. REPRODUCTIVE CHARACTERISTICS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Produces 1-9 seeds per pod, and each plant can produce 15,000 pods per plant or more (Washington State Noxious Weed Control Board 2003). It is thought that seeds remain viable in the soil for 5 to 10 years (Evans 1996). This species has also been noted to forms dense crowns capable of regenerating for several seasons (Klugh 1998), and to produce flowers and fruit despite mechanical control attempts (e.g. mowing, clipping, cutting, or shallow cultivation) (Evans 1996).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: At the site of the largest infestation (38,000 acres) in Utah, control efforts were begun in 1976. At the present time, the species is still present at this site despite considerable expenditure (Washington State Noxious Weed Control Board 2003). On the other hand, for less-entrenched infestations, good control has been achieved in as little as 2 years using the herbicides dicamba, 2,4-D, or their combination (Evans 1996).

18. MINIMUM TIME COMMITMENT

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Because seeds are likely viable in the soil for 5-10 years (Evans 1996), control of a well-established infestation in less than 5 years is unlikely.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: The recommended herbicides are selective for broad-leaved species (Evans 1996). Impacts might therefore be low in the graminoid-dominated habitats invaded by this species, such as marshes and wet meadows. However, co-occurring forb species would likely be damaged.

20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: Because some infestations may result from ornamental or medicinal plantings, they may be located on private land. However, status as a federal noxious weed should expedite access and control.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Hieracium piloselloides

ELEMENT NATIONAL ID: 232255
SCIENTIFIC NAME: *Hieracium piloselloides*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-21
EVALUATOR: K. Maybury

I-RANK: Medium/Insignificant

I-RANK REASONS SUMMARY:
This is ubiquitous species in much of the upper Midwest and Northeast, with the potential to spred to other areas. However, it is primarily a ruderal species of low quality habitats such as old fields and roadsides. The rank could probably be adjusted to "Low" with greater certainty that higher quality habitats are not impacted anywhere in the range.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Unknown

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Europe (Gleason and Cronquist 1991).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS:

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes
COMMENTS:

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No reports of significant alteration found.

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2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: This is a perennial herb that may change the density of the herbaceous layer.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B - MODERATE SIGNIFICANCE

COMMENTS: The rosettes of hawkweeds form mats that prevent other plants from establishing (USDA Forest Service 2004, WeedMapper 2004). Hawkweeds can also outcompete other species for resources (WeedMapper 2004). Some hawkweeds are thought to have allelopathic properties (Czarapata 2005).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No disporportionate impacts noted. Hybridization is common in hawkweeds (Fisher 1988, Voss 1996) and this species does form hybrids with *H. aurantiacum* and possibly other non-natives (Voss 1996). However the introduced species and the native species have maintained their distinctiveness (Fisher 1988).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C - LOW SIGNIFICANCE

COMMENTS: This is primarily a ruderal species of fields, pastures, roadsides, railroad rights-of-way, and disturbed and waste places (Fisher 1988, Gleason and Cronquist 1991, Voss 1996, Haines and Vining 1998, Weakley 2006). It occassionally can invade more significant native species habitats; for example, it was found to be a characteristic herbaceous plant in Great Lakes alvar savannas (Reschke et al. 1999). It is feared that wilderness areas in the Pacific Northwest are at risk of invasion (WeedMapper 2004).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Throughout the northeastern U.S. and upper Midwest and also in Montana, possibly in Washington State, and known from some scattered areas in the southeastern U.S. (Kartesz 1999; J. Kartesz, 2006 unpublished draft distribution data).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: At least some negative impacts assumed in most areas of the Northeast and upper Midwest, where this species is ubiquitous, but very spottily distributed in the West and Southeast.

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8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS:

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Grasslands, dry woods, fields/grasslands, shores; dry and wet soils (Voss 1996). Savannah (Reschke et al. 1999).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Possibly expanding. Voss (1996) notes that it was introduced to Michigan in 1914, more recently than *H. aurantiacum,* and the two species had become about equally abundant in the northern part of the state. Continued spread seems likely. Fears that it will spread to the Pacific Northwest have led to noxious weed designations there. It is currently reported from Washington State without a specimen (WNPS 2006) and is not yet known from Oregon (WeedMapper 2004).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Somewhat widespread now but there is no obvious reason why this species could not expand into Alaska and other parts of the West as its close relative *H. aurantiacum* has done (*H. aurantiacum* is common in Washtingon, Idaho, and western Montana and is also naturalized in Alaska, Oregon, Wyoming, Colorado, etc. [J. Kartesz, 2006 unpublished draft distribution data]).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Assumed not very frequent nor very seldom or never. Seeds are wind-dispersed (Czarapata 2005).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Unknown but assumed not stable/decreasing given general increases in human-caused disturbances.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: This is primarily a post-disturbance colonizer but one that seems to be able to exploit fairly minor disturbances. Hawkweeds in general can grow in open woodlands but do not tolerate heavy shade (USDA Forest Service 2004).

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15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Canada, in similar habitats.

16. REPRODUCTIVE CHARACTERISTICS

C - LOW SIGNIFICANCE

COMMENTS: Spreads by seeds and rhizomes.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

C - LOW SIGNIFICANCE

COMMENTS: Effective herbicides are available (Czarapata).

18. MINIMUM TIME COMMITMENT

U - UNKNOWN

COMMENTS:

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

U - UNKNOWN

COMMENTS:

20. ACCESSIBILITY OF INVADED AREAS

U - UNKNOWN

COMMENTS:

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Invasive Species Assessment Protocol:
U.S. National Assessments

Ipomoea aquatica

ELEMENT NATIONAL ID: 229744
SCIENTIFIC NAME: *Ipomoea aquatica*
COMMON NAME: Swamp-cabbage
I-RANK REVIEW DATE: 2006-06-26
EVALUATOR: J. Cordeiro

I-RANK: Medium

I-RANK REASONS SUMMARY:
This species, although not widespread due to thermal constraints, it has invaded aquatic areas with high concentrations of rare native species. Impact studies are largely lacking but the plant does form dense intertwined stems over water surfaces, shading out native submersed plants and competing with native emergents. The plant is fairly costly and difficult to eradicate and control efforts often have negative impacts on native species. Despite repreated eradication efforts in Florida, it has reinvaded that state numerous times, and threatens wet areas of conservation concern such as the Everglades and parts of the Hawaiian Islands. Invasive potential is high as is potential for dispersal, but the plant is limited to subtropical areas only.

SUBRANK I - ECOLOGICAL IMPACT:	Medium
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Medium

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Ipomoea aquatica is native to southern Asia (Van and Madeira, 1998), particularly central and south China, India, Sri, Lanka, and Thailand (ISSG, 2005; Langeland and Burks, 1998; Rhui-cheng and Staples, 1995), with two main biotypes reported throughout southeast Asia ("red" and "white" or "green").

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: USDA (2006) lists introduced U.S. range as California (two counties in north central), Hawaii (all islands except Hawaii and Kauai), and Florida (Hillsborough, Manatee, Osceola, Pinellas Counties in coastal western peninsula- see ISSG, 2005)

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Although this species has not invaded many areas of the United States, the areas where it does occur are located in areas of high conservation concern (Hawaiian Islands, Florida Everglades) with many endemic species.

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C - LOW SIGNIFICANCE

COMMENTS: In a study of 31 invasive plant species, Gordon (1998) found no documented (in literature) effects of *Ipomoea aquatica* on ecosystem geomorphology, hydrology, or biochemistry but inferred likely negative effects on water chemistry based on the effects other aquatic invasives (*Eichhornia crassidens*, *Hydrilla verticillata*, *Pistia stratiotes*) have shown (citing Schmitz et al., 1993) where dissolved oxygen, pH, and phosphorus decreased while dissolved carbon dioxide, turbidity, and water color increased with these species.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B - MODERATE SIGNIFICANCE

COMMENTS: In a study of 31 invasive plant species, Gordon (1998) found no documented (in literature) effects of *Ipomoea aquatica* on stand structure, but it is known to form dense floating mats of intertwined stems over water surfaces, shading out native submersed plants and competing with native emergents (Benson et al., 2001; Fears, 1999; Langeland and Burks, 1998; ISSG, 2005). The veins of the plant create dense impenetrable canopies over small ponds and retention basins creating an added canopy layer that promotes stagnant water conditions and competetively excludes other species (Fears, 1999).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B - MODERATE SIGNIFICANCE

COMMENTS: In a study of 31 invasive plant species, Gordon (1998) found no documented (in literature) effects of *Ipomoea aquatica* on community composition but inferred likely negative effects from competition for light, water uptake, and nutrient uptake based on the effects other aquatic invasives have shown (citing Schmitz et al., 1993, and others).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

B - MODERATE SIGNIFICANCE

COMMENTS: In a study of 31 invasive plant species, Gordon (1998) found no documented (in literature) effects of *Ipomoea aquatica* on recruitment of native species but inferred likely negative effects of decreased recruitment and altered microclimate based on the effects other aquatic invasives have shown (citing Schmitz et al., 1993). It is known to form dense floating mats of intertwined stems over water surfaces, shading out native submersed plants and competing with native emergents (Benson et al., 2001; Fears, 1999; Florida Department of Environmental Protection, 2003; Langeland and Burks, 1998; ISSG, 2005). Patnaik (1976) (cited in Harwood and Sytsma, 2003) found that *Ipomoea aquatica* grew rapidly in one pond, covering the entire surface, and that the other aquatic plants *Pistia*, *Azolla* and *Utricularia* disappeared - probably due to the shading effect of the over-topping *I. aquatica*.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

A/B - HIGH/MODERATE SIGNIFICANCE

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COMMENTS: Because this species occurs in aquatic tropical and subtropical areas as an invasive in the United States, (Hawaii, Florida Everglades) it can be assumed that negative effects on these communities (primarily areas of high conservation concern) are not negligible. The plant has been introduced to Florida repeatedly since 1973 despite numerous eradication efforts (ISSG, 2005; USDA, 2006).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

C - LOW SIGNIFICANCE

COMMENTS: USDA (2006) lists introduced U.S. range as California (two counties in north central), Hawaii (all islands except Hawaii and Kauai), and Florida (Hillsborough, Manatee, Osceola, Pinellas Counties in coastal western peninsula- see ISSG, 2005). PIER (1999) also lists Hawaii but includes the big island (Hawaii) as well as Maui, Midway Atoll, and Oahu. In Florida, two floating wild biotypes and at least one 'upland' cultivated form identified ("red", "white" or "green", and "upland") with studies showing no evidence the cultivated variety has diverged from the wild types to any greater extent than the wild types are different from each other (Van and Madeira, 1998; Manos and Miller, 2001).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A - HIGH SIGNIFICANCE

COMMENTS: The requirement for warm, humid conditions may explain why the plant survives only in Florida, Hawaii and Puerto Rico and why it has become a problem in Florida but not in any other areas of the USA (Harwood and Sytsma, 2003). The plant is cultivated in California, Texas, and the US Virgin Islands (Harwood and Sytsma, 2003; Van and Madeira, 1998). Its wide usage as a vegetable crop in Asia and among some communities in Florida, Hawaii, Texas, and California may cause further spread in these areas (Harwood and Sytsma, 2003).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

C - LOW SIGNIFICANCE

COMMENTS: It is conservatively estimated that 4 or 5 ecoregions (1 in Hawaii, 1-2 in Florida, 2 in California) have been invaded by *Ipomoea aquatica* in the United States (Cordeiro, pers. obs. March 2006 based on TNC, 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B - MODERATE SIGNIFICANCE

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COMMENTS: This species is a fresh water aquatic found primarily in canals and ditches, but also lakes, ponds, and marshes, but also in very moist soils such as the muddy banks along streams (ISSG, 2005, PIER, 2005; Langeland and Burks, 1998). Typically it is only found in tropical and subtropical areas because it is susceptible to frosts and does not grow well when temperatures drop below 23.9 degrees C (Edie and Ho, 1969; Harwood and Sytsma, 2003) and cannot survive frost (Rhui-cheng and Staples, 1995). It is cultivated in Hawaii in streams, ponds, and taro paddies (Wagner et al., 1999). The two wild forms are usually found floating in freshwater marshes and ponds while the "upland" cultivar roots in non-inundated soils and is grown commercially in raised beds under terrestrial conditions (Van and Madeira, 1998). Although it can grow in both moist soil and in water, growth (in biomass) in soil was found to be higher than in water for experimental plants studied in southeast Asia (Luyen and Preston, 2004), however this type of habitat has not been fully utilized in the invasive populations in the United States. In Florida, isolated populations have been found floating and creeping horizontally along shorelines and over water for long distances, especially in canals and lakes (Florida Department of Environmental Protection, 2003).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: The species is expanding globally into other parts of Asia, Africa, Australia, several Pacific Islands, and South America (Langeland and Burks, 1998), but less so in the United States, and, despite repeated efforts to eradicate it, has reinvaded Florida several times since 1973.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

A - HIGH SIGNIFICANCE

COMMENTS: The requirement for warm, humid conditions may explain why the plant survives only in Florida, Hawaii and Puerto Rico and why it has become a problem in Florida but not in any other areas of the USA (Harwood and Sytsma, 2003). It is susceptible to frosts and does not grow well when temperatures are below 23.9C, thus limiting its spread in the United States (Samkol, 2005). The plant is cultivated in California, Texas, and the US Virgin Islands (Harwood and Sytsma, 2003; Van and Madeira, 1998). Its wide usage as a vegetable crop in Asia and among some communities in Florida, Hawaii, Texas, and California may cause further spread in these areas (Harwood and Sytsma, 2003), but it is currently limited to only 1-2 biogeographic units in Florida, 2 in California, and all but two islands in the Hawaiian Island chain. In Florida, isolated populations have been found floating and creeping horizontally along shorelines and over water for long distances, especially in canals and lakes (Florida Department of Environmental Protection, 2003). As such, total potential range, which includes all tropical areas of the U.S., has not yet been fully utilized.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Potential for long-distance dispersal by human influence is high because the plant is a common herb in many traditional Asian recipes and is used medicinally. Also, the weed spreads rapidly from plant fragments and its floating seeds allow effective colonization of new areas (ISSG, 2005). Potential for further invasion through human introduction exists via food for livestock as this species has recently been recognized as an excellent feed resource in southeast Asia for rabbits (Chat et al., 2005; Phimmmason et al., 2004; Samkol, 2005), as well as people.

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13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: *Ipomoea aquatica* was recognized as a potential threat to natural areas in Florida in 1951 (Osche, 1951 as cited in Langeland and Burks, 1998) and it has been introduced into Florida repeatedly since 1973. Potential for further invasion through human introduction exists via food for livestock as this species has recently been recognized as an excellent feed resource in southeast Asia for rabbits (Chat et al., 2005; Phimmmason et al., 2004; Samkol, 2005), as well as people. In Florida, isolated populations have been found floating and creeping horizontally along shorelines and over water for long distances, especially in canals and lakes (Florida Department of Environmental Protection, 2003).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: All three invasive forms (wild "red", "white" or "green", and cultivated "upland") show a vining habit (Van and Madeira, 1998). The weed spreads rapidly from plant fragments and its floating seeds allow effective colonization of new, undisturbed areas (ISSG, 2005). This is particularly of concern in Florida where it has been introduced repeatedly since 1973 in and around the Everglades despite eradication effort.

15. SIMILAR HABITATS INVADED ELSEWHERE

B - MODERATE SIGNIFICANCE

COMMENTS: This species is considered the second greatest problem plant in the Philippines, where it tends to overgrow freshwater marginal areas (Gangstadt, 1976). Due to its aggressive growth rate and tolerance for moist cultivated areas, such as rice and sugar cane fields, this species has the potential to invade wet areas such as the Everglades, natural lakes, and rivers. Although it can grow in both moist soil and in water, growth (in biomass) in soil was found to be higher than in water for experimental plants studied in southeast Asia (Luyen and Preston, 2004), however this type of habitat has not been fully utilized in the invasive populations in the United States.

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: *Ipomoea aquatica* generally propagates sexually by water-borne seeds, and readily by rooting from nodes and pieces broken (PIER, 2005; Edie and Ho, 1969). A single plant can grow taller than 21 m and branch profusely to over 70 feet long (Harwood and Sytsma, 2003; Langeland, and Burks, 1998) and may root at every node producing new plants when fragmented (Edie and Ho, 1969). Langeland and Burks (1998) also report that this species can produced large amounts of biomass (190,000 kg fresh weight per ha in 9 months) and large numbers of seeds (175-245 per plant) during peak season.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/B - HIGH/MODERATE SIGNIFICANCE

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COMMENTS: Because herbicides, though effective (ISSG, 2005; Ninomiya et al., 2003), are not specific enough to be used in sensitive areas (Hawaii, Florida everglades) where this species has invaded, eradication is very difficult (ISSG, 2005). Although sale and distribution is prohibited in Florida, this plant has repeatedly been introduced there since 1973 (ISSG, 2005).

18. MINIMUM TIME COMMITMENT

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Aquatic herbicides have been successful as a control measure but results are often only temporary (ISSG, 2005; Ninomiya et al., 2003), requiring repeated application.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A - HIGH SIGNIFICANCE

COMMENTS: Because herbicides, though effective (ISSG, 2005; Ninomiya et al., 2003), are not specific enough to be used in sensitive areas (Hawaii, Florida everglades) where this species has invaded, eradication is very difficult (ISSG, 2005), as herbicides are currently the accepted method of control for this species.

20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: It appears most to all areas are easily accessible, as for most aquatic plants outside unusual habitats such as caves or high elevation streams or ponds. Because it is cultivated on private lands in Hawaii in streams, ponds, and taro paddies (Wagner et al., 1999), some areas may be difficult to access.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Ipomoea triloba

ELEMENT NATIONAL ID: 234419
SCIENTIFIC NAME: *Ipomoea triloba*
COMMON NAME: Little-bell
I-RANK REVIEW DATE: 2006-06-23
EVALUATOR: J. Cordeiro

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:
This species has a narrow, disjunct range in the U.S. but is known from areas with high concentrations of rare species and conservation areas such as the Florida Everglades and Hawaii. Impacts are largely unknown, but related species of Ipomoea are known to form dense tangled vine mats in aquatic environments and overshadow native species. In other countries, and parts of Hawaii, this species has spread rapidly with high invasive potential but it has recently been removed from the USDA noxious weed list because of difficulty distinguishing between native and non-native strains in Florida where it is spreading. Control is difficult but possible although negative impact to natives is often high.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Medium

OTHER CONSIDERATIONS:
Many floristic studies of the New World have misrepresented this species (Austin, 1978) making analysis as an invasive difficult. Because no scientific data was available to distinguish between native and foreign strains of *Ipomoea triloba*, the USDA (1999) removed this species from its list of noxious weeds of the U.S. due to lack of authority to regulate native weed species. If taxonomic expertise evolves to a point where taxonomists can distinguish non- native genetic strains of *I. triloba* from native strains of *I. triloba*, the USDA will consider listing the non-native strains as Federal noxious weeds (USDA, 1999).

NATIVE AND NON-NATIVE IN NATION
NATIVE RANGE: Native range includes tropical West Indies (PIER, 2005; Wagner et al., 1999). Rhui-cheng and Staples (1995) list global distribution as Anhui, Guangdong, S Shaanxi, Taiwan, Zhejiang [Indonesia, Japan (Ryukyu Islands), Malaysia, New Guinea, Philippines, Sri Lanka, Thailand, Vietnam; North America (native to the West Indies), Pacific Islands, now a circumtropical weed].

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

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COMMENTS: This species is established as a non-native in the U.S. and placed on the U.S.D.A. list of noxious weeds although it was suggested for removal from this list due to the inability to distinguish non-native invasive strains from native strains in Florida (USDA, 1999; 2006).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: This species is established as a non-native in the U.S. and placed on the U.S.D.A. list of noxious weeds although it was suggested for removal from this list due to the inability to distinguish non-native invasive strains from native strains in Florida (USDA, 1999; 2006). Also considered a noxious weed in southeastern cotton and rice fields.

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C - LOW SIGNIFICANCE

COMMENTS: Little is known about the effect of this species on ecosystem processes. In a study of 31 invasive plant species, Gordon (1998) found no documented (in literature) effects of the related species, *Ipomoea aquatica*, on ecosystem geomorphology, hydrology, or biochemistry but inferred likely negative effects on water chemistry based on the effects other aquatic invasives (*Eichhornia crassidens*, *Hydrilla verticillata*, *Pistia stratiotes*) have shown (citing Schmitz et al., 1993) where dissolved oxygen, pH, and phosphorus decreased while dissolved carbon dioxide, turbidity, and water color increased with these species.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: The plant is a spreading annual vine climber and individual plants can cover more than 1 square meter (Silvestre, 2004). The vines of the related plant, *Ipomoea aquatica*, create dense impenetrable canopies over small ponds and retention basins creating an added canopy layer that promotes stagnant water conditions and competetively excludes other species (Fears, 1999).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Impacts on community composition are not known. In a study of 31 invasive plant species, Gordon (1998) found no documented (in literature) effects of the related *Ipomoea aquatica* on community composition but inferred likely negative effects from competition for light, water uptake, and nutrient uptake based on the effects other aquatic invasives have shown (citing Schmitz et al., 1993, and others).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

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COMMENTS: Impacts on individual natives are not known. In a study of 31 invasive plant species, Gordon (1998) found no documented (in literature) effects of the related *Ipomoea aquatica* on recruitment of native species but inferred likely negative effects of decreased recruitment and altered microclimate based on the effects other aquatic invasives have shown (citing Schmitz et al., 1993). The related species, *I. aquatica*, is known to form dense floating mats of intertwined stems over water surfaces, shading out native submersed plants and competing with native emergents (Benson et al., 2001; Fears, 1999; Florida Department of Environmental Protection, 2003; Langeland and Burks, 1998; ISSG, 2005). Patnaik (1976) (cited in Harwood and Sytsma, 2003) found that *Ipomoea aquatica* grew rapidly in one pond, covering the entire surface, and that the other aquatic plants *Pistia*, *Azolla* and *Utricularia* disappeared - probably due to the shading effect of the over-topping *I. aquatica*.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B - MODERATE SIGNIFICANCE

COMMENTS: Because this species occurs in aquatic tropical and subtropical areas as an invasive in the United States, (Hawaii, Florida everglades) it can be assumed that negative effects on these communities (primarily areas of high conservation concern) are negligible. The related plant, *Ipomoea aquatica*, has been introduced to Florida repeatedly since 1973 despite numerous eradication efforts (ISSG, 2005; USDA, 2006) and threatens conservation areas such as the Everglades. There is difficulty, however, in distinguishing native versus non-native strains of *Ipomoea triloba* (USDA, 1999).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

C - LOW SIGNIFICANCE

COMMENTS: USDA (2006) lists United States distribution as California (1 county each in central, and extreme southern California in Riverside County), Hawaii (all islands except the big island of Hawaii), and Florida (13 counties throughout southern and central peninsula, and 4 counties scattered throughout panhandle), although Florida populations may be native (USDA, 1999; 2006). Oppenheimer and Bartlett (2002) recently confirmed the first record of this species on the big island of Hawaii in Waiakea (South Hilo district) collected in 2000.

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B - MODERATE SIGNIFICANCE

COMMENTS: This species is considered a noxious weed in California (only occurs in small portion of extreme southern California) and formerly Florida (it was removed because of difficulty distinguishing between native and foreign strains) (USDA, 1999; 2006) and Hawaii.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

C - LOW SIGNIFICANCE

COMMENTS: It is conservatively estimated that only 4 (2 if Florida is discounted as it may be endemic there) ecoregions have been invaded by *Ipomoea triloba* in the United States (Cordeiro, pers. obs. March 2006 based on TNC, 2001).

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9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Outside the U.S., this species occurs in various habitats from open, sunny hillsides to relatively dense forest in partial sun or deep shade. In Hawai'i, it "naturalized in low elevation, dry to mesic, disturbed sites" (Wagner *et al.*, 1999).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: Range is not spreading much in the United States except in Hawaii where it is now known from all the islands in the chain. The California introduction is likely a human introduction rather than a range expansion. Florida populations are likely native but there is difficulty distinguishing native from non-native strains. Regardless, it is increasing in Florida at an alarming rate (USDA, 1999).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

B - MODERATE SIGNIFICANCE

COMMENTS: Potential range in the U.S. includes only tropical portions in Hawaii, southern California, and the tropical Gulf of Mexico.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: It can be introduced as a contaminant in rice (Wagner et al., 1999) and cotton (USDA; 1999). Potential for long-distance dispersal by human influence may be high because the plant is a common herb in many traditional Asian recipes and is used medicinally. Also, the related *Ipomoea aquatica* spreads rapidly from plant fragments and its floating seeds allow effective colonization of new areas (ISSG, 2005).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Local expansion has not occurred for the large part, except in Hawaii where it is now documented on all the islands (Oppenheimer and Bartlett, 2002); and Florida where it has greatly expanded its range since the 1990s, however Florida populations are likely native as strains are difficult to distinguish from one another (USDA, 1999; 2006).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: Much like *Ipomoea aquatica*, this species shows a vining habit (Van and Madeira, 1998). It has spread into native areas in South Florida and Hawaii (USDA, 1999; 2006; Oppenheimer and Bartlett, 2000), but not to the extent that *Ipomoea aquatica* has. Other dispersal information into natural areas is lacking.

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15. SIMILAR HABITATS INVADED ELSEWHERE

B - MODERATE SIGNIFICANCE

COMMENTS: This species has now become weedy throughout the tropics (Rhui-cheng and Staples, 1995; Pacific Island Ecosystems at Risk PIER, 2004) often in roadsides or fields.

16. REPRODUCTIVE CHARACTERISTICS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Plants flower abundantly from July to November and produce many fertile seeds (200-228 plantules found per m^2) (Silvestre, 2004). *Ipomoea* generally propagate sexually by water-borne seeds, and readily by rooting from nodes and pieces broken (PIER, 2005; Edie and Ho, 1969).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Because herbicides, though effective (ISSG, 2005; Ninomiya et al., 2003), are not specific enough to be used in sensitive areas (Hawaii, Florida everglades) where this species has invaded, eradication is very difficult (ISSG, 2005). Although sale and distribution is prohibited in Florida, this plant has repeatedly been introduced there since 1973 (ISSG, 2005).

18. MINIMUM TIME COMMITMENT

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Aquatic herbicides have been successful as a control measure but results are often only temporary (ISSG, 2005; Ninomiya et al., 2003), requiring repeated application.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A - HIGH SIGNIFICANCE

COMMENTS: Because herbicides, though effective (ISSG, 2005; Ninomiya et al., 2003), are not specific enough to be used in sensitive areas (Hawaii, Florida everglades) where this species has invaded, eradication is very difficult (ISSG, 2005), as herbicides are currently the accepted method of control for this species.

20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: It appears most to all areas are easily accessible, as for most aquatic plants outside unusual habitats such as caves or high elevation streams or ponds.

REFERENCES:

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Invasive Species Assessment Protocol:
U.S. National Assessments

Iris pseudacorus

ELEMENT NATIONAL ID: 205914
SCIENTIFIC NAME: *Iris pseudacorus*
COMMON NAME:
I-RANK REVIEW DATE: 2005-11-30
EVALUATOR: Gravuer, K.

I-RANK: High/Medium

I-RANK REASONS SUMMARY:

Iris pseudacorus is a popular ornamental species in the United States. It is widespread in riparian and other wetland habitats throughout much of the country, with the exclusion of the Rocky Mountain region and the southwest. Although it is likely near the limits of its generalized range, it continues to spread and increase locally. Pale yellow iris is a very strong competitor that forms dense, monotypic stands. Its rhizome mat can collect sediment, elevate topography, and interfere with stream flow, creating a drier habitat that is less suitable for many native species. Significant changes in community composition and successional trajectories have been reported at invaded sites. Management of this species by either mechanical removal of the rhizome mass or by cutting and spraying with glyphosate herbicide can be labor-intensive, as even small residual rhizome fragments can re-sprout vigorously, necessitating considerable follow-up treatment.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Medium

NON-NATIVE THROUGHOUT NATION

NATIVE RANGE: Native throughout Europe, as well as in some parts of temperate Asia and northern Africa.
Northern Africa: Algeria, Morocco. Temperate Asia: Iran, Palestine, Syria, Turkey, Azerbaijan, Russian Federation [Ciscaucasia, Western Siberia]. Europe: Denmark, Finland, Ireland, Norway, Sweden, United Kingdom, Austria, Belgium, Czechoslovakia, Germany, Hungary, Netherlands, Poland, Switzerland, Belarus, Estonia, Latvia, Lithuania, Moldova, Russian Federation [European part], Ukraine [incl. Krym], Bulgaria, Greece [incl. Crete], Italy [incl. Sardinia, Sicily], Romania, Yugoslavia, France [incl. Corsica], Portugal [incl. Madeira Islands], Spain [incl. Baleares, Canary Islands] (GRIN 2001).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

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S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Most frequently found in riparian habitats and in open, freshwater wetland ecosystems, and could probably be considered an aquatic species in some cases. Also found in brackish and salt marshes and in forested wetland habitats. Apparently found rarely along rocky coastal shores and may persist in more upland grassland environments when planted (Egler 1983, Jacono 2000, Mehrhoff et al. 2003, Tu 2003, Wisconsin State Herbarium 2005).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: The rhizome mat that this species creates collects sediment, elevates topography, and interferes with stream flow, creating a drier habitat (Tu 2003, Heckman 2005). This change in hydrology can have significant impacts on other wetland species in the ecosystem. For example, along the lower Potomac River, this species' elevation of the seed bank facilitated the conversion of riparian marshes into mesic forest dominated by *Fraxinus* species rather than by the willows (*Salix* spp.) that had formerly occurred there (Thomas 1980).

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: The changes in layer density caused by this species are moderate to substantial. Although it frequently invades areas dominated by plants of somewhat similar life-form (e.g. freshwater marshes), the almost impenetrable thickets (ISSG 2005) that it forms can be significantly denser than the native vegetation. In addition, the rhizome mats that it creates on the soil surface can alter microhabitats and prevent germination of native species (Heckman 2005). These structural changes can alter successional trajectories (Tu 2003).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This species is a fast-growing, strong competitor that forms dense, monotypic stands (Ramey and Peichel 2001, Weber 2003). Even native plant species that are thought to be somewhat aggressive themselves (e.g. *Typha latifollia*) are frequently out-competed (Washington State Noxious Weed Control Board 2003). The density of the stand can also exclude native animals (Tu 2003). In addition, because all parts of the plant are poisonous, *I. pseudacorus* does not provide food for native animals, and birds are not known to disperse the seeds (Mehrhoff et al. 2003, Tu 2003).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: In Connecticut, *I. pseudacorus* was able to exclude the native arrow-arum (*Peltandra virginica*), a plant whose fruits are an important food of wood ducks during the nesting season (Cox 1999, cited in Tu 2003). It also out-competes the native cat-tail (*Typha latifolia*) (Washington State Noxious Weed Control Board 2003). In addition, it may impact riparian willows (*Salix* spp.) at some sites by elevating the seed bank (Thomas 1980). No impacts via hybridization are known (Ramey and Peichel 2001).

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5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B - MODERATE SIGNIFICANCE

COMMENTS: In Texas, *Iris pseudacorus* has recently become established in the Frio River, one of the few entirely spring fed and still free flowing rivers in the state (Jacono 2000). In addition, the freshwater marsh ecosystems it invades are uncommon and therefore of conservation significance in some areas of its range (e.g. Miller and Golet 2000).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Widely established in low-elevation areas throughout much of the contiguous U.S., except in the Rocky Mountain region (Kartesz 1999, Tu 2003, NRCS 2005). More frequent in the northeastern states than in the south and west, as its arrival in the western states appears to be relatively recent (perhaps the late 1940s; Jacono 2000). Nevertheless, it is abundantly established in many western and southern locations, including areas of TX, CA, WA, and MT (Jacono 2000).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Reported as an invasive species or listed on some form of invasive or noxious list in 20 out of the 41 states in which it is established (Kartesz 1999, GRIN 2001, Mehrhoff et al. 2003, Tu 2003, Washington State Noxious Weed Control Board 2003, Czarapata 2005, MNDNR 2005, NRCS 2005, Rice 2005, Swearingen 2005, Wisconsin State Herbarium 2005). Seems to be most problematic in the northeast, upper Midwest, and Pacific northwest states (Mehrhoff et al. 2003, Washington State Noxious Weed Control Board 2003, Czarapata 2005); potentially not as invasive in the south because of the warmer temperatures there (Jacono 2000).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: More than 35 ecoregions are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B - MODERATE SIGNIFICANCE

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COMMENTS: Has invaded a diverse range of habitats from sea level to 300 meters (Tu 2003). Usually in sites with a continuously high soil-water content across a range of soil types (Weber 2003, Tu 2003). Tolerant of high soil acidity, long periods of anoxia, and at least some salinity, and established rhizomes can withstand moderate droughts (Tu 2003, Ramey and Peichel 2001, Mehrhoff et al. 2003, King County Noxious Weed Control Board 2005). Requires high levels of nitrogen and prefers sites in sun or partial shade (Czarapata 2005, Whitinger 2005). Most frequently found in riparian habitats (e.g. stream banks and lake shores, including their man-made analogues such as ditches) and in open, freshwater wetland ecosystems. Could probably be considered an aquatic species in some cases (e.g. when rhizomes form floating mats, when it occurs on the edges of floating mats of other vegetation, and when in occurs in coarse-textured stream beds next to riffles (Jacono 2000, Weber 2003, Wisconsin State Herbarium 2005)). Also found in brackish and salt marshes, although some sources indicated that it occurs in these environments more often in its native range than in seems to in the U.S. (Mehrhoff et al. 2003). Several sources listed forested wetland habitats, including swamps and floodplain forests (Flora of North America Editorial Committee 2002, Mehrhoff et al. 2003, Tu 2003). Apparently found rarely along rocky coastal shores (Tu 2003) and may persist in more upland grassland environments when planted (Egler 1983).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: In New England, *I. pseudacorus* has been planted since at least the mid-1800s and was reported as escaped by 1868 (Mehrhoff et al. 2003). However, its spread to the western U.S. appears to be relatively recent, with a 1948 report from Washington and late-1950s reports from Montana and California being among the species' earliest western records (Ramey and Peichel 2001, King County Noxious Weed Control Board 2005). It also appears to be recently spreading southward, with new Texas populations reported in 1998 (Jacono 2000).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: This USDA hardiness zones for this species are zone 4a to zone 9a (Whitinger 2005). Therefore, it may not be suited to most of AK and HI and would probably have difficulty establishing there. Much of the southwest that it has not already invaded may also be unsuitable due to insufficient precipitation, as this species prefers sites with a continuously high soil-water content (Tu 2003). The Rocky Mountains are probably also unsuitable, as the species seems to require lowland areas (< 300 m) (Tu 2003). Nevertheless, there is potentially for additional spread within some of the regions it has already invaded, such as the Pacific Northwest (King County Noxious Weed Control Board 2005).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Popular in the U.S. primarily as an ornamental species in wet gardens and pond plantings (Jacono 2000). Also used for erosion control, in dye and fiber production, and in waste water and storm-water treatment ponds for heavy metal fitration (WISC 2004). Widely available for purchase, including online purchase (Ramey and Peichel 2001, King County Noxious Weed Control Board 2005, Whitinger 2005). In addition, both rhizome fragments and seeds can also disperse long distances by water; seeds are buoyant and can remain so for at least 7 months (Tu 2003).

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13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B - MODERATE SIGNIFICANCE

COMMENTS: Local spread and increase is occurring most rapidly in recently invaded regions, such as the Pacific Northwest (Heckman 2005). However, some degree of local spread is likely occurring throughout much of the range, as it is still widely available and sold as a garden ornamental (Ramey and Peichel 2001, Tu 2003).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This species prefers sun or partially shaded light conditions (Whitinger 2005). Therefore, disturbance events often create more favorable habitat for invasion by increasing light levels. However, a number of sources noted that the species does not appear to be dependent on disturbance for establishment (Heckman 2005), and that it can establish in a variety of existing vegetation types (APRS Implementation Team 2001).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Also naturalized in at least Canada, Australia, New Zealand, Argentina, and Japan (Randall 2002). Invaded habitats appear to be largely similar (e.g. riparian areas and freshwater wetlands, Csurhes and Edwards 1998).

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: Strongly exhibits the following characteristics: reproduces readily both vegetatively and by seed, has quickly spreading rhizomes, resprouts readily when burned, and fragments easily with fragments capable of dispersing and subsequently becoming established (Ramey and Peichel 2001, Tu 2003, Washington State Noxious Weed Control Board 2003, Weber 2003, ISSG 2005).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This species is difficult to manage once firmly established (Tu 2003). Small, isolated patches can be controlled by physical removal of the entire rhizome system, but because rhizomes resprout vigorously, substantial investment of time and labor is required (Tu 2003). Also, resins in leaves and rhizomes can cause skin irritation in humans (King County Noxious Weed Control Board 2005), which may limit the potential for volunteer pulling efforts. Larger patches can be controlled by cutting followed by application of a glyphosate herbicide suitable for aquatic environments (Tu 2003). However, follow-up treatments are necessary with this method as well (Tu 2003).

18. MINIMUM TIME COMMITMENT

B - MODERATE SIGNIFICANCE

COMMENTS: Although this species does not have a long-term seed bank (Peat and Fitter 2005), the ability of even very small rhizome fragements to resprout means that follow-up control for a number of years will likely be necessary (Tu 2003).

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19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Mechanical removal in sensitive areas, such as shallow stream beds, may cause extensive disturbance and permit the establishment of other unwanted plants (Jacono 2000). Therefore, if herbicides are not an option at a site, significant impacts on native species may occur. Cutting followed by herbicide will also likely have some collateral impacts, because the large surface area of this species' foliage may make very precise targeting of the herbicide difficult.

20. ACCESSIBILITY OF INVADED AREAS

B - MODERATE SIGNIFICANCE

COMMENTS: Because this species invades wetlands, some accessibility issues may be present. Also, the very high density of the thickets combined with the skin irritation that the plant causes can present substantial obstacles to individuals attempting to control the species on foot.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Kummerowia stipulacea

ELEMENT NATIONAL ID: 221903
SCIENTIFIC NAME: *Kummerowia stipulacea*
COMMON NAME:
I-RANK REVIEW DATE: 2006-05-01
EVALUATOR: Tomaino, A.

I-RANK: Low

I-RANK REASONS SUMMARY:
Planted for forage and soil improvement. Mainly found in disturbed areas but can thrive in some prairies. May be common in pastures, open woodlands and borders, old fields, roadsides, urban waste areas and lawns. Fixes nitrogren and is highly competitive on infertile sites. Scattered throughout most of the eastern U.S. but apparently having low impacts in most areas.

SUBRANK I - ECOLOGICAL IMPACT:	Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Insignificant

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Korea, Japan, Taiwan, China, Russian Federation (USDA 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Established outside cultivation in the U.S. (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Occurs in pastures, open woodlands and borders, old fields, roadsides, urban waste areas and lawns (Isely 1998).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C - LOW SIGNIFICANCE

COMMENTS: Fixes nitrogren (Mehrhoff 2002).

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2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

COMMENTS: Annual; prostrate or ascending to 4 dm (Isely 1998).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C - LOW SIGNIFICANCE

COMMENTS: May displace desirable vegetation if not properly managed (NRCS 2002).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not significant.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: In Missouri, capable of thriving in some prairie vegetation (Ladd and Churchwell 1999). Occurs in open woodlands (Isely 1998). At least some of these communities may be of conservation significance but apparently, it is not often threatening elements of conservation significance.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Established in scattered counties from New York south to Florida, west to Nebraska and eastern Texas (J. Kartesz, unpublished data).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C - LOW SIGNIFICANCE

COMMENTS: In Missouri, capable of thriving in some prairie vegetation (Ladd and Churchwell 1999). In Indiana, not known to have moved into natural areas (Jacquart et al. 2004).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: Inferred from distribution as currently understood (J. Kartesz, unpublished data; TNC 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Occurs in pastures, open woodlands and borders, old fields, roadsides, urban waste areas and lawns (Isely 1998). In Missouri, capable of thriving in some prairie vegetation (Ladd and Churchwell 1999).

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SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Planted for forage and soil improvement (Isely 1998). It has spread rather quickly and the newer variants have progressively become adapted northward (Great Plains Flora Association 1986).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Inferred from USDA (1990) and J. Kartesz, unpublished data.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Planted for forage and soil improvement (Isely 1998). Seed is readily available from commercial seed dealers (NRCS 2002).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Planted for forage and soil improvement (Isely 1998). It has spread rather quickly and the newer variants have progressively become adapted northward (Great Plains Flora Association 1986).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: Germinates fairly well in infertile, somewhat disturbed sites but not on fertile sites with dense vegetation (Jacquart et al. 2004). Highly competitive in infertile sites, yet often outcompeted on fertile sites (Jacquart et al. 2004). Weak to moderate grassland competitor (Ladd and Churchwell 1999).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Distributed in cultivation and established in both hemispheres (Isely 1998). No mention of invasion of native species habitats elsewhere found in the literature; assumption is that occurs in similar habitats outside the region of interest.

16. REPRODUCTIVE CHARACTERISTICS

C - LOW SIGNIFICANCE

COMMENTS: Reproduces only by seed (Jacquart et al. 2004). Reproduces one or more times a year (Jacquart et al. 2004). Produces a moderate number of seeds, 11-1000 (Jacquart et al. 2004). Flowers appear to be self-fertilized and produce abundant seed in both chasmogamous and cleistogamous types (Great Plains Flora Association 1986).

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SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: No mention of control requiring a major long-term investment found in the literature; assumption is that a major long-term investment is not required.

18. MINIMUM TIME COMMITMENT

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: No mention of control requiring more than 10 years found in the literature; assumption is that control requires less than 10 years.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: No mention of severe management impacts on natives found in the literature; assumption is that management impacts do not cause significant and persistent reductions in native species >75% of the time.

20. ACCESSIBILITY OF INVADED AREAS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Planted for forage and soil improvement (Isely 1998). A potential host of soybean rust (USDA 2004). Assumption is at least in some areas, accessibility may be a problem but problems are not severe or substantial.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Kummerowia striata

ELEMENT NATIONAL ID: 229287
SCIENTIFIC NAME: *Kummerowia striata*
COMMON NAME:
I-RANK REVIEW DATE: 2006-06-14
EVALUATOR: Tomaino, A.

I-RANK: Low

I-RANK REASONS SUMMARY:
Planted for forage and soil improvement. Mainly found in disturbed areas especially pastures, old fields, roadsides, and waste areas. Fixes nitrogren and is highly competitive on infertile sites but is usually overgrown by other pioneers in a few years. It can thrive in some prairies and open woodlands. Scattered throughout most of the eastern U.S. but apparently having low impacts in most areas.

SUBRANK I - ECOLOGICAL IMPACT:	Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Insignificant

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Korea, Japan, Taiwan, China, Vietnam, Russian Federation (USDA 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Established outside cultivation in the U.S. (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Occurs in pastures, old fields, roadsides, diverse barren or eroding ruderal sites, urban waste areas and lawns (Isely 1998).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C - LOW SIGNIFICANCE

COMMENTS: Fixes nitrogren (Erdman 1967).

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2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

COMMENTS: Annual; prostrate, ascending or erect to 4 dm (Isely 1998).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C - LOW SIGNIFICANCE

COMMENTS: May displace desirable vegetation if not properly managed (NRCS 2002). In some open woodlands with acid soil in the Great Plains, it has become well established and locally abundant (Great Plains Flora Association 1986).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not significant.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: In Missouri, capable of thriving in some prairie vegetation (Ladd and Churchwell 1999). In some open woodlands with acid soil in the Great Plains, it has become well established and locally abundant (Great Plains Flora Association 1986). Naturalized in dry open woods, rocky open areas, and gravelly stream banks (Sullivan 1993). At least some of these communities may be of conservation significance but apparently, it is not often threatening elements of conservation significance.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Established in scattered counties from Connecticut south to Florida, west to Kansas and New Mexico (J. Kartesz, unpublished data).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C - LOW SIGNIFICANCE

COMMENTS: In Missouri, capable of thriving in some prairie vegetation (Ladd and Churchwell 1999). In Indiana, not known to have moved into natural areas (Jacquart et al. 2004). In some open woodlands with acid soil in the Great Plains, it has become well established and locally abundant (Great Plains Flora Association 1986).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: Inferred from distribution as currently understood (J. Kartesz, unpublished data; TNC 2001).

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9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Occurs in pastures, old fields, roadsides, diverse barren or eroding ruderal sites, urban waste areas and lawns (Isely 1998). In Missouri, capable of thriving in some prairie vegetation (Ladd and Churchwell 1999). Naturalized in dry open woods, rocky open areas, and gravelly stream banks (Sullivan 1993).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Planted for forage and soil improvement (Isely 1998). In some open woodlands with acid soil in the Great Plains, it has become well established and locally abundant (Great Plains Flora Association 1986).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Inferred from USDA (1990) and J. Kartesz, unpublished data.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Planted for forage and soil improvement (Isely 1998). Seed is readily available from commercial seed dealers (NRCS 2002). Often included in grass mixtures in order to promote rapid establishment of grasses (Sullivan 1993).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Planted for forage and soil improvement (Isely 1998). In some open woodlands with acid soil in the Great Plains, it has become well established and locally abundant (Great Plains Flora Association 1986).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: Germinates fairly well in infertile, somewhat disturbed sites but not on fertile sites with dense vegetation (Jacquart et al. 2004). Highly competitive in infertile sites, yet often outcompeted on fertile sites (Jacquart et al. 2004). Weak to moderate grassland competitor (Ladd and Churchwell 1999). A pioneer on disturbed sites but it is usually overgrown by other pioneers in 2 or 3 years (Sullivan 1993).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Distributed in cultivation and widely established in both hemispheres (Isely 1998). No mention of invasion of native species habitats elsewhere found in the literature; assumption is that occurs in similar habitats outside the region of interest.

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16. REPRODUCTIVE CHARACTERISTICS

C - LOW SIGNIFICANCE

COMMENTS: Reproduces only by seed (Jacquart et al. 2004). Reproduces one or more times a year (Jacquart et al. 2004). Produces a moderate number of seeds, 11-1000 (Jacquart et al. 2004). Strong exhibition of aggressive reproductive characteristics not found in the literature; assumption is that the species is not moderately or extremely aggressive.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: No mention of control requiring a major long-term investment found in the literature; assumption is that a major long-term investment is not required.

18. MINIMUM TIME COMMITMENT

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: No mention of control requiring more than 10 years found in the literature; assumption is that control requires less than 10 years.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: No mention of severe management impacts on natives found in the literature; assumption is that management impacts do not cause significant and persistent reductions in native species >75% of the time.

20. ACCESSIBILITY OF INVADED AREAS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Planted for forage and soil improvement (Isely 1998). A potential host of soybean rust (USDA 2004). Assumption is at least in some areas, accessibility may be a problem but problems are not severe or substantial.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Lespedeza bicolor

ELEMENT NATIONAL ID: 212730
SCIENTIFIC NAME: *Lespedeza bicolor*
COMMON NAME:
I-RANK REVIEW DATE: 2006-06-19
EVALUATOR: Tomaino, A.

I-RANK: Medium

I-RANK REASONS SUMMARY:
Lespedeza bicolor is widely established in the southeastern U.S. and scattered in other eastern states. It is a much branched legume that grows up to 3 meters in height and fixes nitrogen. It is still sold and planted for wildlife food, ornamental use, and erosion control. Of particular concern, is plantings in forest openings from which it spreads. It has the ability to spread under a medium to dense understory and prescribed burning enhances its spread. *Lespedeza bicolor* occurs in areas with some disturbance and can become dominant in those areas. Control is moderately difficult. Herbicides are recommended and longterm follow-up is needed.

SUBRANK I - ECOLOGICAL IMPACT: Medium/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE: Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE: High/Medium
SUBRANK IV - MANAGEMENT DIFFICULTY: High/Medium

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Japan, China, Korea, Mongolia, and Russian Federation (USDA 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Established outside cultivation in the U.S. (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Established in woodlands and borders, mountain slopes, pine flatwoods and savannahs, creek banks, thickets, old fields, roadsides, and waste ares (Isely 1998).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Nitrogen fixer (Miller 2003).

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2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B - MODERATE SIGNIFICANCE

COMMENTS: Much branched shrub or suffrutescent perennial up to 3 meters tall (Isely 1998; Miller 2003). In areas with disturbance, this species may become dominant (Tesky 1992).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B - MODERATE SIGNIFICANCE

COMMENTS: In areas with disturbance, this species may become dominant (Tesky 1992). Interferes with tree seedling growth and survival (Tesky 1992).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not high or moderate.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: No mention of threats to elements of conservation concern found in the literature; assumption is that it is not often threatening elements of conservation concern. Occurs in woodlands, mountain slopes, pine flatwoods, savannahs, creek banks (Isely 1998) and early- to mid-seral grassland (Tesky 1992). At least some of these communities may be of conservation significance.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Established in 28 eastern states from Massachusetts to Texas. Most widely established in the southeast from West Virginia to northern Florida west to Arkansas and Louisiana; scattered in other eastern states (J. Kartesz, unpublished data).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B - MODERATE SIGNIFICANCE

COMMENTS: The North Carolina Native Plant Society placed this species in the category "exotic plant species that have invasive characteristics and spread readily into native plant communities, displacing native vegetation" (Franklin 2005). In Indiana, threatening natural areas (Indiana Native Plant Society, et. al 2003). In Georgia, viewed as extremely aggressive (Evans 2005). In Tennessee, considered a "significant threat" (TNEPPC 2001). In Uwharrie National Forest, NC, this species invades after prescribed burning in longleaf pine and oak-hickory restoration sites (ECOLOG Listserve 2005). In Oklahoma and Kansas, this species is negatively impacting rangeland (Plants for a Future 2004). In Virginia, occasionally invasive in native plant habitats (DCR and VNPS 2003).

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8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: Inferred from distribution as currently understood (J. Kartesz, unpublished data; TNC 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Spreads into adjacent forest when planted in openings (Miller 2003). Established in woodlands and borders, mountain slopes, pine flatwoods and savannahs, creek banks, thickets, old fields, roadsides, and waste ares (Isely 1998). Occurs in fields, open woodlands, clearings, fence/hedge row and roadsides, and early- to mid-seral grassland (Tesky, 1992). "Wildlife food plots", and roadsides (Weakely 2006). Disturbed sites (Wunderlin and Hansen 2003).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: It is still available for sale (Kemper Center for Home Gardening, not dated). Occurs in disturbed areas; assumption is that disturbed areas are not declining and therefore this species' total range is not declining.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Inferred from USDA (1990) and J. Kartesz, unpublished data.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Available for sale over the internet (Kemper Center for Home Gardening, not dated). Still planted for wildlife (Miller 2003) Planted as an ornamental (Tesky 1992). Birds and animals disperse seeds (Kemper Center for Home Gardening, not dated).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Occurs in disturbed areas; assumption is that disturbed areas are not decreasing or remaining stable and therefore this species' local range is not decreasing or remaining stable.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

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COMMENTS: Can reproduce and spread in medium-to-dense overstory (Miller 2003). In areas with disturbance, this species may become dominant (Tesky 1992). In the absence of further disturbance, its abundance will gradually decline; however, in areas with a disturbance regime of 4 years, densities remain high (Tesky 1992). Often establishes in severely disturbed areas but spreads slowly or not at all beyond these disturbed sites (DCR and VNPS 2003). "Spread encouraged by burning" (Miller 2003).

15. SIMILAR HABITATS INVADED ELSEWHERE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Occurs in Ontario, Canada (Kartesz 1999); therefore it is known as an escape outside the region of interest.

16. REPRODUCTIVE CHARACTERISTICS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Seeds are long lived in the soil seed bank (Miller 2003). May self-seed in optimal conditions (Kemper Center for Home Gardening, not dated). If cut to ground in late winter, will grow rapidly to 5' in next growing season (Kemper Center for Home Gardening, not dated). Will sprout from root crown if top-killed (Tesky 1992).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B - MODERATE SIGNIFICANCE

COMMENTS: Herbicides are recommended to control this species; mowing 1 to 3 months before herbicide application can assist in controlling it (Miller 2003). This species was found to be tolerant to a particular herbicide (Morisawa 1999). Some native insects such as the eastern tailed-blue butterly are beginning to adapt to use this species and may one day help keep it under control (Cook 2006). Prescribed burning promotes the spread of this species (Miller 2003).

18. MINIMUM TIME COMMITMENT

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Seeds are long lived in the soil seed bank and long-term monitoring is required (Miller 2003).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Herbicides may impact non-target species.

20. ACCESSIBILITY OF INVADED AREAS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Still planted for quail food plots (Miller 2003) and as an ornamental and for erosion control (Kemper Center for Home Gardening, not dated). Assumption is that accessibility is a problem in more than 5% of the infested area.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Lespedeza thunbergii

ELEMENT NATIONAL ID: 220766
SCIENTIFIC NAME: *Lespedeza thunbergii*
COMMON NAME:
I-RANK REVIEW DATE: 2006-06-26
EVALUATOR: Tomaino, A.

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:
Lespedeza thunberii is is established in scattered counties in 22 eastern states. It is still sold and planted for wildlife food and as an ornamental. It has some aggressive characteristics, such as the ability to grow 5 feet tall in a single growing season. It also fixes nitrogen. *Lespedeza thunbergii* occurs in areas with some disturbance and can replace other species. Currently, it appears to be rarely escaped from cultivation but if its use increases, impacts on biodiversity may increase. Some taxonomists view *Lespedeza thunberii* as a variant of *Lespedeza bicolor* which is more widely established and documented as impacting native species habitats.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Insignificant

OTHER CONSIDERATIONS:
Some taxonomists do not consider *Lespedeza thunbergii* to be distinct from *Lespedeza bicolor*. (Isely 1998). The two taxa seemingly intergrade, possibly because of hybridization (Isely 1998). *Lespedeza bicolor* is more widely established and documented as a having impacts on native species habitats than *Lespedeza thunbergii*.

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Native to China and Japan (Gleason and Cronquist 1991).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS: Established outside cultivation in the U.S. (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes
COMMENTS: Occurs in woodland borders and roadsides in the U.S. (Isely 1998).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Nitrogen fixer (NRCS 2002).

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: A perennial, 4 to 6 feet tall (NRCS 2002).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: May become invasive and displace desirable vegetation if not properly managed (NRCS 2002).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Easily hybridizes with other members of the genus (NRCS 2002). However, no mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not high or moderate.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No mention of threats to elements of conservation significance found in the literature; assumption is that it is not often or occasionally threatening elements of conservation significance.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Established in scattered counties in 22 eastern states from Massacuhusetts to Florida to Oklahoma (J. Kartesz, unpublished data).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C - LOW SIGNIFICANCE

COMMENTS: In Oklahoma and Kansas, this species is negatively impacting rangeland (Plants for a Future 2004). In Kentucky, considered to principally spread and remain in disturbed corridors, not readily invading natural areas (Kentucky Exotic Pest Plant Council 2000). In Georgia, a minor problem in Georgia natural areas (Georgia Exotic Pest Plant Council 2006). In a Missouri prairie, it is an accidental established in one area (Ladd and Churchwell 1999).

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8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Inferred from distribution as currently understood (J. Kartesz, unpublished data; TNC 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Occurs in woodland borders and roadsides in the U.S. (Isely 1998). In Florida, occurs in disturbed sites (Wunderlin and Hansen 2003). In Pennsylvania, rarely escaped from cultivation to dry fields and open woods (Rhoads and Block 2000). In North Carolina, South Carolina, and Georgia, it occurs rarely, in "wildlife food plots". In a Missouri prairie, it is an accidental established in one area (Ladd and Churchwell 1999).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: It is still available for sale (Kemper Center for Home Gardening, not dated). Occurs in disturbed areas; assumption is that disturbed areas are not declining and therefore this species' total range is not declining.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Inferred from USDA (1990) and J. Kartesz, unpublished data.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Planted for game animal food (NRCS 2002). Sold on the internet as an ornamental garden plant (Kemper Center for Home Gardening).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Occurs in disturbed areas; assumption is that disturbed areas are not decreasing or remaining stable and therefore this species' local range is not decreasing or remaining stable.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: Occurs in woodland borders and roadsides in the U.S. (Isely 1998). In Kentucky, considered to principally spread and remain in disturbed corridors, not readily invading natural areas (Kentucky Exotic Pest Plant Council 2000).

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15. SIMILAR HABITATS INVADED ELSEWHERE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Occurs in Ontario, Canada (Kartesz 1999); therefore it is known as an escape outside the region of interest. In Western Australia, it is prohibited to import this species (Randall 2003).

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: A perennial (NRCS 2002). On production fields, 21.6 million seeds per acre are produced (NRCS 2002). After being cut to the ground in early spring, it will grow rapidly up to 5 feet tall and 10 feet wide in a single growing season (Kemper Center for Home Gardening, not dated).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B - MODERATE SIGNIFICANCE

COMMENTS: On production fields, 21.6 million seeds per acre are produced (NRCS 2002). After being cut to the ground in early spring, it will grow rapidly up to 5 feet tall and 10 feet wide in a single growing season (Kemper Center for Home Gardening, not dated).

18. MINIMUM TIME COMMITMENT

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: No mention of control requiring more than 10 years found in the literature; assumption is that control requires less than 10 years.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: No mention of severe management impacts on natives found in the literature; assumption is that management impacts do not cause significant and persistent reductions in native species >75% of the time.

20. ACCESSIBILITY OF INVADED AREAS

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Planted for wildlife food (NRCS 2002) and as an ornamental (Kemper Center for Home Gardening, not dataed). ; assumption is, at least in some areas, accessibility may be a problem.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Ligustrum obtusifolium

ELEMENT NATIONAL ID: 246670
SCIENTIFIC NAME: *Ligustrum obtusifolium*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-10
EVALUATOR: K. Maybury

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:
This species of privet has naturalized reasonably extensively in the Northeast and to a lesser extent in the Midwest. It generally invades lower quality disturbed habitats but it can form dense thickets and could have impacts on native biodiversity in a number of locales.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Japan

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS:

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes
COMMENTS:

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No evidence of significant impacts on abiotic processes.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Forms dense thickets (IPANE, no date).

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3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Thickets can crowd out native species (IPANE, no date).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No evidence of disproportionate impacts.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C - LOW SIGNIFICANCE

COMMENTS: In disturbed places in the Southeast (Weakley 2006). In edge habitats such as old fields undergoing succession, roadsides, forest edges and open woods (IPANE, no date; Batcher 2000; Rhodes and Klein 1995; Cooperrider 1995; Voss 1996).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Escaped in much of the Northeast, Midatlantic, and Midwest (Kartesz 1999; IPANE, no date)

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: At least some negative impacts presumed in much of the generalized range. Along with *Ligustrum vulgare*, this is one of the two most common privets naturalized in New England (IPANE, no date). Noted as uncommon generally in the Virginia-to-Georgia region (Weakely 2006) but as far south as Virginia considered "moderately invasive" (VNPS and VDCR 2003). Frequently naturalized in Pennsylvania (Rhodes and Klein 1993), infrequently in Ohio (Cooperrider 1995) and occassionally in Michigan (Voss 1996).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS:

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Disturbed open to somewhat open habitats such as old fields, roadsides, forest edges and open woods (IPANE, no date).

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SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Unknown but assumed not expanding in all directions nor declining.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

U - UNKNOWN

COMMENTS:

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Privet seeds are eaten and transported long distances by birds (Batcher 2000; IPANE, no date). This species may also be sold as a hedge plant.

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Unknown but assumed not increasing rapidly nor stable (given general increases in disturbance in many landscapes). Local expansion (and very high densities of plants) were documented by Ebinger (1983) in an old field in Illinois.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Privets in general become established in old fields and landscapes that have abundant sunlight; they can become established in forests but will not produce fruit in low-light situations (Remaley, no date). This species is found in disturbed places in the Southeast (Weakley 2006). In edge habitats such as old fields undergoing succession, roadsides, forest edges and open woods (IPANE, no date; Batcher 2000; Rhodes and Klein 1995; Cooperrider 1995; Voss 1996).

15. SIMILAR HABITATS INVADED ELSEWHERE

D - INSIGNIFICANT

COMMENTS:

16. REPRODUCTIVE CHARACTERISTICS

C - LOW SIGNIFICANCE

COMMENTS: *Ligustrum* species in general resprout readily and produce fairly abundant seed (pers. obs. and see Batcher 2000).

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SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Foliar herbicides or cutting and manually applying herbicide to the stump should be effective where management is needed (see Batcher 2000).

18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS: Inferred.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Inferred.

20. ACCESSIBILITY OF INVADED AREAS

A - HIGH SIGNIFICANCE

COMMENTS: Privets were widely planted in the past as a hedge plant. They are still used for hedging and many plants are on private lands.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Ligustrum ovalifolium

ELEMENT NATIONAL ID: 235325
SCIENTIFIC NAME: *Ligustrum ovalifolium*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-10
EVALUATOR: K. Maybury

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:
This species of privet seems to be only infrequently naturalized and then in disturbed, low quality sites or persisting from former cultivation.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Insignificant
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low/Insignificant

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Japan

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS:

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes
COMMENTS:

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No evidence of significant impacts on abiotic processes.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

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COMMENTS: This species appears to be only sparingly naturalized and occassionally persisting in old homesites. There is no evidence that this occurs frequently or densely enough to alter vegetation structure in any significant way. Considered "accidental" in Missouri prairies, where can become problematic in unburned areas (Ladd and Churchwell 1999), presumably because it can overtop and take over the herbaceous vegetation in these areas.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C - LOW SIGNIFICANCE

COMMENTS: This species appears to be only sparingly naturalized and occassionally persisting in old homesites. There is no evidence that this occurs frequently or densely enough to alter composition in any significant way. Considered "accidental" in Missouri prairies, where can become problematic in unburned areas (Ladd and Churchwell 1999), presumably because succession in these areas will alter the herbaceous vegetation.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No evidence of disproportionate impacts.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Very sparingly naturalized and usually or always in human-disturbed sites. Characterized as being found (rarely) in disturbed places in parts of the southeastern U.S. (Weakley 2006) and in Florida (Wunderlin and Hansen 2003). In California, the only collections are from distrurbed fields and persisting at old homesites in California (Ertter 2003). Similarly, in Michigan only known from an area where fill had been placed (Voss 1996). Found in Missouri prairies but only considered an "accidental" there (Ladd and Churchwell 1999).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: The generalized range is fairly large, with some naturalized occurrences from NY and MI south through MO, KY, and NC and sporadic escapes elsewhere (FL, AL, TX, CA) (J. Kartesz, 2005 draft distribution data).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

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COMMENTS: Although identifying privets to the species level can be dificult, it appears that *L. ovalifolium* is has naturalized only very infrequently throughout its generalized range (J. Kartesz, 2005 draft distribution data). Some reports are simply plants that have persisted where planted at old homesites. Weakley (2006) and Wunderlin and Hansen (2003) indicate that this species is rare in the Southeast. Thre is only one collection each from Ohio and Michigan (Cooperrider 1995, Voss 1996), with the Michigan plant(s) growing on fill (Voss 1996). Perhaps most problematic in the northeast? Noted as "occassionally escaped to roadsides and thickets" in Pennsylvania (Rhoades and McKinley 1993). However, not nearly as commonly naturalized in the northeast as *Ligustrum vulgare* and *L. obtusifolium* (Gleason and Cronquist 1991; IPANE, no date).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS:

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Prairies, old fields/old lawns, roadsides.

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Unknown but assumed not expanding in all directions nor declining.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

U - UNKNOWN

COMMENTS:

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Privet seeds are eaten and transported long distances by birds (Batcher 2000). This species may also be sold as a hedge plant, (although it appears to be much more popular for landscaping in the U.K. than in the U.S.).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: Unknown but assumed expansion, if any, is not extremely rapid.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

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COMMENTS: Very sparingly naturalized and usually or always in relatively open human-disturbed sites. Characterized as being found (rarely) in disturbed places in parts of the southeastern U.S. (Weakley 2006) and in Florida (Wunderlin and Hansen 2003). In California, the only collections are from distrurbed fields and persisting at old homesites in California (Ertter 2003). Similarly, in Michigan only known from an area where fill had been placed (Voss 1996). Found in Missouri prairies but only considered an "accidental" there (Ladd and Churchwell 1999).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Naturalized in the British Isles (Stace 1997) but presumably in similar situations.

16. REPRODUCTIVE CHARACTERISTICS

C - LOW SIGNIFICANCE

COMMENTS: *Ligustrum* species in general resprout readily and produce fairly abundant seed (pers. obs. and see Batcher 2000).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Foliar herbicides or cutting and manually applying herbicide to the stump should be effective where management is needed (see Batcher 2000).

18. MINIMUM TIME COMMITMENT

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Inferred. Control in the localized sites where this species is found should not take longer than 2 years.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

D - INSIGNIFICANT

COMMENTS: Inferred.

20. ACCESSIBILITY OF INVADED AREAS

A - HIGH SIGNIFICANCE

COMMENTS: Privets were widely planted in the past as a hedge plant. They are still used for hedging and many plants are on private lands.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Lolium arundinaceum

ELEMENT NATIONAL ID: 199834
SCIENTIFIC NAME: *Lolium arundinaceum*
COMMON NAME:
I-RANK REVIEW DATE: 2005-12-06
EVALUATOR: Oliver, L., rev. Maybury (2005)

I-RANK: High/Medium

I-RANK REASONS SUMMARY:
Lolium arundinaceum (tall fescue), is a non-native species that has escaped from cultivation throughout the United States. It currently is known from nearly every state in the country, including Alaska and Hawaii. It threatens several natural communitites, including fens, prairies, woodlands, salt desert scrub, sagebrush, and other grasslands. This species is usually infected with a fungal endophyte which is estimated to be in at least 75% of tall fescue plants in the country. When infected with the fungus tall fescue is allelopathic, inhibiting other plants from growing around it, and is poisonous to animals including soil organims. In addition, when tall fescue is infected with the fungus it produces more seed, these seeds produce larger more vigorous seedlings which are more capable of persisting than those not infected and the plants have high instances of tillering. Overall, this species is an aggressive non-native species, especially when infected with the fungal endophyte and it is suspected that this species is currently spreading due to the fact that it is still planted.

SUBRANK I - ECOLOGICAL IMPACT:	Medium
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Medium

OTHER CONSIDERATIONS:
Lolium arundinaceum, or tall fescue, includes cultivars 'Alta', 'Goar', and 'Fawn' used in western states and 'Kentucky 31' used in eastern and central states, and 'Kenmount' is used in the Great Plains and the southeast (Batcher 2003). The cultivar Georgia 5 was released for use in the southern Coastal Plain by the USDA Soil Conservation Service (NRCS) and the Univ. of Georgia Agricultural Experiment Stations. This species is commonly infected with the fungal endophyte, *Neotyphodium coenophialum (=Acremonium coenophialum)* (Batcher).

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Tall fescue is native to Europe (Randall and Marinelli 1996).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS: Lolium arundinacea is a non-native well established throughout the United States (Kartesz 1999).

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S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Tall fescue has invaded prairies and other native herbaceous communities in the midwest and in northern Texas (Randall and Marinelli 1996).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

B - MODERATE SIGNIFICANCE

COMMENTS: Much of Tall fescue is infected with an endophytic fungus that fortifies this species and makes is generally unpalatable to grazing animals (Hensen 2001). Some 75% of this species in the United States is infected with this endophyte, which in turn allows the species to alter the soil characteristics (Hensen 2001). When the fescue is infected with the endophyte this species becomes allelopathic, killing soil organisms from nematodes to beneficial mycorrhizal fungi. It is documented that at least twenty insect species from ten families are detrimentally affected (Hensen 2001). While the infected fescue affects a biotic aspect of the ecosystem where it occurs, the alteration of the soil organisms presumably changes the character of the soil and ultimately changes what species can grow in the soil.
Further, this species when infected with the fungus does impact succession in fields as the native plants are outcompeted, which results in a greater density of the fescue (Batcher 2003).
Noted as causing "significant" negative impacts to ecosystem processes (NRCS 2002).

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B - MODERATE SIGNIFICANCE

COMMENTS: The tall fescue does affect at least one vegetation layer. This species is capable of shading herbaceous plants that might be growing around or underneath. This species grows to be 2m tall (Batcher 2003). Also, it is documented that this species affects soil organisms, which is another layer below ground (Hensen 2001).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A - HIGH SIGNIFICANCE

COMMENTS: The tall fescue, when infected with the endophyte, is highly detrimental to both the plant and animal community composition. The following groups of animal species are negatively impacted by this species game birds, such as dove and quail, soil organisms and small mammals such as voles. The endophyte produces chemicals which are toxic to the animals that eat the fescue or its seeds (Hensen 2001). Futher, this fescue when infected with the fungus is allelopathic causing a decline in plant diversity. Studies reveal that the fescue is allelopathic to *Brassica napus* (rape), *Lotus corniculatus* (bird's foot trefoil), *Trifolium pratense* (white clover), *Liquidambar styraciflua* (sweet gum) and *Pinus taeda* (loblolly pine) (Hensen 2001). Other plant species' growth has also been reduced because of this species too, including *Cornus amomum, Robinia pseudoacacia, Juglans nigra, Quercus rubra and Platanus occidentalis* (Batcher 2003). The Georgia 5 cultivar of tall fescue was noted as causing "major negative alterations in community composition" and as being "highly competitive for limiting factors (NRCS 2002).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

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COMMENTS: Many species, both animal and plant are negatively affected by this species, however, no information was found suggesting that the tall fescue disproportionately affects an individual species.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B - MODERATE SIGNIFICANCE

COMMENTS: It is known that this species impacts rare fens and remnant prairies (Randall and Marinelli 1996, Batcher 2003).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: This species is known from nearly every state in the United States (Kartesz 1999), and it is reported in most ecosystems (Batcher 2003).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B - MODERATE SIGNIFICANCE

COMMENTS: The tall fescue is certainly having negative impacts on biodiversity in many areas where it does occur. Its generalized range in the United States is nearly the entire country (Kartesz 1999) and it is reported to have invaded most ecosystems (Batcher 2003).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This species has invaded many ecosystems throughout the US (Batcher 2003, TNC 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: *Lolium arundinaceum* has invaded savannas, open marshes, fen systems, prairies, woodlands and other herbaceous plant communities (Batcher, Randall and Marinelli 1996). It is also reported in salt desert scrub, sagebrush and various forested communities (Walsh 1995).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: This species is still being planted for various uses, and while there is an effort being made to plant plants that aren't infected with the endophyte (Hensen 2001) there is still the potential of the fungus to spread from infected populations of tall fescue to uninfected populations. When infected with the endophyte, tall fescue more negatively impacts the areas where it is growing, namely because it becomes allelopathic (Batcher 2003).

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11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

D - INSIGNIFICANT

COMMENTS: Since this species already has invaded nearly every state in the United States (Kartesz 1999), including Alaska and Hawaii, so greater than 90% of its potential range in the country is currently occupied.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Spread by seeds and is still planted for various uses.

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B - MODERATE SIGNIFICANCE

COMMENTS: This species probably is expanding in at least some directions locally. It is reported that some 75% of tall fescue plants are infected with the fungal endophyte (Hensen 2001). Plants that are infected have several mechanisms that allow them to spread and persist. Specifically, plants that are infected with the fungal endophyte are allelopathic, and produce toxins that leach into the soil and inhibit the growth of other native plant species which ultimately allows for space for more fescue plants. Also, the endophyte is transferred to the seeds of infected plants and seeds that are infected germinate more quickly and produce larger more vigorous seedlings which have a better chance of survival (Batcher 2003). Finally, plants that are infected with the fungus are produce more seeds and have higher instances of tillering (Batcher 2003). All of these qualities of tall fescue plants infected with the fungal endophyte suggest local expansion is occurring.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: This species is capable of invading many areas with different ecological attributes. It is documented that this species has spread into disturbed places as well as undisturbed intact natural areas such as prairies, marshes and fens (Batcher 2003). Batcher 2003 says that tall fescue 'can invade, open, natural communities, and displace native species. This is most likely when *F. arundinacea* already grows in the area ... and when the natural community has either been subejcted to disturbance or where the natural fire regime has been suppressed". Tall fescue is tolerant of a wide range of climatic conditions and soils, but prefers cool and humid conditions (Hensen 2001).

15. SIMILAR HABITATS INVADED ELSEWHERE

U - UNKNOWN

COMMENTS:

16. REPRODUCTIVE CHARACTERISTICS

C - LOW SIGNIFICANCE

COMMENTS: Tall fescue spreads by tillering as well as by seed, that is, vegetatively as well as sexually (Batcher 2003).

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SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: NRCS (2002) notes that effective control is difficult, requiring more than one chemical or mechanical treatment. Several methods are used to control the species including the use of herbicide and burning (Batcher 2003). Batcher also remarks that little information is available about the control of this species in natural areas.

18. MINIMUM TIME COMMITMENT

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Since this species is managed for using several techniques and it probably does take at least one year to manage it, however, it could take much more time. No information was found mentioning the amount of time needed to eradicate tall fescue from areas.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Repeated and varied measures must be taken; NRCS (2002) indicates that control methods will cause major effects on other plants: "kills them."

20. ACCESSIBILITY OF INVADED AREAS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Planted as a forage and cover crop.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Lolium pratense

ELEMENT NATIONAL ID: 215916
SCIENTIFIC NAME: *Lolium pratense*
COMMON NAME:
I-RANK REVIEW DATE: 2004-06-29
EVALUATOR: Tomaino, A.

I-RANK: High/Low

I-RANK REASONS SUMMARY:
Lolium pratense occurs in every U.S. state except Hawaii. It is a tall coarse perennial grass that grows in heavy clumps and often forms dense stands that may crowd out native species. It produces allelopathic substances that inhibit the growth of competing plants. *Lolium pratense* is planted for pasture, hay, and eroision control. It has established in abandoned fields, meadows, pastures, roadsides, grazed woods, levees, stream banks, and in open natural communities such as prairies and glades. Apparently it usually occurs in disturbed areas and has negative impacts on biodiversity in a small portion of the area it has invaded but more information is needed. *Lolium pratense* is slow to establish but once the clumps are formed it is difficult to eradicate. Mechanical methods are virtually useless in controlling it because of the thick root system and vegetative reprouting.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Low

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Native to Europe, temperate Asia, and Pakistan (GRIN 2001).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Established outside cultivation in the U.S. (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Established in fields, meadows, and moist soil throughout most of the U.S. (Gleason and Cronquist 1991).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: No mention of changes in abiotic ecosystem processes or system-wide parameters found in the literature; assumption is that any alterations are not major/irreversible.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B - MODERATE SIGNIFICANCE

COMMENTS: *Lolium pratense* is a tall coarse perennial grass with short creeping rootstocks that grows in heavy clumps; it often forms dense stands and may reach five feet in height (Hutchison 1990).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: *Lolium pratense* produces allelopathic substances that inhibit the growth of competing species (Hutchison 1990). In Missouri and Illinois, it occasionally invades open natural communities such as prairies and glades and in a few places is changing the species composition and possibly crowding out native species (Hutchison 1990; Smith 1993).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: No mention of impacts on particular native species found in the literature; assumption is that any impacts are not major.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: In Illinois and Missouri, *Lolium pratense* occasionally invades open natural communities such as prairies and glades and in a few places changes the species composition, possibly crowding out native species (Hutchison 1990). These communities are likely of conservation concern.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: *Lolium pratense* occurs in every state except Hawaii (Kartesz 1999). It is widespread in many states. See the subnational distribution data in these sources: Baldwin et al. 2004, Rice 2004, Rocky Mountain Herbarium 1998, Weber et al. 2004, Wisconsin State Herbarium 2004, Iverson et al. 1999, Weldy et al. 2002, Angelo and Boufford 2003, University of Tennessee Herbarium 2002, Rayner et al. 2000, and Texas A&M University BWG 1996.

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7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: In Kentucky, *Lolium pratense* is classified as a severe threat (KY EPPC 2000). In Tennessee, *L. pratense* is classified as a significant threat (TN EPPC 2001). In Oregon and Washington, *Lolium pratense* is classified as a wildland weed of lesser invasiveness (less agressive) (WNPS 1997). It is not listed by the California EPPC (CAL EPPC 1999). *Lolium pratense* occurs throughout Illinois, but is particularly common in southern Illinois where there is much pasture land (Hutchison 1990). In Missouri and Illinois, it occasionally invades open natural communities such as prairies and glades and in a few places is changing the species composition and possibly crowding out native species (Hutchison 1990; Smith 1993).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: At most 99% of units, inferred from Kartesz (1999) and TNC (2001). At least 20% of units, inferred from Kartesz (1999) and TNC (2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: In abandoned fields, meadows, roadsides, waste places, and moist soil throughout most of the U.S. (Hitchock 1950; Gleason and Cronquist 1991). In California, it occurs in disturbed places (Baldwin et al. 2004). In Illinois and Missouri, it occurs in pastures, abandoned fields, roadsides, grazed woods, levees, stream banks, along railroad tracks, and occasionally in open natural communities such as prairies and glades (Hutchison 1990; Smith 1993). In Michigan, it occurs on roadsides, shores, meadows, and waste ground, often damp (Voss 1972). In Virginia, it occurs in fields, roadsides, pastures, disturbed areas, railroad embankments, levees, and stream banks (Weakley draft 2004; VNPS & VDCR, not dated).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: *Lolium pratense* already occurs in every state except Hawaii (Kartesz 1999). Once established, *L. pratense* is difficult to eradicate (Smith 1993). Presumeably its total range is remaining stable.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

D - INSIGNIFICANT

COMMENTS: Inferred from USDA (1990) and Kartesz (1999), greater than 90% of its potential generalized range in the U.S. is currently occupied.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: *Lolium pratense* seeds are spread in manure (Hutchison 1990). At Indiana Dunes National Lakeshore *Lolium pratense* has little potential for long-distance dispersal (APRS Implementation Team 2001).

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13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: In abandoned fields, meadows, roadsides, waste places, and moist soil throughout most of the U.S. (Hitchock 1950; Gleason and Cronquist 1991). Occurs in disturbed areas; assumption is that disturbed areas are not decreasing or remaining stable and therefore this species' local range is not decreasing or remaining stable.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: In abandoned fields, meadows, roadsides, waste places, and moist soil throughout most of the U.S. (Hitchock 1950; Gleason and Cronquist 1991). In Illinois and Missouri, *Lolium pratense* occasionally invades open natural communities such as prairies and glades (Hutchison 1990). *Lolium pratense* is slow to establish (Smith 1993).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: In Canada, it occurs on roadsides, meadows, and waste places (Scoggon 1978).

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: At Indiana Dunes National Lakeshore, *Lolium pratense* produces 11-1000 seeds per plant and seeds remain viable in the soil for more than 5 years (APRS Implementation Team 2001). Reproduces vegetatively and by seeds (APRS Implementation Team 2001). Mechanical methods are virtually useless in controlling it because of the thick root system and vegetative reprouting (VNPS & VDCR, not dated).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: *Lolium pratense* is slow to establish but once the clumps are formed it is difficult to eradicate (Smith 1993). Mechanical methods are virtually useless in controlling it because of the thick root system and vegetative reprouting; the most effective method for severe infestation is burning early in the growing season, followed by spot appliation late in the growing season of a glyphosate herbicide (VNPS and VDCR, not dated). It may be necessary to burn and spray 2 or 3 years in succession (Smith 1993). It can withstand trampling and heavy grazing by livestock (Hutchison 1990). Mowing and grazing do not reduce existing populations and may encourage spreading by root stocks (Hutchison 1990).

18. MINIMUM TIME COMMITMENT

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: It may be necessary to burn and spray 2 or 3 years in succession (Smith 1993). Repeated burning for 2-4 years may be needed to achieve good control (Hutchison 1990). At Indiana Dunes National Lakeshore seeds remain viable in the soil for more than 5 years (APRS Implementation Team 2001).

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19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Glyphosate is nonselective (VNPS and VDCR, not dated). On native prairies with a major invasion, scout the prairie just prior to herbicide application to make sure prairie species are dormant and fesuce is active or expect some damage to those species (Smith 1993).

20. ACCESSIBILITY OF INVADED AREAS

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: *Festuca pratensis* is commonly sown for pasture and hay (Hutchison 1990). It is tolerant of a wide range of moisture conditions and has been planted for eroision control along levees and stream banks (VNPS & VDCR, not dated). At least in some areas, accessibility may be a problem.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Lonicera maackii

ELEMENT NATIONAL ID: 232592
SCIENTIFIC NAME: *Lonicera maackii*
COMMON NAME: Amur Honeysuckle
I-RANK REVIEW DATE: 2006-06-26
EVALUATOR: J. Cordeiro

I-RANK: High

I-RANK REASONS SUMMARY:
Thickets of this species exhibit significant canopy disturbance reducing species richness and abundance and inhibiting native tree seedlings. It has already reached much of its invasive range potential in the United States occurring in most states. Migratory birds disperse seeds and fruits widely and the species is capable of invading native wooded areas. Control is costly and difficult, but repeated clipping has been shown to have some effect over multiple years.

SUBRANK I - ECOLOGICAL IMPACT:	High/Medium
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Lonicera maackii is native to northeastern Asia (Luken and Mattimiro, 1991) including China, Manchuria, Korea, and, less commonly, Japan (Batcher and Stiles, 2000; Munger, 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: In North America, this species has escaped from cultivation in at least 25 states east of the Mississippi River (Batcher and Stiles, 2000; Hutchinson et al., 1998; Munger, 2005). In north-central Kentucky and south-central Ohio, much effort has been devoted to eradication because this species has come to dominate nature reserves to the exclusion of endemic species (Luken and Mattimiro, 1991). This shrub is highly productive and invades forests and colonizes recently disturbed ground (Luken, 1988).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: In North America, this species has escaped from cultivation in at least 25 states east of the Mississippi River (Batcher and Stiles, 2000; Hutchinson et al., 1998). In north-central Kentucky and south-central Ohio, much effort has been devoted to eradication because this species has come to dominate nature reserves to the exclusion of endemic species (Luken and Mattimiro, 1991).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C - LOW SIGNIFICANCE

COMMENTS: Suppression of advance regeneration of native tree seedlings is reported by Woods (1993) in Vermont and Massachusetts for the related species, *Lonicera tatarica*, which would potentially lead to changes in canopy composition or even failure of canopy tree replacement resulting in conversion of forests to more open canopies and shrublands.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: *Lonicera maackii* has become abundant and forests and exhibits significant canopy disturbance. Canopy disturbance facilitates invasion into deciduous forests in southwestern Ohio and tree regeneration becomes inhibited and tree seedling abundance declines (Hutchinson and Vankat, 1997). Over the past three decades in Ohio and neighboring states, dense thickets have replaced relatively open understories that apparently had no abundant native shrubs indicating *L. maackii* has been an addition rather than a replacement in these forests, filling an open niche (Collier et al., 2002). The species can form a dense shrub layer (Batcher and Stiles, 2002; Nyboer, 1992; Williams, 2001). Most control measures (many outlined in Munger, 2005) require several years for any measure of success.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A - HIGH SIGNIFICANCE

COMMENTS: Over the past three decades in Ohio and neighboring states, dense thickets have replaced relatively open understories that apparently had no abundant native shrubs indicating *L. maackii* has been an addition rather than a replacement in these forests, filling an open niche (Collier et al., 2002). Collier et al. (2002) confirmed what was previously anecdotally supported; that species richness and abundance below crowns of *L. maackii* was lowered in its presence. Because *L. maackii* dramatically increases in both density and cover following colonization, the effects at the scale of single shrubs should become increasingly apparent at the scale of forest stands. Where this species becomes established in the understory of forests, it has a negative impact on tree seedlings and herbs (Hutchinson and Vankat, 1997; 1998), presumably due to reduced light under *Lonicera maackii* canopies as this species is light limited. It also suppresses spring emphemerals and forest regeneration (Batcher and Stiles, 2002; Nyboer, 1992; Williams, 2001).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

A - HIGH SIGNIFICANCE

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COMMENTS: Gould and Gorchov (2000) demonstrated that the presence of *L. maackii* shrubs reduced fecundity of *Galium aparine*, *Impatiens pallida* and *Pilea pumila* in undisturbed deciduous forest stands and reduced survial of *G. aparine* and *I. pallida* only in more anthropogenically disturbed stands; leading to the assumption that *L. maackii* most negatively impacts the survival of shade-intolerant or early season annuals. Leaves of *L. maackii* also have negative effects on *Fraxinus americana* germination and *Acer saccharum* seedling growth (Trisel and Gorchov, 1995 cited in Gould and Gorchov, 2000). Schmidt and Whelan (1999) found exotic *L. maackii* enhanced nest predation (by large mammals) in American robins (which, despite this, increased their usage of *L. maackii* following its establishment), through a combination of lower nest height, absence of sharp thorns, and a branch of architecture that may facilitate predation movement. Similar higher predation was also found in the same study for wood thrushes than the pooled native species in the area.
Miller and Gorchov (2004) studied the effects of Amur honeysuckle presence on growth, reproduction and survival of 3 native forest understory perennial forbs over 5 growing seasons. Species studied included narrowleaf wild leek (*Allium burdickii*), a spring ephemeral, and the full-season species rue anemone (*Thalictrum thalictroides*) and downy yellow violet (*Viola pubescens* var. *pubescens*). They found Amur honeysuckle presence generally reduced growth and reproduction of target species, but not their survival.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Collier et al. (2002) demonstrated that *Lonicera maackii* appears detrimental to 98% of uncommon forest plant taxa leading to the potential to cause local extinctions of plant populations.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: In North America, this species has escaped from cultivation in at least 25 states east of the Rocky Mountains (Batcher and Stiles, 2000; Hutchinson et al., 1998; Luken and Thieret, 1996; USDA, 2006; Munger, 2005) and is considered a widespread invasive almost everywhere it occurs.

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A - HIGH SIGNIFICANCE

COMMENTS: In North America, this species has escaped from cultivation in at least 25 states east of the Rocky Mountains (Hutchinson et al., 1998; Luken and Thieret, 1996) and is considered a widespread invasive almost everywhere it occurs.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: It is conservatively estimated that most ecoregions east of the Rocky Mountains have been invaded by *Lonicera maackii* in the United States (Cordeiro, pers. obs. April 2006 based on TNC, 2001).

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9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: *Lonicera maackii* establishes in most forest habitats and often becomes abundant along forest edges, where seedling establishment is greater (Luken and Goessling, 1995) and in forests with some canopy disturbance (Hutchinson and Vankat, 1997; Zheng et al., 2004). In Ohio and Kentucky, forest grown populations were significantly older than open area grown populations (Luken and Mattimiro, 1991). Slightly disturbed and/or young secondary forests with less tree canopy cover have proven more invasible than less disturbed forests (Hutchinson and Vankat, 1997). Amur honeysuckle commonly grows on sites with some type of canopy cover (open forests, flood plain forests, periodically disturbed floodplains, riparian habitats and scrub communities). In North America, it is found in both open and wooded habitats (Munger, 2005).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Over the last few decades, *Lonicera maackii* has become the most abundant shrub in many forests in southwestern Ohio and adjacent states (Luken and Goessling, 1995; Hutchinson and Vankat, 1997; 1998; Luken et al., 1997; Collier et al., 2002). Both Hutchinson and Vankat (1998) and Deering and Vankat (1999) reported separate average rates of migration of 0.5 km/year in separate areas of Ohio. The trend of increase has resulted in more than 25 states east of the Rocky Mountains now have substantial populations of this species with more added annually. Over the past three decades in Ohio and neighboring states, dense thickets have replaced relatively open understories that apparently had no abundant native shrubs indicating *L. maackii* has been an addition rather than a replacement in these forests, filling an open niche (Collier et al., 2002).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Over the last few decades, *Lonicera maackii* has become the most abundant shrub in many forests in southwestern Ohio and adjacent states (Luken and Goessling, 1995; Hutchinson and Vankat, 1997; 1998; Luken et al., 1997; Collier et al., 2002). Both Hutchinson and Vankat (1998) and Deering and Vankat (1999) reported separate average rates of migration of 0.5 km/year in separate areas of Ohio. The trend of increase has resulted in more than 25 states east of the Rocky Mountains now have substantial populations of this species with more added annually. Over the past three decades in Ohio and neighboring states, dense thickets have replaced relatively open understories that apparently had no abundant native shrubs indicating *L. maackii* has been an addition rather than a replacement in these forests, filling an open niche (Collier et al., 2002). It is likely close to potential range, given moisture and climate needs (Batcher and Stiles, 2002; Nyboer, 1992; Williams, 2001).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

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COMMENTS: The main dispersal agents are birds (Luken, 1988; Deering and Vankat, 1999), many of which are migratory and prefer the fruits. The plant produces numerous red berries that ripen in autumn and are bird- and in some cases mammal-dispersed. Hutchinson and Vankat (1998) found that greater native forest cover and connectivity of forests facilitated the spread of *Lonicera maackii*, whereas the abundance of agricultural land acted as a barrier to dispersal in a high impact natural forest preserve area well studied in Oxford, Ohio. This is because birds, the primary dispersal agent, are less likely to disperse seeds across large areas of agricultural land, especially where woody vegetation that serves as recruitment foci for the bird-dispersed plants is lacking.

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A - HIGH SIGNIFICANCE

COMMENTS: Over the last few decades, *Lonicera maackii* has become the most abundant shrub in many forests in southwestern Ohio and adjacent states (Luken and Goessling, 1995; Hutchinson and Vankat, 1997; 1998; Luken et al., 1997; Collier et al., 2002). Both Hutchinson and Vankat (1998) and Deering and Vankat (1999) reported separate average rates of migration of 0.5 km/year in separate areas of Ohio. The trend of increase has resulted in more than 25 states east of the Rocky Mountains now have substantial populations of this species with more added annually. Over the past three decades in Ohio and neighboring states, dense thickets have replaced relatively open understories that apparently had no abundant native shrubs indicating *L. maackii* has been an addition rather than a replacement in these forests, filling an open niche (Collier et al., 2002).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

A - HIGH SIGNIFICANCE

COMMENTS: This species is listed as an "invasive plant of major concern" in Czarapata (2005). Hutchinson and Vankat (1998) found that greater native forest cover and connectivity of forests facilitated the spread of *Lonicera maackii*, whereas the abundance of agricultural land acted as a barrier to dispersal in a high impact natural forest preserve area well studied in Oxford, Ohio. This is because birds, the primary dispersal agent, are less likely to disperse seeds across large areas of agricultural land, especially where woody vegetation that serves as recruitment foci for the bird-dispersed plants is lacking. Slightly disturbed and/or young secondary forests with less tree canopy cover have proven more invasible than less disturbed forests (Hutchinson and Vankat, 1997). Light appears to be important in the invasibility of forests as suggested by the inverse relationships of *L. maackii* cover to canopy cover and shade tolerance index in stands in Ohio (Hutchinson and Vankat, 1997). Late successional forests are more resistant to invasion than younger forests, presumably due to less light reaching the forest floor. Overall the species has a high potential for long-term persistence in native forest areas, as evidenced by over 40 years of rapid growth in Ohio and Kentucky natural forest preserves. The ability to establish seedlings in forest edges and interiors, coupled with continuous activity of adventitious buds on the bases of parent plants (Luken, 1988), provides a potent combination for long-term site occupation despite the poor seed banking capability (Luken and Goessling, 1995). Deering and Vankat (1999) reported that initial populations can result from a single individual shrub (the species is self-compatible) and remain small for the first several years but then begin to experience exponential growth when populations become larger from radial growth producing radical increases in basal shrub area.

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: In Eurasia, this species grows in communities similar in generic composition to those of northeastern U.S. (Woods, 1993).

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16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: *Lonicera maackii* is capable of sexual and asexual reproduction with dual reproductive modes maintained in both forest and open area habitats (Luken and Mattimiro, 1991). The species also produces abundant annual seed crops as reproduction is primarily by seed although greenwood and hardwood cuttings have been used extensively in commerical propagation (Batcher and Stiles, 2000). It maintains resprouting potential following biomass removal in both forests and open sites and sprouting ability does not appear to decline with age as in other shrub species (Luken, 1988). The plant produces numerous red berries that ripen in autumn and are bird- and in some cases mammal-dispersed. The species has been observed to expand its leaves earlier in the spring and retains its leaves later in the fall than native shrubs and trees (Hutchinson and Vankat, 1997), which has been shown to increase carbon gain in other invasive *Lonicera* taxa. Although the species has a high potential for long-term persistence in native forests once established as a result of annual stem release from the shrub base (Luken, 1988), root sprouts do not usually occur and new areas must be colinized by seedlings (seed banking capability is poor) (Luken and Goessling, 1995). Mean seedling densities in northern Kentucky were up to 328 per square meter, especially at forest edges (more light) (Luken and Goessling, 1995). Estimates of annual fruit production for Amur honeysuckle and European fly honeysuckle in southwestern Ohio ranged from 0 to 1.2 million berries per plant, and approximately 400 million berries per ha (Ingold and Craycraft, 1983). Seed banking capability is poor for this species and most new stems produced by forest grown shrubs die during the first year of stem life (Luken, 1988).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Control is best approached in a habitat specific manner as well as based on size of the infestation. Clipping has been found to be successful (limited) in controlling this species in forests reducing mortality among forest-grown shrubs and causing declines in stem populations, but, in contrast, open grown shrub populations remained stable and stem populations continued to increase in response to clipping (Luken and Mattimiro, 1991). Both habitats experienced a decline in seedling establishment following clipping. In open areas, clipping must be accompanied with herbicides or burning following removal of adult stems. Because this species prefers slightly disturbed or undisturbed young forest habitat and open agricultural land serves as a dispersal barrier, a broad zone of unsuitable habitat surrounding a forest patch may inhibit invasion and prove an effective management strategy, but this must be weighed against the negative effects of removing a secondary vegetation zone around the forest patch that might otherwise buffer edge effects (Hutchinson and Vankat, 1998). Generally, in regions where *L. maackii* is present, forests should be managed to minimize tree canopy disturbance, but when this is not possible, forests should be continually monitored for plants following disturbance. In forests where *L. maackii* is already established, management to recue cover is recommended (Luken and Mattimiro, 1991; Hutchinson and Vankat, 1997).
Deering and Vankat (1999) conclude managing small colonizing populations will be largely successful during the early slow expansion phase but if control efforts are not started until after the population reproduces and exponential population growth begins, cost and effort of control will rise greatly while probability of successful removal declines.
Use of fire as a management tool is discussed in depth in Munger (2005).

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18. MINIMUM TIME COMMITMENT

B - MODERATE SIGNIFICANCE

COMMENTS: Although clipping has limited control success (esp. for forest populations), this species is fully capable of regenerating most shrubs after a single clipping event so multiple clippings are necessary. A combination of clipping of adult plants with herbicide application and/or burning should follow clipping for open area populations (Luken and Mattimiro, 1991). In all cases repeated control measures are necessary (a few times a year for 2 or more years). Because seed banking capability is poor, long-term (5+ years) shrub removal experiments have been shown to be successful (Luken and Mattimiro, 1991). Repeated prescribed burning annually or biennially for several years may be necessary. Stem cutting with glyphosate herbicide application requires two cuts per year for three to five years (Batcher and Stiles, 2005; Wisconsin Department of Natural Resources, 2004).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Because this species prefers slightly disturbed or undisturbed young forest habitat and open agricultural land serves as a dispersal barrier, a broad zone of unsuitable habitat surrounding a forest patch may inhibit invasion and prove an effective management strategy, but this must be weighed against the negative effects of removing a secondary vegetation zone around the forest patch that might otherwise buffer edge effects (Hutchinson and Vankat, 1998). It is best to spray new foliage in the spring (Metsulfuron-methyl plus a surfactant is broadleaf specific) before the leaves of native shrubs and ground flora emerge (Czarapata, 2005).

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: As this species may occur on some private land (often on forest service land, however), some access issues will arise and cooperation with landownders for management will be necessary.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Lonicera tatarica

ELEMENT NATIONAL ID: 196949
SCIENTIFIC NAME: *Lonicera tatarica*
COMMON NAME: Tatarian Honeysuckle
I-RANK REVIEW DATE: 2006-06-26
EVALUATOR: J. Cordeiro

I-RANK: High/Medium

I-RANK REASONS SUMMARY:

Although not as impactful as some of the other *Lonicera* species, this species exhibits some canopy disturbance reducing species richness and abundance and inhibiting native tree seedlings. Negative impacts on community composition and native species seem to be greatest when this species crosses with other *Lonicera* species to produce much more invasive hybrids. It has already reached a large portion of its invasive range potential in the United States occurring in many states, particularly in lower elevation forests of the northeastern U.S.. Migratory birds disperse seeds and fruits widely and the species is capable of invading native wooded areas. Control is difficult, though easier than for some *Lonicera* species, but repeated clipping, hand removal, and herbicide spraying has been shown to have some effect over multiple years, although effects on native species may occur.

SUBRANK I - ECOLOGICAL IMPACT:	Medium
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium

NON-NATIVE THROUGHOUT NATION

NATIVE RANGE: Native range of Lonicera tatarica includes forests of west-central Eurasia including western and central Russia (Batcher and Stiles, 2000; Munger, 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species was introduced to North America as an ornamental in 1752 and has naturalized from New England south to North Carolina and west to Iowa and Wisconsin (Wisconsin Department of Natural Resources, 2004; Woods, 1993; Barnes and Cottam, 1972; Munger, 2005).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: This species was introduced to North America as an ornamental in 1752 and has naturalized from New England south to North Carolina and west to Iowa and Wisconsin (Wisconsin Department of Natural Resources, 2004; Woods, 1993; Munger, 2005).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C - LOW SIGNIFICANCE

COMMENTS: Suppression of advance regeneration of native tree seedlings reported by Woods (1993) in Vermont and Massachusetts by *Lonicera tatarica* would potentially lead to changes in canopy composition or even failure of canopy tree replacement resulting in conversion of forests to more open canopies and shrublands.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B - MODERATE SIGNIFICANCE

COMMENTS: In many U.S. forests, previously open understories are now near-impenetrable masses of *Lonicera tatarica*, or the hybrid cross of *L. tartarica* and *Lonicera morrowi*, *Lonicera* x *bella* (Woods, 1993), although the hybrid swarm is most extensively distributed in the northeastern U.S.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A - HIGH SIGNIFICANCE

COMMENTS: In 3 Vermont stands and 1 in Massachusetts, Woods (1993) found both native herb richness and cover declined with increasing *Lonicera tatarica* cover and native tree seedling density similarly declined as new seedlings were prevented once the *L. tatarica* was established. Mechanisms for this are likely due to earlier establishment of *L. tatarica* with leaf expansion beginning approximately 2 weeks earlier than for trees in the same stands and longer retention of greeen leaves later in the season. It also suppresses spring emphemerals and forest regeneration (Batcher and Stiles, 2002; Nyboer, 1992; Williams, 2001).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: In 3 Vermont stands and 1 in Massachusetts, Woods (1993) found both native herb richness and cover declined with increasing *Lonicera tatarica* cover and native tree seedling density similarly declined as new seedlings were prevented once the *L. tatarica* was established. Mechanisms for this are likely due to earlier establishment of *L. tatarica* with leaf expansion beginning approximately 2 weeks earlier than for trees in the same stands and longer retention of green leaves later in the season.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Collier et al. (2002) demonstrated that the related *Lonicera maackii* appears detrimental to 98% of uncommon forest plant taxa leading to the potential to cause local extinctions of plant populations.

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SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: This species is common in southeastern and south-central Canada, and in most northeastern and mid-Atlantic states and in some midwestern and western states. Reported occurrences include: Alberta, California, Colorado, Connecticut, Delaware, District of Columbia, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Manitoba, Maryland, Massachusetts, Michigan, Minnesota, Montana, Nebraska, New Brunswick, New Hampshire, New Jersey, New York, North Dakota, Nova Scotia, Ohio, Ontario, Pennsylvania, Quebec, Rhode Island, Saskatchewan, South Dakota, Utah, Vermont, Virginia, West Virginia, Wisconsin, and Wyoming (Batcher and Stiles, 2000; USDA, 2006; Munger, 2005).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A - HIGH SIGNIFICANCE

COMMENTS: This species is considered a noxious invader in most places it occurs and is a listed invader in many states.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: It is conservatively estimated that most ecoregions east of the Rocky Mountains and several in the west as well, have been invaded by *Lonicera tatarica* in the United States (Cordeiro, pers. obs. April 2006 based on TNC, 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This species has become an aggressive invader of lower elevation forests throughout northeastern U.S., growing most densely along forest edges and in clearings, but also invading the interior of intact forests (Woods, 1993). It is capable of living in a broad range of plant communities with varying moisture and shade levels. Woodlands are most affected, and are particularly vulnerable if the habitat is already disturbed. Plants thrive in sunny, upland habitats, including forest edges, roadsides, pastures, and abandoned fields. They can also be found in fens, bogs, and lakeshores (Wisconsin Department of Natural Resources, 2004).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: This species continues to increase its range in the United States, especially the hybrid crosses with other *Lonicera* species that appear to be more invasive than either parent but has spread into many states already.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

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COMMENTS: Although widespread, several states have still not reported (probably there but not reported yet) this species. Tatarian honeysuckle is found in mesic sugar maple- and red maple (*Acer saccharinum*)-dominated forests in Vermont and Massachusetts (Woods, 1993). It has also become problematic across vast areas of the upper Midwest (Czarapata,. 2005).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Dispersal is primarily by birds and some small mammals (Batcher and Stiles, 2000; Barnes and Cottam, 1974). Several migratory birds prefer the fruits. The plant has been used extensively in North America in shelter beds and wildlife planting (Woods, 1993) and as an ornamental (Barnes and Cottam, 1974).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Presumed to be expanding like the other *Lonicera* species. Birds often favor the fruits (Batcher and Stiles, 2002; Nyboer, 1992; Williams, 2001). Tatarian honeysuckle is found in mesic sugar maple- and red maple (*Acer saccharinum*)-dominated forests in Vermont and Massachusetts of late with negative impacts on native species there (Woods, 1993).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This species is listed as an "invasive plant of major concern" in Czarapata (2005). Most information generalized from the related *Lonicera maackii*. Hutchinson and Vankat (1998) found that greater native forest cover and connectivity of forests facilitated the spread of the related *Lonicera maackii*, whereas the abundance of agricultural land acted as a barrier to dispersal in a high impact natural forest preserve area well studied in Oxford, Ohio. This is because birds, the primary dispersal agent, are less likely to disperse seeds across large areas of agricultural land, especially where woody vegetation that serves as recruitment foci for the bird-dispersed plants is lacking. Slightly disturbed and/or young secondary forests with less tree canopy cover have proven more invasible than less disturbed forests (Hutchinson and Vankat, 1997). Light appears to be important in the invasibility of forests as suggested by the inverse relationships of *L. maackii* cover to canopy cover and shade tolerance index in stands in Ohio (Hutchinson and Vankat, 1997). Late successional forests are more resistant to invasion than younger forests, presumably due to less light reaching the forest floor. Overall the species has a high potential for long-term persistence in native forest areas, as evidenced by over 40 years of rapid growth in Ohio and Kentucky natural forest preserves. The ability to establish seedlings in forest edges and interiors, coupled with continuous activity of adventitious buds on the bases of parent plants (Luken, 1988), provides a potent combination for long-term site occupation despite the poor seed banking capability (Luken and Goessling, 1995). Deering and Vankat (1999) reported that initial populations can result from a single individual shrub (the species is self-compatible) and remain small for the first several years but then begin to experience exponential growth when populations become larger from radial growth producing radical increases in basal shrub area.

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: In Eurasia, this species grows in communities similar in generic composition to those of northeastern U.S. (Woods, 1993).

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16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: *Lonicera tatarica* grows rapidly and produces large quantities of showy, bird-dispersed berries (Woods, 1993). The species also produces abundant annual seed crops as reproduction is primarily by seed although greenwood and hardwood cuttings have been used extensively in commerical propagation (Batcher and Stiles, 2000). Crosses may have similar characters, although *Lonicera* x *bella* also reproduces asexually by root suckering and layering (Barnes, 1972 in Munger, 2005) which also may occur in either parent.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B - MODERATE SIGNIFICANCE

COMMENTS: Since honeysuckle roots are fairly shallow, small- to medium-sized plants can often be dug or pulled particularly in spring when the soil is moist. In sensitive areas, the type of physical removal may disturb the soil and lead to more invasion, in which case it should be avoided or soil should be tamped down to discourage further honeysuckle seedling establishment or physical removal should be coupled with herbicide or burning. Cutting of stems followed by treatment of 20% active glyphosate solution with a hand sprayer, sponge applicator, or contact solution bottles is effective (Wisconsin Department of Natural Resources, 2004). Use of fire as a management tool is discussed in depth in Munger (2005).

18. MINIMUM TIME COMMITMENT

B - MODERATE SIGNIFICANCE

COMMENTS: Repeated prescribed burning annually or biennially for several years may be necessary. Stem cutting with glyphosate herbicide application requires two cuts per year for three to five years (Batcher and Stiles, 2005; Wisconsin Department of Natural Resources, 2004).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Where burning is not possible (sensitive native species), 1.5% active glyphosate solution can be sprayed to cover foliage and spraying prior to emergence of native shrubs and ground flora is the safest time to spray without impacting native species. In wetlands, glyphosate formlated for water must be used (Wisconsin Department of Natural Resources, 2004). Caution should be exercised when treating seedlings with herbicides as some can damage native plants (Snyder and Kaufman, 2004). It is best to spray new foliage in the spring (Metsulfuron-methyl plus a surfactant is broadleaf specific) before the leaves of native shrubs and ground flora emerge (Czarapata, 2005).

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: As this species may occur on some private land (often on forest service land, however), some access issues will arise and cooperation with landownders for management will be necessary.

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Batcher, M.S. and S.A. Stiles. 2000. Element stewardship abstract for Lonicera maackii (Rupr.) Maxim (Amur honeysuckle), Lonicera morrowii A. Gray (Morrow's honeysuckle), Lonicera tatarica L. (Tatarian honeysuckle), Lonicera x bella Zabel (Bell's honeysuckle): the bush honeysuckles. The Nature Conservancy, Arlington, Virginia. unpaginated.

Collier, M.H., J.L. Vankat, and M.R. Hughes. 2002. Diminished plant richness and abundance below Lonicera maackii, an invasive shrub. American Midland Naturalist, 147(1): 60-71.

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USDA Forest Service. 2006. Invasive Plants - Weeds of the Week fact sheets. USDA Forest Service northeastern area. Online. Available: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/index.shtm (Accessed 2006)

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Zheng, H., Y. Wu, J. Ding, D. Binion, W. Fu, and R. Reardon. 2004. Invasive plants of Asian origin established in
the United States and their natural enemies. Volume 1. USDA Forest Service, FHTET-2004-05[http://www.invasive.org/weeds/asian/].

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Invasive Species Assessment Protocol:
U.S. National Assessments

Lonicera x bella

ELEMENT NATIONAL ID: 198385
SCIENTIFIC NAME: *Lonicera x bella*
COMMON NAME:
I-RANK REVIEW DATE: 2006-06-26
EVALUATOR: J. Cordeiro

I-RANK: High/Medium

I-RANK REASONS SUMMARY:
Much like the other *Lonicera* species, this highly invasive hybrid exhibits invasive characters of both parent species. Impacts on canopy disturbance reduces species richness and abundance and inhibits native tree seedlings. Although not as widespread and common as either parent species, it has spread significantly in the United States, particularly in New England and the Great Lakes. Possibly due to hybrid vigor, tolerance for habitat and environmental conditions is extremely high allowing this species to easily invade new areas. Migratory birds disperse seeds and fruits widely and the species is capable of invading native wooded areas through massive seed production and asexually. Control is difficult, with multiple control measures used in conjunction over several years necessary, and some negative effects on native species may occur.

SUBRANK I - ECOLOGICAL IMPACT:	High/Medium
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Medium

OTHER CONSIDERATIONS:
This plant is a highly invasive hybrid cross between two other noxious invaders, *Lonicera tatarica* and *Lonicera morrowii* (Barnes and Cottam, 1974). References to the literature should bear in mind that there may be considerable confusion in the identification of the taxa involved as this cross has often been confused with the two parent species and most often shares hybrid characters with both (Barnes and Cottam, 1974).

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Native range includes forests of west-central Eurasia including western and central Russia (Batcher and Stiles, 2000).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

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COMMENTS: In many U.S. forests, previously open understories are now near-impenetrable masses of Lonicera tatarica, or the hybrid cross of L. tartarica and Lonicera morrowi, Lonicera x bella (Woods, 1993), although the hybrid swarm is most extensively distributed in the northeastern U.S.. It was likely first introduced outside cultivation in the U.S. in the late 1800s to early 1900s (Munger, 2005).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: In many U.S. forests, previously open understories are now near-impenetrable masses of Lonicera tatarica, or the hybrid cross of L. tartarica and Lonicera morrowi, Lonicera x bella (Woods, 1993), although the hybrid swarm is most extensively distributed in the northeastern U.S.

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Suppression of advance regeneration of native tree seedlings reported by Woods (1993) in Vermont and Massachusetts by the parent species, *Lonicera tatarica*, would potentially lead to changes in canopy composition or even failure of canopy tree replacement resulting in conversion of forests to more open canopies and shrublands.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: In many U.S. forests, previously open understories are now near-impenetrable masses of *Lonicera tatarica*, or the hybrid cross of *L. tartarica* and *Lonicera morrowi*, *Lonicera* x *bella* (Woods, 1993), although the hybrid swarm is most extensively distributed in the northeastern U.S.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A - HIGH SIGNIFICANCE

COMMENTS: In 3 Vermont stands and 1 in Massachusetts, Woods (1993) found both native herb richness and cover declined with increasing *Lonicera tatarica* (parent species) cover and native tree seedling density similarly declined as new seedlings were prevented once the *L. tatarica* was established. Mechanisms for this are likely due to earlier establishment of *L. tatarica* with leaf expansion beginning approximately 2 weeks earlier than for trees in the same stands and longer retention of greeen leaves later in the season. The parent, *Lonicera morrowii*, suppresses spring emphemerals and forest regeneration (Batcher and Stiles, 2002; Nyboer, 1992; Williams, 2001).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

A/B - HIGH/MODERATE SIGNIFICANCE

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COMMENTS: In 3 Vermont stands and 1 in Massachusetts, Woods (1993) found both native herb richness and cover declined with increasing *Lonicera tatarica* (parent species) cover and native tree seedling density similarly declined as new seedlings were prevented once the *L. tatarica* was established. Mechanisms for this are likely due to earlier establishment of *L. tatarica* with leaf expansion beginning approximately 2 weeks earlier than for trees in the same stands and longer retention of greeen leaves later in the season. In addition, fruits of bush honeysuckles are not as high in fats and nutrients as native fruits so migrating birds feeding on them must feed more or suffer reduced fitness. Fruits of the parent *Lonicera morrowii* have been shown to change the plumage color of cedar waxwings when the birds feed primarily on them (Witmer, 1996).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Collier et al. (2002) demonstrated that the parent *Lonicera maackii* appears detrimental to 98% of uncommon forest plant taxa leading to the potential to cause local extinctions of plant populations.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: In the United States, the hybrid is distributed in Connecticut, Illinois, Indiana, Kentucky, Massachusetts, Maine, Michigan, Minnesota, North Carolina, New Hampshire, New Mexico, New York, Ohio, Pennsylvania, Rhode Island, Virginia, Vermont, and Wisconsin (USDA, 2006; Munger, 2005).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A - HIGH SIGNIFICANCE

COMMENTS: Little is known about this hybrid cross as far as impact is concerned although it is likely as impactfull as its two parent species, both considered highly invasive. It is considered an invasive in several states, particularly western states, as well as approximately eight eastern states (Snyder and Kaufman, 2004). It is also particularly invasive around New England and the southern Great Lakes (Barnes and Cottam, 1974; Munger, 2005).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: It is conservatively estimated that more than 20 ecoregions have been invaded by *Lonicera* x *bella* in the United States (Cordeiro, pers. obs. April 2006 based on TNC, 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

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COMMENTS: This hybrid cross has become an aggressive invader of lower elevation forests throughout northeastern U.S., growing most densely along forest edges and in clearings, but also invading the interior of intact forests (Woods, 1993). It is capable of living in a broad range of plant communities with varying moisture and shade levels; much more broad than either of its two parents (Munger, 2005). Woodlands are most affected, and are particularly vulnerable if the habitat is already disturbed. Plants thrive in sunny, upland habitats, including forest edges, roadsides, pastures, and abandoned fields. They can also be found in fens, bogs, and lakeshores (Wisconsin Department of Natural Resources, 2004).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This species continues to increase its range in the United States, especially the hybrid crosses with other *Lonicera* species that appear to be more invasive than either parent (see Barnes and Cottam, 1974).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: The northeastern U.S. is particularly impacted by this hybrid. *Lonicera* x *bella* competetive success may be due in part to hybrid vigor as both parent species are extremely successful invaders (Batcher and Stiles, 2000) and *Lonicera* x *bella* is very adaptable sharing hybrid characters of both parents (Barnes and Cottam, 1974).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Dispersal is primarily by birds and some small mammals (Batcher and Stiles, 2000; Barnes and Cottam, 1974) that disperse the seeds. The plant has been used extensively in North America in shelter beds and wildlife planting (Woods, 1993; Barnes and Cottam, 1974). Migrant bird species favor the fruit and the plant is still sold for horticultural purposes (Batcher and Stiles, 2002; Nyboer, 1992: Williams, 2001).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B - MODERATE SIGNIFICANCE

COMMENTS: This species is expanding like the other *Lonicera* species in the United States with high tolerance for environmental conditions (Barnes and Cottam, 1974). As far back as 1974, it was identified as the single most important and prolific weed in the University of Wisconsin Herbarium (Barnes and Cottam, 1974). It occurs in mesic sugar maple- and red maple-dominated forests in Vermont and Massachusetts (Woods, 1993).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

A - HIGH SIGNIFICANCE

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COMMENTS: This species is listed as an "invasive plant of major concern" in Czarapata (2005). *Lonicera* x *bella* competetive success may be due in part to hybrid vigor as both parent species are extremely successful invaders (Batcher and Stiles, 2000). Although primarily a plant of disturbance, *Lonicera* x *bella* has a tremendous amplitude of tolerance for temperature, soil moisture, soil type, and light; much more so than either of its parent species. It is often associated with woods including second growth woods or open woods (Barnes and Cottam, 1974).

15. SIMILAR HABITATS INVADED ELSEWHERE

U - UNKNOWN

COMMENTS: Hybrids unknown or understudied elsewhere.

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: *Lonicera tatarica* grows rapidly and produces large quantities of showy, bird-dispersed berries (Woods, 1993). The species also produces abundant annual seed crops as reproduction is primarily by seed although greenwood and hardwood cuttings have been used extensively in commerical propagation (Batcher and Stiles, 2000). Crosses may have similar characters, although *Lonicera* x *bella* also reproduces asexually by root suckering and layering (Barnes, 1972 in Munger, 2005) which also may occur in either parent. A typical plant of *Lonicera* x *bella* may produce > 20,000 seeds annually (Munger, 2005).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Since honeysuckle roots are fairly shallow, small- to medium-sized plants can often be dug or pulled particularly in spring when the soil is moist. In sensitive areas, the type of physical removal may disturb the soil and lead to more invasion, in which case it should be avoided or soil should be tamped down to discourage further honeysuckle seedling establishment or physical removal should be coupled with herbicide or burning. Cutting of stems followed by treatment of 20% active glyphosate solution with a hand sprayer, sponge applicator, or contact solution bottles is effective (Wisconsin Department of Natural Resources, 2004). Mid-April burns for two years was found to reduce stands of this plant in a southern Wisconsin oak forest (Kline and McClintock, 1994 in Rice, 2005).
Use of fire as a management tool is discussed in depth in Munger (2005).

18. MINIMUM TIME COMMITMENT

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Repeated prescribed burning annually or biennially for several years may be necessary (Rice, 2005). Stem cutting with glyphosate herbicide application requires two cuts per year for three to five years (Batcher and Stiles, 2000; Wisconsin Department of Natural Resources, 2004). Most control measures (many outlined in Munger, 2005) require several years for any measure of success.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

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COMMENTS: Where burning is not possible (sensitive native species), 1.5% active glyphosate solution can be sprayed to cover foliage and spraying prior to emergence of native shrubs and ground flora is the safest time to spray without impacting native species. In wetlands, glyphosate formlated for water must be used (Wisconsin Department of Natural Resources, 2004). It is best to spray new foliage in the spring (Metsulfuron-methyl plus a surfactant is broadleaf specific) before the leaves of native shrubs and ground flora emerge (Czarapata, 2005).

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: As this species may occur on some private land (often on forest service land, however), some access issues will arise and cooperation with landownders for management will be necessary.

REFERENCES:

Barnes, W.J. and G. Cottam. 1974. Some autoecological studies of the Lonicera x bella complex. Ecology 55: 40-50.

Batcher, M.S. and S.A. Stiles. 2000. Element stewardship abstract for Lonicera maackii (Rupr.) Maxim (Amur honeysuckle), Lonicera morrowii A. Gray (Morrow's honeysuckle), Lonicera tatarica L. (Tatarian honeysuckle), Lonicera x bella Zabel (Bell's honeysuckle): the bush honeysuckles. The Nature Conservancy, Arlington, Virginia. unpaginated.

Collier, M.H., J.L. Vankat, and M.R. Hughes. 2002. Diminished plant richness and abundance below Lonicera maackii, an invasive shrub. American Midland Naturalist, 147(1): 60-71.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Ludwigia grandiflora

ELEMENT NATIONAL ID: 234788
SCIENTIFIC NAME: *Ludwigia grandiflora*
COMMON NAME: Large-flower Primrose-willow
I-RANK REVIEW DATE: 2006-06-27
EVALUATOR: J. Cordeiro, rev. K. Gravuer

I-RANK: High

I-RANK REASONS SUMMARY:
This species is considered a nuisance plant throughout most of its invaded range and forms dense stands that eliminate native vegetation by forming monospecific stands that competitively exclude other flora. It also eliminates open-water habitats that are important foraging-grounds for birds and other wildlife including rare fish and invertebrates. Large plant biomass results in a reduction in dissolved oxygen, an increase in acidity of the water, the euthrophication of the water body, and an increase in sedimentation. The species continues to spread aggressively in the Gulf and southeastern states and the western states including into undisturbed areas as the plant is easily dispersed and reproduces rapidly and aggressively. No management method is known to effect successful long-term control and management impacts on native species are high.

SUBRANK I - ECOLOGICAL IMPACT:	High/Medium
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Medium

OTHER CONSIDERATIONS:
Ludwigia grandiflora was recently (Zardini et al., 1991; 1992) delineated as a distinct species from the *Ludwigia uruguanyensis* species complex, but confusion still exists, even in recent literature, as to whether *Ludwigia grandiflora* and *Ludwigia hexapetala* are distinct species or not. Taxonomically, many synonymies have not been reconciled and in North America, *Ludwigia grandiflora* and *Ludwigia hexapetala* have often been used interchangeably (Crow and Hellquist, 2000a; ITIS, 2005; Kartesz, 1999; Washington State Noxious Weed Control Board, 2006; Wittenberg, 2005), and are likely the same species. *Ludwigia grandiflora* and *Ludwigia hexapetala* are treated as synonyms here.

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Global range includes two disjunct areas, one in southern Brazil, Bolivia, northeastern Argentina, Uruguay, and Paraguay (also locally in Guatemala), and the second (with relevance here) in the southeastern United States coastal plains of southern South Carolina, Georgia, northern Florida, and Louisiana, west to central Texas; and once in southwest Missouri (Zardini et al., 1991; Crow and Hellquist, 2000a).

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SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: In the southeastern and Gulf portions of the United States, water primrose has been considered a nuisance plant in most of its range (Benson et al., 2001; Chester and Holt, 1990; McGregor et al., 1996; Washington State Noxious Weed Control Board, 2006); as well as in some parts of California where it is locally common and Washington where it can dominate ditch margins in the Longview/Kelso Diking District in Cowlitz County (Washington State Noxious Weed Control Board, 2006; Zardini et al., 1991). Although there is some question as to whether is naturalized or native in the southestern United States, it has certainly invaded portions of this region and is an established invasive in the northeast and Pacific northwest.

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: In the southeastern and Gulf portions of the United States, water primrose has been considered a nuisance plant in most of its range (Benson et al., 2001; Chester and Holt, 1990; McGregor et al., 1996; Washington State Noxious Weed Control Board, 2006); as well as in some parts of California where it is locally common and Washington where it can dominate ditch margins in the Longview/Kelso Diking District in Cowlitz County (Washington State Noxious Weed Control Board, 2006; Zardini et al., 1991). Although there is some question as to whether is naturalized or native in the southestern United States, it has certainly invaded portions of this region and is an established invasive in the northeast and Pacific northwest.

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Large plant biomass results in a reduction in dissolved oxygen, an increase in acidity of the water, the euthrophication of the water body, and an increase in sedimentation (Dutartre, 2004; Wittenberg, 2005). Mats impair water flow and has the potential to dominate shoreline vegetation if introduced to lakes, rivers, ponds, ditches, or streams (Washington State Noxious Weed Control Board, 2006). In Laguna, California, *Ludwigia* may also contribute to flooding in the Laguna system, as plant biomass fills in flood control channels, reducing its capacity for flood-retention and altering the characteristics of the wetland. Perennial *Ludwigia* mats slow the movement of water through the system, trapping trash and debris and likely fine sediments, further reducing flood-storage capacity and degrading the wetland. Over the long term, with no remediation, *Ludwigia* will potentially lead to a decrease in shallow wetland areas overall, but with increased flooding during storm events (Sonoma County Water Agency, 2005).

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

A - HIGH SIGNIFICANCE

COMMENTS: *Ludwigia grandiflora* forms dense stands that eliminate native vegetation by forming monospecific stands that competitively exclude other flora (Wittenberg, 2005).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A/B - HIGH/MODERATE SIGNIFICANCE

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COMMENTS: *Ludwigia grandiflora* forms dense stands that eliminate native vegetation by forming monospecific stands that competitively exclude other flora (Wittenberg, 2005). Mats impair water flow and has the potential to dominate shoreline vegetation if introduced to lakes, rivers, ponds, ditches, or streams (Washington State Noxious Weed Control Board, 2006). Recent expansions in California have prompted the California Invasive Plant Council to rate *Ludwigia* as a High Impact invasive species due to its ability to rapidly invade unexploited ecosystems (Sonoma County Water Agency, 2005); and it is also listed as a noxious weed in Washington, Florida, North Carolina, and South Carolina.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: *Ludwigia grandiflora* forms dense stands that eliminate native vegetation by forming monospecific stands that competitively exclude other flora. Dense mats can also reduce the habitat of surface water birds (Wittenberg, 2005). In France, it has been found to compete with native plants (Dutartre, 2004). Similarly, evidence suggests *Ludwigia hexapetala* (here considered a synonym) outcompetes native wetland species in the Laguna de Santa Rosa, California. *Ludwigia* is also a direct threat to the diversity of native plant and animal communities, growing over surrounding vegetation to produce a thick mat of woody perennial stems and decaying plant matter. This mat inhibits the recovery and recruitment of other plants, and eliminates open-water habitats that are important foraging-grounds for birds and other wildlife. As *Ludwigia* tissue sloughs off or dies back and decomposes, microbial growth reduces dissolved oxygen in the water, impacting fish and invertebrate populations. Eighteen species of fish are found in the Laguna, including threatened populations of steelhead that use Laguna channels for seasonal passage to upstream breeding habitats. Current efforts to protect and enhance wetland habitats for migratory birds and waterfowl on the Pacific Flyway are substantially limited by *Ludwigia* growth, especially in the CDFG's Laguna Wildlife Area, site of the proposed *Ludwigia* control project (Sonoma County Water Agency, 2005).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: *Ludwigia* is also a direct threat to the diversity of native plant and animal communities, growing over surrounding vegetation to produce a thick mat of woody perennial stems and decaying plant matter. This mat inhibits the recovery and recruitment of other plants, and eliminates open-water habitats that are important foraging-grounds for birds and other wildlife. As *Ludwigia* tissue sloughs off or dies back and decomposes, microbial growth reduces dissolved oxygen in the water, impacting fish and invertebrate populations. Eighteen species of fish are found in the Laguna, California, including threatened populations of steelhead that use Laguna channels for seasonal passage to upstream breeding habitats. Current efforts to protect and enhance wetland habitats for migratory birds and waterfowl on the Pacific Flyway are substantially limited by *Ludwigia* growth, especially in the CDFG's Laguna Wildlife Area, site of the proposed *Ludwigia* control project (Sonoma County Water Agency, 2005). The Sonoma County Water Agency (2005) listed several dozen common and rare avian species that will benefit from *Ludwigia* removal in Laguna, California, because the growth of Ludwigia in this area actively promotes mosquito production, including mosquitos carrying the West Nile Virus, discovered in the area in 2004, which can kill native bird fauna.

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SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: *Ludwigia grandiflora* was recently (Zardini et al., 1991; 1992) delineated as a distinct species from the *Ludwigia uruguanyensis* species complex, but confusion still exists, even in recent literature, as to whether *Ludwigia grandiflora* and *Ludwigia hexapetala* are distinct species or not. Taxonomically, many synonymies have not been reconciled and in North America, *Ludwigia grandiflora* and *Ludwigia hexapetala* have often been used interchangeably (Crow and Hellquist, 2000a; ITIS, 2005; Kartesz, 1999; Washington State Noxious Weed Control Board, 2006; Wittenberg, 2005), and are likely the same species. Global range of *L. grandiflora* includes two disjunct areas, one in southern Brazil, Bolivia, northeastern Argentina, Uruguay, and Paraguay (also locally in Guatemala), and the second (with relevance here) in the southeastern United States coastal plains of southern South Carolina, Georgia, northern Florida, and Louisiana, west to central Texas; and once in southwest Missouri (Zardini et al., 1991; Crow and Hellquist, 2000a). *Ludwigia hexapetala* was also similarly delineated but has since been synonymized with *Ludwigia grandiflora*. Its global range included southern Brazil, Uruguay, eastern Paraguay, and northern and central Argentina; also central Chile and scattered localities in Bolivia, Peru, Ecuador, Colombia, Costa Rica, and (introduced) widespread in the southeastern United States but scattered introductions elsewhere including California (Zardini et al., 1991) all the southeast and Gulf states (Benson et al., 2001) and north to New England (Benson et al., 2004). USDA (2006) lists the range in the U.S. as the eastern coastal states from New York to Florida (absent from Delaware and Maryland) through the Gulf states to Texas and up the Mississippi River drainage to Missouri; also California to Washington.

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: In the southeastern and Gulf portions of the United States, water primrose has been considered a nuisance plant in most of its range (Benson et al., 2001; Chester and Holt, 1990; McGregor et al., 1996; Washington State Noxious Weed Control Board, 2006); as well as in some parts of California where it is locally common and Washington where it can dominate ditch margins in the Longview/Kelso Diking District in Cowlitz County (Washington State Noxious Weed Control Board, 2006; Zardini et al., 1991). In California, the worst *Ludwigia* infestations appear to be associated with symptoms of wetland degradation: thick sediments in shallow, slow-moving, nutrient-rich waters in full sun (Sonoma County Water Agency, 2005).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: It is conservatively estimated that between 35 and 40 ecoregions have been invaded by this species (Cordeiro, pers. obs. March 2006 based on TNC, 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

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COMMENTS: Found in coastal plains ponds where it forms a floating plant mat community favored by warm, southern climate (Hunt, 1943). It is a rooted herb found in areas of shallow water to about 1 meter deep with some flowing water tolerance that favors the margines of lakes, ponds, ditches, and streams (Washington State Noxious Weed Control Board, 2006). Also in shallow marshy areas, burrow pits, and ditches; as well as river banks and humid pastures (Wittenberg, 2005). In Oregon, southwestern Washington and California, *Ludwigia* is found at low elevations in rivers, streams, lakes, ponds, irrigation canals and other wet habitats (Sonoma County Water Agency, 2005).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This species is expanding rapidly in the United States beyond its original early invasion into the Pacific Northwest and the American southeast. It is now found in more than 20 states. Similar rapid expansion has been observed in some parts of Europe, particularly France (Dutartre, 2004; Wittenberg, 2005).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Potential range unknown but it is estimated that this species could potentially occupy most, if not all, coastal states as well as all the states east of the Mississippi River excepting those in the western and central Great Lakes.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Aerial stems are killed by frost, but rhizomes will survive as indicated by the recent colonization of *Ludwigia grandiflora* in the continental climate of north-eastern France (Wittenberg, 2005). It also easily disperses by stem fragmentation with seed production uncommon. Growth is very rapid and biomass can double within 15 days in standing water (Wittenberg, 2005). In addition to to water currents, rooted fragments are also thought to be dispersed by birds or other wildlife (Sonoma County Water Agency, 2005).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B - MODERATE SIGNIFICANCE

COMMENTS: This species has expanded rapidly in the past in the United States beyond its original early invasion into the Pacific Northwest and the American southeast. It is now found in more than 20 states with recent expansion continuing, though not as rapidly because a significant portion of its potential range has already been filled. Recent expansions in California have prompted the California Invasive Plant Council to rate *Ludwigia* as a High Impact invasive species due to its ability to rapidly invade unexploited ecosystems (Sonoma County Water Agency, 2005); and it is also listed as a noxious weed in Washington, Florida, North Carolina, and South Carolina. Recent rapid epansion is also documented in Tennessee and Kentucky (Chester and Holt, 1990).

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14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

A - HIGH SIGNIFICANCE

COMMENTS: Aerial stems are killed by frost, but rhizomes will survive as indicated by the recent colonization of *Ludwigia grandiflora* in the continental climate of north-eastern France (Wittenberg, 2005). It also easily disperses by stem fragmentation with seed production uncommon. Growth is very rapid and biomass can double within 15 days in standing water (Wittenberg, 2005). In France, this species has shown a high invasiveness adaptability as it was recently found growing in a large range of water and substrate quality, reproduces easily and quickly, fragments readily, and produces viable seeds and plantlets in the south part of France (highly unusual) (Dutartre, 2004). Along with the ability to tolerate low levels of oxygen, *Ludwigia* prospers in nutrient enriched water (Sonoma County Water Agency, 2005). In general, however, invasion depends on some form of disturbance, natural or anthropogenic.

15. SIMILAR HABITATS INVADED ELSEWHERE

B - MODERATE SIGNIFICANCE

COMMENTS: *Ludwigia grandiflora* is much more prevalent in streams (shallow, still, or flowing) in Europe than in the U.S., particularly in France where it has adapted to multiple flow conditions in rivers (Dutartre, 2004). Recently, this species has colonized wet grasslands in southern France (Wittenberg, 2005). Recent populations have been found in Sweden but it is not expected this species will pose any major problems there as the climate is largely too cold for this warmer climate species (Hallstan, 2005).

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: Fragmentation of stems is the main mode of dispersal of *Ludwigia* spp. although reproduction by seeds is known though unusual (Sonoma County Water Agency, 2005). Individuals resprout readily when broken or cut and stems fragment very easily (see management). The role of seeds remains to be studied further (viable seeds were able to germinate in laboratory conditions but no data has yet been obtained in outdoor conditions).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/B - HIGH/MODERATE SIGNIFICANCE

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COMMENTS: Mechanical management can be used, however, it is essential to prevent the spread of plant fragments by creating filters downstream before carried out removal. All removed plants must be carefully disposed of to prevent fragment dissemination. Draining and sediment removal also is effective. Biological control is being investigated but is far from perfected. It mostly involves use of the water primrose flea beetle, *Lysathia ludoviciana* (McGregor et al., 1996) which naturally infects water primrose effectively reducing biomass. No method provides effective long-term control (Wittenberg, 2005). Herbicide control has been limited to a few herbicides only (McGregor et al., 1996). For example, the herbicide isoproturon was found to have only limited effectiveness on the related species, *Ludwigia natans* (= *Ludwigia repens*) (Feurtet-Mazel et al., 1996; Grollier et al., 1997). In Laguna, California, the Sonoma County Water Agency (2005) found that mechanical removal alone was essentially ineffective, and that the combined treatment of mechanical removal plus herbicidee treatment, though most expensive, gave the most lasting control. *Ludwigia* is a perennial weed, that re-sprouts readily from root and stem fragments. For this reason, biomass removals that do not completely eliminate the root system, or that are not done in conjunction with an herbicide treatment to kill the roots, can result in rapid re-growth. This is similarly true of flaming and crushing methods, and ignition is likely to be difficult in this aquatic environment.

18. MINIMUM TIME COMMITMENT

B - MODERATE SIGNIFICANCE

COMMENTS: No management method provides effective long-term control (Wittenberg, 2005). Dutarte (2004) quickly evaluated a few control methods in France and determined that hand-pulling and other mechanical removal are useful for small occurrences but are expensive, and herbicide application has only short-term efficiency. In Laguna, California, a control plan is being implemented. The initial phase of the *Ludwigia* Control Project plans an integrated pest management approach that includes 3 years of herbicide treatments to control *Ludwigia* plants in project areas, and mechanical removals to reduce further eutrophication from rotting vegetation, as well as 5 years of monitoring during and after treatments. Strategies for controlling *Ludwigia* over the long-term include restoring the riparian canopy to increase shading, developing a biological control program, and potentially dredging to increase water depth in key areas. Long-term goals also include reductions in nutrient loading and control of sediment inputs; other restoration-based control methods are actively being investigated (Sonoma County Water Agency, 2005).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Impacts on native species vary by control measure but it is assumed that most measures (herbicides, drainage, fire) impact non-target plant and animal species to varying degrees due to the broad nature of their application. For example, control by flooding followed by burning to remove will affect all species in an area. Draining and sediment removal has high negative impact on habitat and native species (Wittenberg, 2005). Biological control has just recently been investigated and some promise has been shown preliminarily for the flea beetle, *Lysathia ludoviciana*, which seems to have minimal impact on native species, but more studies are needed (McGregor et al., 1996). Usage recommendations for herbicides, including maximizing impact on *Ludwigia* and minimizing impact on natives (minimal effect was found for several glyphosate based herbicides), is discussed in detail in Sonoma County Water Agency (2005), although many herbicides are ineffective against this species.

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

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COMMENTS: It appears most to all areas are easily accessible, as for most aquatic plants outside unusual habitats such as caves or high elevation streams or ponds. Because of the wide variety of aquatic and marshy habitats this species occupies, some areas may be difficult to access.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Lupinus polyphyllus

ELEMENT NATIONAL ID: 218655
SCIENTIFIC NAME: *Lupinus polyphyllus*
COMMON NAME:
I-RANK REVIEW DATE: 2006-05-15
EVALUATOR: G. Davis

I-RANK: Low

I-RANK REASONS SUMMARY:
Lupinus polyphyllus does not seem to be a major threat to healthy, high quality natural areas currently, however it does seem to be developing as a problem in Alaska. It does have great opportunity for spread into natural areas because it is so widely seeded and planted as an ornamental and it also has potential as a nitrogen fixer to alter local nutrient levels where it colonizes. This species should be monitored for future spread.

SUBRANK I - ECOLOGICAL IMPACT:	Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low/Insignificant

NATIVE AND NON-NATIVE IN NATION
NATIVE RANGE: Native to California north to British Columbia and in Idaho and Nevada (Hickman 1993).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Lupinus polyphyllus is native to western North America, but is introduced to eastern North America, including the northeastern U.S. and it is thought by most to be exotic in Alaska (USDA, ARS 2006, Alaska Natural Heritage Program 2006).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Lupinus polyphyllus has escaped from gardens to roadsides, fields, and open woods in the northeastern U.S. and adjacent Canada (GLIFWC 2006). In Alaska, Lupinus polyphyllus is well established in open to dense forest (Alaska Natural Heritage Program 2006).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

B - MODERATE SIGNIFICANCE

COMMENTS: The species is a nitrogen fixer which has been found in Lithuania to alter soil fertility to the extent that there are fast, irreversible changes of plant communities and entire ecosystems in native habitats (Gudzinskas 2005).

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: The species may replace species in the herbaceous layer, but there are no studies that show it significantly alters the structure of that layer.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: The species forms dense colonies that exclude other vegetation (GLIFWC 2006).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No known reports of impact on a particular native species.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C - LOW SIGNIFICANCE

COMMENTS: In the northeastern U.S. and Canada, typically established along roadsides (Voss 1985) and unmanaged fields (Don Cameron, pers. comm.). As of 2006 there is not abundant evidence of it colonizing rare communities or high quality natural areas, however a colony has been observed along a rivershore, which is a habitat that could be vulnerable to further colonization (Don Cameron, pers. comm.) and in sandy river terraces in southcentral Alaska (Alaska Natural Heritage Program 2006). Also in Alaska it is well established in open to dense mixed forests often near habitations (perhaps because it can remain in areas disturbed over 15 years ago) and is also abundant in disturbed areas, particularly in burned areas (Alaska Natural Heritage Program 2006).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: The current range in the U.S. - outside of its native range - stretches from northern Minnesota through Wisconsin, Michigan, and New England south to New York (Czarapata 2005, Kartesz 1999). There is also report of it in Illinois (Kartesz 2005 draft). It is also considered to be exotic in Alaska where it is well-established from Fairbanks to southern Alaska (Alaska Natural Heritage Program 2006).

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7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: There are very few reports in the literature of this species establishing in areas other than roadsides and disturbed areas. However, there are reports from Alaska that it does persist in areas disturbed at least 15 years ago and has been seen on sandy river terraces (Alaska Heritage Program 2006). It also has been observed along a rivershore in the northeastern U.S. (Don Cameron, pers. comm.).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

C - LOW SIGNIFICANCE

COMMENTS: Has invaded approximately 5-10 of the TNC ecoregions.

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Lupinus polyphyllus has been described invading roadsides, grasslands, and savannas by Czarapata (2005); roadsides and some fallow or unmanaged fields and a rivershore by Cameron in Maine (pers. comm. 2006); dry roadsides, banks, and fields by Haines and Vining (1998); and roadsides, open to dense mixed forests, burns, and other disturbed areas by the Alaska Natural Heritage Program (2006).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: The species appears to have no problem moving around on its own (Don Cameron, pers. comm. 2006) but has not been identified as spreading rapidly. It does appear to be spreading and very persistent in disturbed areas in Alaska (Alaska Natural Heritage Program 2006)

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: There is no indication in the literature of biological limitiations which could restrict the range of Lupinus polyphyllus and it occurs in most hardiness zones of the U.S. However, it does require sunny sites with consistent moisture, though it will tolerate partial shade (Alaska Natural Heritage Program 2006).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: This species is commonly sold commercially and planted in gardens and seeded along roadsides.

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B - MODERATE SIGNIFICANCE

COMMENTS: Lupinus polyphyllus is spreading along roads in Alaska (Alaska Natural Heritage Program 2006) and is locally well-established and spreading rather rapidly in the Lake Superior region of Minnesota, Wisconsin, Michigan, and Ontario (Great Lakes Indian Fish and Wildlife Commission 2005).

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14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: There have only been a few observations so far of Lupinus polyphyllus colonizing undisturbed areas. In southern Alaska it is described as well-established in open to dense mixed forests often near habitations (Alaska Heritage Program 2006) but it is not clear whether these populations colonized after disturbance and then persisted or if they are very close to areas where the species is seeded along roadsides.

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Lupinus polyphyllus invades braided riverbeds in New Zealand where it impacts ecological function (changing waterflow so that steep banks form, reducing habitat for the native fauna and flora) as well as directly shading out native species (New Zealand Department of Conservation 2003). Naturalized in Europe (USDA, GRIN 2006) and listed there as an invasive alien species (EPPO 2006). It is widespread in alpine areas of Australia (Australian Government, Department of the Environment and Heritage 2004).

16. REPRODUCTIVE CHARACTERISTICS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Lupinus polyphyllus reproduces from seed and forms extensive clones from creeping rhizomes. It also sprouts after removal of aboveground growth (Alaska Natural Heritage Program 2006). Seeds have a hard seed coat and long dormancy periods (Alaska Natural Heritage Program 2006).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Plants can be eradicated when populations are small by digging up rhizomes, but repeated weedings may be necessary (Alaska Natural Heritage Program 2006).

18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS:

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS:

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20. ACCESSIBILITY OF INVADED AREAS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: The main source of colonizing plants seems to be from roadsides which are highly accessible, however, since the plant is sold commercially it may be difficult to control recolonization from private land.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Lysimachia nummularia

ELEMENT NATIONAL ID: 219416
SCIENTIFIC NAME: *Lysimachia nummularia*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-11
EVALUATOR: Gravuer, K.

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:

Lysimachia nummularia is established throughout the eastern U.S. (except FL), as well as in a few Plains states and along the Pacific coast. It is locally common over a significant part of its range (the mid-Atlantic states, the Great Lakes states, and New England), and has been reported as invasive and/or listed on a state invasive list in many of the states where common. It invades a wide variety of (predominantly wetland) habitats, including riparian floodplain forest, riparian herbaceous wetland, other herbaceous wetlands (e.g. marshes), swamps, moist upland grasslands (e.g. prairies), disturbed open uplands (including lawns and cemeteries), partially open moist upland habitats (e.g. early successional forest), and roadsides. It has quickly spread stolons which root at the nodes, and forms mats which can exclude other herbaceous vegetation. This horticultural species is still available for Internet sale. Management methods include hand-pulling and prescribed burning.

SUBRANK I - ECOLOGICAL IMPACT: Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE: High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE: Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY: Low

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Native to southern Europe and adjacent temperate Asia, including Turkey, Russian Federation (European part, Ciscaucasia), Ukraine, Albania, Bulgaria, Greece, Italy, Yugoslavia, and France (USA ARS 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

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COMMENTS: Invades a variety of (predominantly wetland) habitats, including riparian floodplain forest/woodland, riparian herbaceous wetland (including stream banks and lakeshores), other herbaceous wetlands (e.g. wet meadows and marshes), swamps and low woods, moist upland grasslands (e.g. prairies and meadows), disturbed open uplands (including lawns and cemeteries), partially open moist upland habitats (including pine barrens, early successional forest, open woods, and woodland borders), and roadsides and railroad ROWs (Spencer 1940, Muenscher 1955, Hitchcock et al. 1959, Crockett 1977, Great Plains Flora Association 1986, Kennay and Fell 1990, Gleason and Cronquist 1991, Hickman 1993, Voss 1996, Rhoads and Block 2000, Mehrhoff et al. 2003, Czarapata 2005, Hilty 2006, Rice 2006, Tenaglia 2006, Weakley 2006, Whitinger 2006, Wisconsin State Herbarium 2006).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No mention of major impacts on ecosystem processes was found, despite the species' presence in the U.S. for over 130 years (Mehrhoff et al. 2003). However, where the species has high local abundance, it may disrupt water flow by choking small springs and seeps in rich woods (Mehrhoff et al. 2003).

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Forms mats which can exclude other herbaceous vegetation (Kennay and Fell 1990), significantly altering the structure of the herbaceous layer.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Forms mats which can exclude other herbaceous vegetation (Kennay and Fell 1990). Noted to be displacing native plants (Knouse 2006).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not significant.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B - MODERATE SIGNIFICANCE

COMMENTS: Noted to occur in either natural or disturbed areas (Hilty 2006) and invades a number of natural habitat types (e.g. riparian floodplain forests, marshes, swamps, prairies, pine barrens). However, Kennay and Fell (1990) note that it does not appear to be a problem in high-quality communities.

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SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Established throughout the eastern U.S. with the exception of Florida, as well as in a few Plains states (KS, NE, CO) and along the Pacific coast (WA, OR, CA) (Kartesz 1999). Most abundant in the mid-Atlantic states, the Great Lakes states, and New England; more scattered in the Southeast, the Plains states, and the Pacific coast states (Crockett 1977, Kennay and Fell 1990, Weakley 2006).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B - MODERATE SIGNIFICANCE

COMMENTS: Locally common over a significant part of its range (the mid-Atlantic states, the Great Lakes states, and New England). Reported as invasive and/or listed on a state invasive species list in many of the states where common (CT, DC, IN, MD, MI, MO, NJ, OR, PA, TN, VA, WI, WV; Swearingen 2006).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Approximately 35 ecoregions are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Can grow at a variety of moisture levels (from slightly mesic soil to floating or submersed in shallow water), but prefers moist to wet, rich soil; can also grow in diverse light environments, from full sun to shade. Invades a variety of (predominantly wetland) habitats, including riparian floodplain forest/woodland, riparian herbaceous wetland (including stream banks and lakeshores), other herbaceous wetlands (e.g. wet meadows and marshes), swamps and low woods, moist upland grasslands (e.g. prairies and meadows), disturbed open uplands (including lawns and cemeteries), partially open moist upland habitats (including pine barrens, early successional forest, open woods, and woodland borders), and roadsides and railroad ROWs (Spencer 1940, Muenscher 1955, Hitchcock et al. 1959, Crockett 1977, Great Plains Flora Association 1986, Kennay and Fell 1990, Gleason and Cronquist 1991, Hickman 1993, Voss 1996, Rhoads and Block 2000, Mehrhoff et al. 2003, Czarapata 2005, Hilty 2006, Rice 2006, Tenaglia 2006, Weakley 2006, Whitinger 2006, Wisconsin State Herbarium 2006). In New England (and possibly elsewhere), the species is known to grow most vigorously and pose the biggest threat in open, moist to wet habitats such as wet meadows and open pond shores (Mehrhoff et al. 2003). The range of invaded habitats appears more restricted in regions where the species is less locally abundant - e.g. in the Pacific Northwest, where it is predominantly found along moist roadsides and railroad ROWs (Hitchcock et al. 1959).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Present in New England at least as early as the 1870s (Mehrhoff et al. 2003). Expansion from the eastern U.S. to the north-central states and the west coast appears relatively recent (Kennay and Fell 1990).

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11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Hardy in USDA zones 3a - 10b (Whitinger 2006). Preference for moist to wet substrates may limit the potential distribution of this species in the western U.S., but there appears to be some potential for expansion within the Pacific coast states.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: A horticultural species available for sale over the Internet from many vendors (Whitinger 2006). More local dispersal mechanisms include passive dispersal, possibly by water, birds or humans (Mehrhoff et al. 2003).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

C - LOW SIGNIFICANCE

COMMENTS: Expansion from the eastern U.S. to the north-central states and the west coast (and therefore expansion within these areas) appears relatively recent (Kennay and Fell 1990). Adapted to disturbed habitats, so assumption is that range is not decreasing.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: Can occur in either natural or disturbed areas (Hilty 2006). Its creeping habit and ability to root at nodes appears to enable it to invade the understory of established vegetation (Hilty 2006).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Also established in at least Canada, Australia, New Zealand, Japan, and Europe north of its native range (e.g. Finland, Britain) (Randall 2002). Does not appear to invade habitats in these areas that it has not already invaded in the U.S. (Webb et al. 1988, White et al. 1993).

16. REPRODUCTIVE CHARACTERISTICS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Reproduces both vegetatively and by seed, and has quickly spreading stolons that root at the nodes (Muenscher 1955, Kennay and Fell 1990, Czarapata 2005). Appears to be able to reproduce from fragments (Czarapata 2005, Knouse 2006).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

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COMMENTS: Hand-pulling can be successful where practical, but if stem fragments or roots remain in the soil, the plant may re-sprout (Muenscher 1955, Czarapata 2005). More research is needed on the potential effectiveness of herbicides, although the plant's preference for wetland habitats may complicate the use of this method in some situations (Knouse 2006). Prescribed burning in spring or fall when most native vegetation is dormant can be a successful strategy (Kennay and Fell 1990).

18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS: If prescribed fire is used, a regular burning regime for several years is needed for control (Kennay and Fell 1990). Seed may also persist in the soil for a few years (Peat and Fitter 2006).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Either prescribed burning or hand-pulling should have relatively minor impacts on native species if implemented properly (Kennay and Fell 1990).

20. ACCESSIBILITY OF INVADED AREAS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: The species' horticultural importance, and the presence of many infestations in lawns, gardens, and cemeteries, means that many populations will likely be on private lands.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Lythrum salicaria

ELEMENT NATIONAL ID: 227601
SCIENTIFIC NAME: *Lythrum salicaria*
COMMON NAME: Purple Loosestrife
I-RANK REVIEW DATE: 2006-06-26
EVALUATOR: J. Cordeiro

I-RANK: High

I-RANK REASONS SUMMARY:
This extremely invasive species has the potential to completely dominate a wetland setting, forming a vast, monotypic stand. It can crowd out, outcomplete, and completely eliminate native species and aquatic plant layers and suppresses and eliminates native plants and seed growth. It can potentially hybridize with native loosestrife, which is considered rare in some states. The species is very widespread in the U.S. occurring almost everywhere and is considered invasive in most states. Seeds are easily and widely dispersed by water and the plant is extremely prolific, even in undisturbed areas. Eradication is possible for early infestations but is often costly and time consuming with millions of dollars being spent annually on removal of this species in the U.S.

SUBRANK I - ECOLOGICAL IMPACT:	High
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High
SUBRANK IV - MANAGEMENT DIFFICULTY:	High

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Lythrum salicaria is native to Eurasia (Bender, 1987) extending from Great Britain to central Russia, Japan, Manchurian China, southeastern Asia, and northern India (ISSG, 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species was introduced to the United States in the early 1800s (Bender, 1987) and has invaded many areas of the world including Canada, the United States, Ethiopia, and Australia (ISSG, 2005). This species has been listed among the most frequently listed in a recently compiled database of noxious weeds in the United States and Canada (Skinner et al., 2000).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: This species is widespread across the United States and 24 states have laws to discourage its spread (Czarapata, 2005).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: In its native habitat, purple loosestrife only comprises one to four percent of the native vegetation, but in North America, densities of up to 80,000 stalks per acre have been recorded (Strefeler et al., 1996). It can completely dominate a wetland setting, forming a vast monotypic stand.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

A - HIGH SIGNIFICANCE

COMMENTS: Purple loosestrife crowds out native species by creating an overstory and eventually may become monospecific. In its native habitat, purple loosestrife only comprises one to four percent of the native vegetation, but in North America, densities of up to 80,000 stalks per acre have been recorded (Strefeler et al., 1996). Uncontrolled, purple loosestrife eventually forms a near monoculture that alters the structure of natural plant communities and reduces biological diversity. Dense stands can change drainage patterns by restricting the flow of water (Snyder and Kaufman, 2004). Recent studies (Morrison, 2002), however, have shown that purple loosestrife stands were not monospecific in wetlands and other non-native species may come to dominate if purple loosestrife is removed, and that small gaps may provide regeneration niches for other species amidst dense assemblages of purple loosestrife.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A - HIGH SIGNIFICANCE

COMMENTS: Once established, purple loosestrife displaces native vegetation through rapid growth and heavy seed production (Bender, 1987).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

A - HIGH SIGNIFICANCE

COMMENTS: Conflicting reports exist as to whether *Lythrum salicaria* impacts density, richness, or diversity of other plant species. It has been reported that seeds often germinate in such high numbers that native seedling growth is suppressed and native species may be outcompeted (ISSG, 2005). Wildlife food plants such as cattails and pondweed are displaced or shaded out as *Lythrum salicaria* expands across a wetland (Rawinski, 1982 cited in Bender, 1987). Studies have documented the competetive displacement of cattail (Mal et al., 1997; Weihle and Neely, 1997) and declines in habitat quality for muskrats and waterfowl (ISSG, 2005). Gabor et al. (1996) found native species replaced adult purple loosestrife after its removal but purple loosestrife eventually reestablished dominance. On the other hand, Farnsworth and Ellis (2001) found little correlation between *L. salicaria* density or cover and other plant species, and loose correlation with actual increase in numbers of some other species (they did find lower biomass of other plants, however, in presence of *L. salicaria*). Morrison (2002) similarly found overall richness measurements in New York, Ontario, and Connecticut wetlands do not support the perception that purple loosestrife establishes monospecific stands and displaces native species. This indicates that although diversity and density of other wet meadow plant species is not negatively affected, *L. salicaria* may come to predomonate n these systems by attaining a larger size (competition for biomass). As for impact on animals, Gardner et al. (2001), however, determined that monotypic stands of purple loosestrife are not lacking in aquatic invertebrates, although individual sizes of some taxa tend to be smaller. In recent years, its has spread rapidly in the midwest in recent years, threatening native plants (including rare species0, but also the widllife that depend on them for food and shelter (Czarapata, 2005).

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5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

A - HIGH SIGNIFICANCE

COMMENTS: *Lythrum salicaria* can potentially hybridize with native loosestrife, *Lythrum alatum*, which is considered rare in some states, potentially reducing the gene pool for the rarer species. In recent years, its has spread rapidly in the midwest in recent years, threatening native plants (including rare species), but also the wildlife that depend on them for food and shelter (Czarapata, 2005). In 1995, the National Park Service determined that purple loosestrife was a potential threat to state listed endangered plant species, special concern plant species, and two globally rare calcareous riverside plant communities documented from the Delaware Water Gap National Recreation Area (Shank and Shreiner, 1999). Several limestone fens, a globally rare plant community, are threatened by the invasion of purple loosestrife in New Jersey (Snyder and Kaufman, 2004). Also in New Jersey, several populations of the federally listed bog turtle (*Clemmys muhlenbergii*) are threatened by loss of habitat through the invasion of purple loosestrife and a population of the state listed endangered wiry panic grass (*Panicum flexile*) was lost when its open fen habitat was succeeded by a dense stand of purple loosestrife (Snyder and Kaufman, 2004).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: This species occurs in nearly all sections of the United States, with the heaviest concentrations in the glaciated wetlands of the northeast; occurrences west of the Mississippi River are scattered (Bender, 1987; Mills et al., 1997; ISSG, 2005), notable exceptions include Florida, New Mexico, Arizona, Lousiana, Georgia, Alaska, and Hawaii (Benson et al., 2001; 2004).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A - HIGH SIGNIFICANCE

COMMENTS: Although it is considered invasive throughout the United States, purple loosestrife has become extremely aggressive in the northeast (Crow and Hellquist, 2000). In recent years, its has spread rapidly in the midwest in recent years, threatening native plants (including rare species0, but also the widllife that depend on them for food and shelter (Czarapata, 2005). This species has been listed among the most frequently listed in a recently compiled database of noxious weeds in the United States and Canada (Skinner et al., 2000). Not less than 24 states have laws to discourage the spread of purple loosestrife (Czarapata, 2005).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: It is conservatively estimated that far greater than half of the 81 ecoregions have been invaded by *Lythrum salicaria* in the United States (Cordeiro, pers. obs., June 2006, based on TNC, 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B - MODERATE SIGNIFICANCE

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COMMENTS: Purple loosestrife is found in a variety of wetlands such as cattail marshes, sedge meadows, floodplains, and open bogs, but also occurs along stream and river margins and lake shorelines (Crow and Hellquist, 2000). It is also found in ditches and disturbed wet soil areas (Bender, 1987; ISSG, 2005). It grows best in high organic soils but tolerates a wide range including clay, sand, muck and silt.

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Purple loosestrife is increasing rapidly across North America although it is already found in nearly every state. Although it is considered invasive throughout the United States, purple loosestrife has become extremely aggressive in the northeast (Crow and Hellquist, 2000). In recent years, its has spread rapidly in the midwest in recent years, threatening native plants (including rare species), but also the widllife that depend on them for food and shelter (Czarapata, 2005). This species has been listed among the most frequently listed in a recently compiled database of noxious weeds in the United States and Canada (Skinner et al., 2000). Not less than 24 states have laws to discourage the spread of purple loosestrife (Czarapata, 2005).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Since this species is present in nearly every U.S. state, most of its potential range is nearly occupied.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Seeds are borne in capsules that burst at maturity in late July or August and can be carried downstream in rivers and survive submerged for 20 months in water (Czarapata, 2005). Dispersal is mainly by wind but seeds can also be transported on feet or feathers of waterfowl or other wetland animals. Humans also carry seeds inadvertently on clothing and shoes. At the cotyledon stage are buoyant can can be dispersed by water (Bender, 1987). Mills et al. (1997) cited original infestations in the Hudson River basin (as far back as 1867) from dry ballast waste from ships and in waste from woolen mills. Although considered a noxious weed by the U.S. federal government and in many states, it continues to be sold in the nursery and landscape trade (Uva et al., 1997).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A - HIGH SIGNIFICANCE

COMMENTS: In the United States, mean rate of spread since 1940 is estimated to be 645 square km per year (Thompson, 1991). In recent years, its has spread rapidly in the midwest in recent years, threatening native plants (including rare species0, but also the widllife that depend on them for food and shelter (Czarapata, 2005). Not less than 24 states have laws to discourage the spread of purple loosestrife (Czarapata, 2005).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

A - HIGH SIGNIFICANCE

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COMMENTS: This species is listed as an "invasive plant of major concern" in Czarapata (2005). Seed production is prolific with an average of 120 seeds per capsule and up to 900 capsules per plant (Rawinski, 1982 cited in Bender, 1987). Single stems can produce 100,000 to 300,000 seeds annually and large, mature plants can have 50 or more stems (Czarapata, 2005). Most seeds fall near the parent plant but water, animals, boats, and humans assist in transporting them long distances. Natural dispersal is mainly by wind but seeds can also be transported on feet or feathers of waterfowl or other wetland animals. Humans also carry seeds inadvertently on clothing and shoes. At the cotyledon stage are buoyant can can be dispersed by water. The seed bank potential is enhanced by high seed viability, even in acidic or alkaline soils or soils that are nutrient poor (Bender, 1987). Seedlings that germinate in spring grow rapidly, but the species also germinates in summer (Shamsi and Whitehead, 1974). Although not as viable as spring germinating seedlings, seedlings that emerge during late summer through early September in Minnesota were found to survive the winter to create additional populations in wetland mudflats the following year (Katovich et al., 2003). Plants can propogate vegetatively by resprouting from cut stems and regenerating from root stock pieces (Bender, 1987; ISSG, 2005). In one growing season, an individual plant may produce over a million seeds, which can remain viable for several years (Welling and Becker, 1990), even under water for about 20 months (ISSG, 2005). Survival rate of seeds is 60-70% (Czarapata, 2005). In its native habitat, purple loosestrife only comprises one to four percent of the native vegetation, but in North America, densities of up to 80,000 stalks per acre have been recorded (Strefeler et al., 1996). Seedlings of purple loosestrife are also highly tolerant of submergence accumulating very high biomass at up to 6 cm depth submergence (Fraser and Karnezis, 2005).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Habitats invaded elsewhere are believed to be similar to in the U.S. This species is considered an invasive in many countries.

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: Plants reproduce by seed and vegetatively and begin to bloom (seeds borne in capsules burst and fall to the ground after ripening) in July and continue until September or October with flowers pollinated by bees and butterflies (Bender, 1987; Czarapata, 2005), often with seed production by new plants in the same season (Uva et al., 1997). A single mature plant can produce 2.7 million seeds (Gutin, 1999). Flowers are tristylous and pollination restricted to crosses between the style of one length with stamens of the corresponding length. Purple loosestrife can also spread vegetatively by leftover pieces of plants and roots (ISSG, 2005). A single plant can produce more than 2 million seeds per year (Uva et al., 1997) with each stem (there are 1-50 per plant) producing as much as 100,000 to 300,000 seeds annually (Czarapata, 2005). Even so-called infertile cultivars produce viable seeds and can become invasive (Randall and Marinelli, 1996). Seed banking capability is very high as seeds remain viable for twenty years and can live twenty months submerged in water (Czarapata, 2005).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A - HIGH SIGNIFICANCE

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COMMENTS: Large populations extending over three acres or more are difficult if not impossible to completely eradicate so prevention is the best control measure (Bender, 1987; Czarapata, 2005). In such cases, prevention of expansion is the best management policy through hand pulling new plants along the periphery or herbicide spraying on plants extending beyond the main body of the population. For small infestations, eradication is possible with spot applications of glyphosate herbicides (Bender, 1987). Cutting and pulling also is effective (not mowing because it disperses seeds and fragments) on small infestations (<100 plants), just before flowering (Czarapata, 2005; ISSG, 2005), and plant materials should be dried and burnt before disposal. Use of golden loosestrife beetle (*Galerucella calmariensis*) and black-margined loosestrife beetle (*Galerucella pusilla*) as a biological control has been successful (Malecki et al., 1993; Sebolt and Landis, 2002) and these beetles pose little risk to nontarget plants such as crepe murtle because beetles can feed but cannot complete their life cycle on crepe myrtle (Schooler et al., 2003). Other biological control measures that have met with success are the root mining weevil (*Hylobius transversovittatus*) and a herbivorous weevil (*Nanophyes marmoratus*) (ISSG, 2005).

18. MINIMUM TIME COMMITMENT

A - HIGH SIGNIFICANCE

COMMENTS: A huge sum of money ($45 million) is spent each year on management of this species in the United States (Simberloff, 2003). Any control effort should be followed up the same growing season and for several years afterwards since some plants will be missed, new seedlings may sprout from the extensive seed bank, and a few plants will survive low dosage herbicide treatment (ISSG, 2005). Cost nationally is estimated in the several million dollar range annually to control this species and time commitment lengthy (Snyder and Kaufman, 2004). For small populations, frequent cutting of stems at ground level is effective somewhat but needs to be continued for several years and cut stems must be burned because plants resprout from fragments (Randall and Marinelli, 1996).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B - MODERATE SIGNIFICANCE

COMMENTS: Herbicides should be used with caution given that loosestrife is restricted to wetlands, often covering
extensive acreage (Snyder and Kaufman, 2004). Glyphosate herbicides are non specific and tend to impact native species when used widely or when used in sensitive areas (ISSG, 2005). Use of golden loosestrife beetle and black-margined loosestrife beetle as a biological control has been successful (Malecki et al., 1993) and these beetles pose little risk to nontarget plants such as crepe murtle because beetles can feed but cannot complete their life cycle on crepe myrtle (Czarapata, 2005; Schooler et al., 2003). Gabor et al. (1996) found native species replaced adult purple loosestrife after its removal but purple loosestrife eventually reestablished dominance. Impact of root mining weevils on native, non-target species is also considered low (ISSG, 2005).

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: It appears most to all areas are easily accessible, as for most aquatic plants outside unusual habitats such as caves or high elevation streams or ponds.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Maclura pomifera

ELEMENT NATIONAL ID: 222486
SCIENTIFIC NAME: *Maclura pomifera*
COMMON NAME:
I-RANK REVIEW DATE: 2005-12-16
EVALUATOR: Maybury, K.

CALCULATED I-RANK: Medium/Low

I-RANK: Low

I-RANK ADJUSTMENT JUSTIFICATION:
Adjusted slightly down as serious impacts in a single preserve in California were reported and taken into account in the ranking but do not seem to be at all typical of this species in other parts of the range or even in nearby areas in California. If other evidence of spreading/invasiveness comes to light, particularly in western riparian habitats, this assessment should be revisited. Currently, persisting but not noted as spreading significantly in most of Washington, Oregon, California.

I-RANK REASONS SUMMARY:
This species persists from previous extensive plantings and in much of the U.S. can spread aggressively into disturbed areas and lower-quality habitats such as abandoned pastures and drainages. However, It does not readily invade high-quality natural communities. Its impact on native biodiversity is certainly not negligible, but neither is it thought to be significant.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low

NATIVE AND NON-NATIVE IN NATION
NATIVE RANGE: Native to Texas and small parts of Oklahoma, and Arkansas. See map in Little (1971). Some authors also include Louisiana in in its native range.

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Naturalized elsewhere, especially the eastern U.S. (FNA 1997).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Widely naturalized from very extensive hedgerow plantings in earlier times.

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: In a preserve in California, lower branches on older trees began to die causing a significant fire hazard (R. Waegell, pers. comm.) No other reports of abiotic ecosystem alteration.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This thicket-forming tree invades prairies/grasslands, especially those that have been moderately to severely impacted by grazing (Smith 2004, T. Smith, pers. comm.; C. Freeman, pers. comm.). Will establish in these areas in the absence of annual haying and fire, or other active management (C. Freeman, pers. comm.).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Significant alterations in community composition have been reported or are feared in riparian forests in the Central Valley of California (Meyers-Rice and Tu 2001). In one of these areas, although the trees did not form dense stands, older trees did eliminate plants in the understory (R. Waegell, pers. comm.). In other areas, this tree is known to form thickets in grasslands (C. Freeman, pers. comm.; T. Smith, pers. comm.).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

U - UNKNOWN

COMMENTS: No definite reports of disproportionate impacts but chemical substances produced by the tree have long been thought to be repellant to insects, bacteria, and fungi (the rot- and termite-resistant wood has long been used for fence posts).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C - LOW SIGNIFICANCE

COMMENTS: Apparently Osage-orange can invade high quality riparian forests (Meyers-Rice and Tu 2001) but it is most commonly and characteristically a plant of disturbed, low-quality sites such as abandoned hedgerows, fencerows, pasturelands, ditch banks, etc. (Burns and Honkala 1990, Hickman 1993, Smith 2004). When it does invade high-quality forests, at least in Missouri, it is only as an occassional tree along streambanks; it doesn't grow beyond the streambanks due to shade intolerance nor does it "take over the streambanks" (T. Smith, pers. comm.). Similarly, only occassional, scattered individuals are found in high-quality grasslands, usually in draws, ravines, and other drainages where there is shelter from fire along with some disturbance from waterflow (C. Freeman, pers. comm; T. Smith, pers. comm.).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: General range is most of the eastern half of the conterminous U.S. and isolated areas in the West (see maps in FNA 1997, Kartesz 1999).

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7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Some negative impacts on biodiversity presumed in most areas.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS:

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Various riparian and non-riparian forests and woodlands, savannas, prairies in many parts of the U.S.

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: No reports of rapid expansion and assumption is that range is not decreasing markedly either.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Not winter hardy in the northern Great Plains, Alaska, or in northern New England (Gilman and Watson 1994) so no range expansion possible there. Possible further range expansion in California and the Pacific Northwest? There is currently only one collection in Oregon herbaria. In Washington State, persisting (and reproducing a bit) where planted in a couple of locations, but not thought to be spreading (F. Caplow, pers. comm.).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Still planted and available from some mail-order / internet nurseries. (However, the plant is dioecious and many cultivars sold are non-fruit-producing males.) Seeds are sold as a natural pesticide by several sources on the Web. Long-distance dispersal other than by humans is probably infrequent as the fruits are unpalatable (to humans) and very large, often weighing more than 2 lbs (Burnes and Honkala 1990). Squirrels do eat the fruit and transport the seeds (Gilman and Watson 1994).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

C - LOW SIGNIFICANCE

COMMENTS: Inferred.

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14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: In general, this species appears to persist from previous plantings, and spread and establish in new areas only with disturbance. Natural regeneration requires exposed mineral soil and full light (Burnes and Honkala 1990). In Missouri, does not readily invade high-quality natural communities; only occasional individuals seen except in areas with substantial disturbance (T. Smith, pers. comm.). In Kansas, primarily invades moderately to severely disturbed plant communities (C. Freeman, pers. comm.). In Illinois, noted spreading into badly disturbed areas and along the edges of low-quality woodlands, but not in good-quality natural areas (B. Dolbeare, pers. comm.) In Tennessee and other parts of the southeastern U.S., it is generally found in heavily disturbed areas (A. Bishop, pers. comm., Weakley 2005) In one high-quality riparian area in California, it appeared to be reproducing quite agressively, but for unknown reasons, it does not appear to be as aggressive in other areas in California (R. Waegell, pers. comm.). In Washington State it is occasionally seen along the Snake River and tributaries and also persists at old homesteads (C. Bjork, pers. comm. to F. Caplow).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: A serious problem in New South Wales, Australia (North West Weeds 2004) but in riparian areas; probably similar to habitats invaded in California.

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: Large numbers of seeds produced and can also spread vegetatively (Burns and Honkala 1990). Resprouting from stumps and root suckers is vigorous (Smith 2004).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B - MODERATE SIGNIFICANCE

COMMENTS: Because of vigorous resprouting, repeated cutting may be necessary, followed if possible (where impacts on non-target species can be controlled) by herbicides applied to the cut surfaces (Smith 2004). Gummy bark makes this tree somewhat hard to cut (M. Tu, pers. comm.). For areas where the trees are abundant, burning or chipping is required after cutting because debris is very decay resistant (Smith 2004). In grasslands, periodic burning prevents or hinders reestablishment (Smith 2004, C. Freeman, pers. comm.)

18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS: Relatively low for getting the trees removed but reestablishment in grasslands must be controlled by periodic burning or other methods. For riparian areas periodic monitoring and pulling of seedlings might be possible.

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19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Apparently can be controlled effectively without great non-target damage if herbicide application is done carefully or not at all (see Smith 2004).

20. ACCESSIBILITY OF INVADED AREAS

A - HIGH SIGNIFICANCE

COMMENTS: The many plantings on private lands will provide a source for re-infestation.

REFERENCES:

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Invasive Species Assessment Protocol:
U.S. National Assessments

Melilotus officinalis

ELEMENT NATIONAL ID: 204553
SCIENTIFIC NAME: *Melilotus officinalis*
COMMON NAME:
I-RANK REVIEW DATE: 2005-12-19
EVALUATOR: Fellows, M., rev. Maybury (2005).

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:
This is a widespread exotic species with some evidence that it can alter soil nitrogen, at least in nitrogen-poor systems. It requires some disturbance to become established and is often found on roadsides but it also impacts recovering prairies and other sites of greater biodiversity value. It is still widely planted.

SUBRANK I - ECOLOGICAL IMPACT:	Medium
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Mediterranean regions from central Europe to Tibet (Eckardt 1987).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Many Midwestern native prairies and open, unflooded communities (Cole 1990).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

B - MODERATE SIGNIFICANCE

COMMENTS: Nitrogen-fixing, which may change the species composition of invaded areas (Eckardt 1987; Weber 2003). Some sources say it is more of an aesthetic than ecological issue (Eckardt 1987); however, work in very low-nitrogen Badlands sparse vegetation demonstrated that this species increased soil nitrogen, which presumably led to floristic changes (Van Riper 2005). (In an less nitrogen deficient ecosystem, this species did not have this effect.)

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2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B - MODERATE SIGNIFICANCE

COMMENTS: Herb up to 250 cm in height (Weber 2003). Forms dense stands (Weber 2003) that can overtop and shade native species (WI DNR 2002).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Displaces native species (Weber 2003). In Badlands sparse vegetation, this species acted as a nurse plant and led to increased cover of both exotic and native species (Van Riper 2005).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS:

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B - MODERATE SIGNIFICANCE

COMMENTS: Grassland, riparian habitats and disturbed habitats (Weber 2003). Especially threatening to efforts to restore native prairies (Eckardt 1987).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Throughout US (Kartesz 1999).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

U - UNKNOWN

COMMENTS: Some sources say it is more of an aesthetic than an ecological issue (Eckardt 1987).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: Potentially in all ecoregions (Kartesz 1999; TNC 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Grassland, riparian habitats and disturbed habitats (Weber 2003). Open disturbed habtiats, such as prairies, savannas and dunes (WI DNR 2002).

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SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: Throughout U.S. (Kartesz 1999; Hiebert pers. comm.).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

D - INSIGNIFICANT

COMMENTS: Throughout U.S. (Kartesz 1999).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Dispersed by water (Eckardt 1987; Weber 2003). Originally introduced for forage and honey production (WI DNR 2002).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Locally aggressive (WI DNR 2002) although it can be stable (Hiebert, pers. comm.).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: Grassland, riparian habitats and disturbed habitats (Weber 2003). Establishes well in grasslands following fire disturbance (Weber 2003). Can establish in the disturbed areas around fox dens and expand to a larger invasion (WI DNR 2002).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Canada (Kartesz 1999). Also found in similiar habitats in New Zealand, South America and the British Isles (Weber 2003).

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: Seed bank viable for 20 years or more (Weber 2003) to 30 years (WI DNR 2002). Up to 350,000 seeds per plant (Ohio DNAP 2001).

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SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B - MODERATE SIGNIFICANCE

COMMENTS: Repeated cuttings of large infestions to reduce vigor; dig out scattered plants; some herbicides are effective (Weber 2003). Burning encourages germination, however burning two years in a row reduces the invasion (WI DNR 2002). Must be managed nearly continuously (WI DNR 2002).

18. MINIMUM TIME COMMITMENT

B - MODERATE SIGNIFICANCE

COMMENTS: Seed bank viable for 20 years or more (Weber 2003) to 30 years (WI DNR 2002), although, with proper burning, could be controlled in 6 years (Eckhardt 1987).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Should not need to use herbicides to manage *Melilotus officinalis* (WI DNR 2002). If herbicides used, can be applied before most natives emerge in the spring (Eckardt 1987).

20. ACCESSIBILITY OF INVADED AREAS

A - HIGH SIGNIFICANCE

COMMENTS: This species will continue to be planted for it's economic/wildlife values (WI DNR 2002).

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Invasive Species Assessment Protocol:
U.S. National Assessments

Microstegium vimineum

ELEMENT NATIONAL ID: 202628
SCIENTIFIC NAME: *Microstegium vimineum*
COMMON NAME:
I-RANK REVIEW DATE: 2004-12-09
EVALUATOR: Tomaino, A.

I-RANK: High/Medium

I-RANK REASONS SUMMARY:
Microstegium vimineum is established in most eastern states; it occurs from New York to Illinois south to Florida and Texas. *M. vimineum* is slow to invade undisturbed vegetation but spreads quickly and forms dense monocultures in areas with natural or human-caused disturbance. It's habitats include stream banks, river bluffs, floodplains, emergent and forested wetlands, moist woodlands and forests, early successional fields, woodland thickets, and rights-of-way. *M. vimineum* grows very well under low light conditions such as under a forest canopy. *M. vimineum* can displace native vegetation in a few years and also impacts ground nesting birds. *M. vimineum* may also impact ecosystems by altering soil conditions. *M. vimineum* produces 100-1000 seeds per plant. Seeds remain viable in the soil for at least 3-5 years. Once established, the removal of *M. vimineum* requires major eradication and restoration efforts.

SUBRANK I - ECOLOGICAL IMPACT:	Medium
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Medium

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Native to the Russian Federation, China, Japan, Korea, Taiwan, India, Nepal, Indochina, Thailand, and the Philippines (GRIN 2001).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Established outside cultivation in the U.S. (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Invaded habitats in the U.S. include floodplains, riparian habitats, forests, and swamps (Weber 2003).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C - LOW SIGNIFICANCE

COMMENTS: *Microstegium vimineum* may alter soil conditions, creating an inhospitable environment for native species; soils beneath *M. vimineum* had increased nitrification (Tu 2000, Ehrenfeld et al. 2001). Litter and organic soil horizons were thinner and soil pH was higher than in uninvaded areas (Kourtev et al. 1998 cited by Tu 2000).

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B - MODERATE SIGNIFICANCE

COMMENTS: A grass with slender culms, 50-120 cm in height (Weber 2003). *Microstegium vimineum* spreads quickly and forms dense monocultures (Flora of North America 2003). Dominates the herb layer (E. Farnsworth, pers. comm. 2001). Increases the density of the herb layer (D. Keech, pers. comm. 1999).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A - HIGH SIGNIFICANCE

COMMENTS: *Microstegium vimineum* produces sprawling colonies that expand and form dense monocultures; native vegetation can be displaced in a few years (Weber 2003). *Microstegium vimineum* displaces native wetland and forest vegetation (Swearingen 2002). *Microstegium vimineum* takes over quality nesting habitat that quail and other wildlife would use (Tu 2000). *M. vimineum* provides habitat for rats, which prey on native bobwhite and attract other predators (A. Houston, pers. comm. cited by Tu 2000). White-tail deer tend to avoid *M. vimineum* and feed on native plant species instead (Swearingen 2004). *Microstegium vimineum* grows very well under low light conditions such as under a forest canopy (Winter et al. 1982). *Microstegium vimineum* may impact the microbial community of the soil (Kourtev et al. 2002).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not significant.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: *Microstegium vimineum* occurs on stream banks, river bluffs, floodplains, emergent and forested wetlands, moist woodlands, and in forests (Swearingen et al. 2002; Weber 2003; Swearingen 2004). Some of these communities are likely to be of conservation significance. *Microstegium vimineum* poses a threat to rare native plants in New York and adjacent states (Hunt and Zaremba 1992). *Microstegium vimineum* impacts freshwater tidal wetlands and high quality riparian corridors (E. Farnsworth, pers. comm 2001).

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SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Established in most eastern states; occurs from New York to Illinois south to Florida and Texas (Kartesz 1999; Flora of North America 2003; Swearingen 2004). Distribution is concentrated in lower New England, the Piedmont, Appalachians, and Cumberlands (Flora of North America 2003).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: *Microstegium vimineum* apparently has negative impacts in greater than 20% of its current generalized range (Tu 2000).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: Approximately 20% of units, inferred from TNC (2001), Kartesz (1999), and Flora of North America (2003).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: *Microstegium vimineum* occurs on stream banks, river bluffs, floodplains, emergent and forested wetlands, moist woodlands, forests, early successional fields, woodland thickets, roadside ditches, gas and power-line corridors, paths, roadsides, clearings, disturbed areas, lawns, and gardens (Swearingen et al. 2002; Weber 2003; Swearingen 2004).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: *Microstegium vimineum* spreads rapidly into disturbed areas (Weber 2003). Occurs in disturbed areas; assumption is that disturbed areas are not declining or remaining stable and therefore this species' total range is not declining or remaining stable.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: *Microstegium vimineum* may be near its northern limit in southeastern New York, due to a lack of cold hardiness (Hunt and Zaremba 1992). Another possibility is that *Microstegium vimineum* may require red clay soils; if soil type is limiting the spread of *Microstegium vimineum* then it may also be approaching its maximum geographic extent in New York and New England (Hunt and Zaremba 1992). Based on USDA (1990) and Flora of North America (2003), 30-90% of its potential generalized range in the U.S. is currently occupied.

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12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: *Microstegium vimineum* seeds are dispersed by surface runoff, floodwaters, on human and animal feet, and are carried in hay (Swearingen 2004).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: *Microstegium vimineum* spreads rapidly into disturbed areas (Weber 2003). Occurs in disturbed areas; assumption is that disturbed areas are not decreasing or remaining stable and therefore this species' local range is not decreasing or remaining stable.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: *Microstegium vimineum* is slow to invade undisturbed vegetation but rapidly fills disturbed, mesic, shaded areas (Barden 1987).

15. SIMILAR HABITATS INVADED ELSEWHERE

D - INSIGNIFICANT

COMMENTS: No mention of *Microstegium vimineum* being established elsewhere outside its native range found in the literature; assumption is that it is not known as an escape except in the region of interest.

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: *Microstegium vimineum* is a colonial species that spreads by rooting at stem nodes that touch the ground (Swearingen 2004). *Microstegium vimineum* is still considered to be an annual (Flora of North America 2003). However, there is evidence needing further investigation, that a rhizomatous, perennial form occurs in several populations in New Jersey (Ehrenfeld 1999). *Microstegium vimineum* seeds remain viable in the soil for at least 3 years (Barden 1987). *Microstegium vimineum* produces 100-1000 seeds per plant (Miller 2003).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Once established, the removal of *Microstegium vimineum* requires major eradication and restoration efforts (Tu 2000). For large investations herbicides such as glyphosate are more practical and effective than hand-pulling or mowing (Swearingen 2004).

18. MINIMUM TIME COMMITMENT

B - MODERATE SIGNIFICANCE

COMMENTS: *Microstegium vimineum* seeds remain viable in the soil for at least 3 to 5 years or more (Barden 1987; Swearingen 2004).

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19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: For large investations herbicides such as glyphosate are more practical and effective (Swearingen 2004). Care must be taken to avoid applying glyphosate to non-target plants because it will kill or damage most plants it contacts (Swearingen 2004). Since the plant often occurs in monospecific stands this may not be a large issue.

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Avoided by grazing animals and infestations are not in extreme or remote habitats (Swearingen 2004); assumption is that accessibility problems are not severe or substantial.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Morus alba

ELEMENT NATIONAL ID: 247549
SCIENTIFIC NAME: *Morus alba*
COMMON NAME: White Mulberry
I-RANK REVIEW DATE: 2006-06-26
EVALUATOR: J. Cordeiro, Fellows, M.

I-RANK: High/Medium

I-RANK REASONS SUMMARY:
Impacts of this species largely occur at the native species level except where stands are dense and prevent native forest regeneration. This species spreads/carries disease that kills native red mulberry, itself considered an endangered species in Canada. White mulberry also hybridizes readily with native red mulberry and, with time, could eleminate native genetic strains and come to replace native red mulberry in the United States. It is already distributed throughout most of the United States except the southwest and Alaska but is considered particularly invasive in the northeast and Wisconsin. It is easily spread by birds and mammals and has moderate capability of invading undisturbed areas. Control is not difficult although success over time has not been evaluated.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Low

OTHER CONSIDERATIONS:
White mulberry is very difficult to differentiate from native red mulberry (Weeks, 2003). Species identification in mulberry (*Morus*) continues to be a point of great debate among scientists despite the number of criteria such as floral characters, wood, and leaf anatomical and biochemical characters used to identify the species within this genus. The results of genetic cluster analysis revealed relatively high degrees of DNA polymorphism among several species of *Morus* where *Morus laevigata* was found to be a separate species of mulberry while *Morus latifolia*, *Morus bombycis*, *Morus alba,* and *Morus indica* were grouped together and treated as subspecies (Vigayan et al., 2004). Many horticultural varieties of white mulberry have been planted in the United States including Russian mulberry, *Morus alba* var. *tartarica* (Weeks, 2003).

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: This species is native to temperate Asia (Weber, 2003), particularly central and northern China (Czarapata, 2005; Zheng et al., 2006).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

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COMMENTS: The species was introduced to the United States by the British before the Revolutionary War in an unsuccessful attempt to establish a silkworm industry (Czarapata, 2005).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: For thousands of years, white mulberry, native to China, was cultivated as a source for silk worm, although this has largely been unsuccessful in the United States despite repeated attempts. The species has still become widespread in native species habitat across the U.S. (Weeks, 2003).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

U - UNKNOWN

COMMENTS:

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

COMMENTS: The tree grows up to 15 m tall (Weber, 2003) and forms dense stands, although they are usually not monospecific.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: When stands are dense, they can prevent native forest regeneration (Weber, 2003).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

B - MODERATE SIGNIFICANCE

COMMENTS: This species spreads/carries disease that kills native red mulberry (*Morus rubra*) (MD Cooperative Extension, undated), itself considered an endangered species in Canada with a National Recovery Strategy in preparation (Ambrose, 1999). White mulberry also hybridizes readily with native red mulberry and, with time, could eleminate native genetic strains and come to replace native red mulberry in the United States (Husband et al., 2001; Ambrose, 1999; Burgess et al., 2005; Randall and Marinelli, 1996; Weeks, 2003). Many horticultural varieties of white mulberry have been planted in the United States including Russian mulberry, *Morus alba* var. *tartarica* (Weeks, 2003), which also hybridize with and outcompete native red mulberry.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B - MODERATE SIGNIFICANCE

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COMMENTS: This species spreads/carries disease that kills native red mulberry (*Morus rubra*) (MD Cooperative Extension, undated), itself considered an endangered species in Canada with a National Recovery Strategy in preparation (Ambrose, 1999). White mulberry also hybridizes readily with native red mulberry and, with time, could eleminate native genetic strains and come to replace native red mulberry in the United States (Husband et al., 2001; Ambrose, 1999; Burgess et al., 2005; Randall and Marinelli, 1996; Weeks, 2003). Many horticultural varieties of white mulberry have been planted in the United States including Russian mulberry, *Morus alba* var. *tartarica* (Weeks, 2003), which also hybridize with and outcompete native red mulberry.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: This species is distributed throughout the United States except Arizona, Utah, and Alaska (Kartesz, 1999).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B - MODERATE SIGNIFICANCE

COMMENTS: For thousands of years, white mulberry, native to China, was cultivated as a source for silk worm, although this has largely been unsuccessful in the United States despite repeated attempts. The species has still become widespread in native species habitat across the U.S. (Weeks, 2003). It is considered particularly invasive in the northeast and Wisconsin (USDA, 2006).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: This species is distributed throughout the United States except Arizona, Utah and Alaska (Kartesz, 1999). It is conservatively estimated that well over half of the U.S. ecoregions have been invaded by the either invasive strains of this species or native x invasive crosses of white and red mulberry (Cordeiro, pers. obs. June 2006 based on TNC, 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: The species is known to invade forests, forest edges, grassland and rocky places (Weber, 2003). It can also be found in waste areas, roadsides, no-till fields, woodland edges, fencerows; and tolerates poor soils, drought, air pollution, and salt, but cannot grow in shade, unlike the native red mulberry which requires shade (Czarapata, 2005; Weeks, 2003).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Of late, *Morus alba* has become particularly invasive in northeastern states and is also considered invasive in Wisconsin (USDA, 1999). Since its deliberate introduction in the 1700s, it has been spreading considerably throughout the United States (and the world) for the last 300 years (Czarapata, 2005).

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11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: White mulberry has a long agronomic history in the U.S. with forage cultivation occurring as early as the 1700s in New England for silk production and continuing much actively today for horticulature (Czarapata, 2005). A significant portion of its potential range is likely occupied although there is still room for expansion as it displaces native red mulberry.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Many varieties are in cultivation, especially for silk production, food, or as ornamentals (Weber, 2003). Birds and mammals relish mulberry fruits and spread the seeds through their feces (Weeks, 2003).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A - HIGH SIGNIFICANCE

COMMENTS: The species spreads rapidly and is very widely distributed (Weber, 2003).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: This species is listed as an "invasive plant of lesser concern" in Czarapata (2005). The species is cabable of invading some natural areas including fields, forest edges, and reoadsides.

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: The species has also invaded Southern and Central Europe, Africa, Canada, South America (Weber, 2003) although likely in similar habitats.

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: The root system is widely aggressive and spreads rapidly, clogging areas quickly. Reproduction is by seed (Czarapata, 2005) and the species is capable of self-pollination and sex reversal (Schaffner, 1936).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

C - LOW SIGNIFICANCE

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COMMENTS: To control this species, pull or dig out smaller plants; cut and treat stumps with herbicide for larger plants (Weber, 2003). Czarapata (2005) cautions that this species should be properly identified before beginning control measures as it is easily confused with the native red mulberry. Girdling is sometimes used (especially for large trees) and a basal bark treatment with triclopyr formulated for use with oil is also effective. Imazapyr has been effective, as well. Cut stems buried in the soil are able to regenerate so must be properly disposed of (Czarapata, 2005).

18. MINIMUM TIME COMMITMENT

U - UNKNOWN

COMMENTS:

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B - MODERATE SIGNIFICANCE

COMMENTS: Experiments have demonstrated that culling of White Mulberry can increase the reproductive success of Red Mulberry and reduce hybridization. However, due to White Mulberry's fitness advantage over Red Mulberry, it is anticipated that a large amount intervention will be necessary to prevent the extirpation of Red Mulberry. Results from this work showed that the removal of White and hybrid Mulberry in culled plots successfully increased the number of seeds sired by Red Mulberry and decreased the proportion of matings with White and hybrid Mulberry (Ambrose, 1999). Zheng et al. (2006) cite at least 61 species of fungi (with references) reported to infect the genus *Morus* with 54 of them infecting white mulberry and also cite 263 species of arthropods reported to occur on white mulberry. Application of these fungi and arthropods in control measures in the United States has not been explored.

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Accessibility should be fairly straightforward except in areas where trees are on private land.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Muscari botryoides

ELEMENT NATIONAL ID: 200994
SCIENTIFIC NAME: *Muscari botryoides*
COMMON NAME:
I-RANK REVIEW DATE: 2006-02-01
EVALUATOR: Maybury, K.

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:
A widely planted and widely but sporadically naturalized plant that persists from former plantings and can escape and spread locally. Typically found in lower quality habitats (persisting in lawns, cemetaries, found in roadside ditches, etc.) and not in high quality native species habitats. No serious impacts to native biodiversity have been documented in the U.S.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Central and southeast Europe (FNA 2002).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS:

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes
COMMENTS:

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No evidence of abiotic alterations.

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2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No evidence of significant influences on vegetation structure or density changes.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Inferred: few reports of dense stands, although Yatskievych (1999) noted that it can become "quite prolific" in certain situations.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No evidence of any disproportionate impacts.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C - LOW SIGNIFICANCE

COMMENTS: Most sources describe lower-quality habitats such as abandoned gardens, lawns, roadsides and neighboring woods, suburban woodlands, disturbed urban areas, old fields, and cemeteries (e.g., Voss 1985, Hickman 1993, Ball State Univ. 2001, FNA 2002, Weakley 2006). The plant has been found in openings in moist bottomland forests in Missouri (Yatskievych 1999) but it was listed in Missouri as a species that "after review, does not appear to pose a significant threat to native plant communities" (MEPPC 2002). It had been reported in 1989 at Camassia Preserve in Oregon but the few individuals at the preserve entrance have not spread (J. Soll, pers. comm., 2006).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Much of the eastern U.S., west to Minnesota in the north and Kansas and Texas in the south. Also in Utah, Washington, Oregon, and California (Kartesz 1999, FNA 2002) and expected elsewhere (FNA 2002).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: At least some negative impacts possible in a large portion of the generalized range; however, the species has only naturalized sporadically and/or is reported as uncommon in many areas (Yatskievych 1999; Weakley 2006; Kartesz, unpublished county distribution data). It occurred in only one of nearly 2,000 vegetation sample plots in a Virginia study (Heffernan et al. 2001). In Utah, apparently only established locally, perhaps persisting from former plantings or establishing where garden soils have been transported (Welsh et al. 2003). Only on the watch list in Tennessee as a plant that may become a problem in the future (Tennessee- EPPC, not dated) and ***not*** believed to pose a significant threat to native plant communities in Missouri (MEPPC 2002).

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8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Inferred.

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

U - UNKNOWN

COMMENTS:

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Assumed neither rapidly expanding nor decreasing.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Widely planted and already widely, if sporadically, naturalized.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Commonly sold and planted and can reseed in the vicinity or bulbs can be transported in soil (FNA 2002).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

C - LOW SIGNIFICANCE

COMMENTS: Inferred.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: This is largely a plant of disturbed habitats such as roadsides and rights-of-way and persisting from former plantings in old gardens, lawns, cemetaries (e.g., Voss 1985, Hickman 1993, FNA 2002, Weakley 2006).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Eastern Candada (Kartesz 1999, FNA 2002). The genus is expected introduced elsewhere (FNA 2002).

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16. REPRODUCTIVE CHARACTERISTICS

C - LOW SIGNIFICANCE

COMMENTS: "Weedy" in the sense that the large bubs produce numerous bulblets as offsets and these can persist and spread (Welsh et al. 2003). Otherwise, does not appear to be strongly agressive.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

C - LOW SIGNIFICANCE

COMMENTS: Few if any reports of attempts at eradication or serious management; in most situations this species' presence in disturbed and marginal landscapes has been tolerated.

18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS: Inferred.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Inferred.

20. ACCESSIBILITY OF INVADED AREAS

A - HIGH SIGNIFICANCE

COMMENTS: Widely planted on private lands for its early spring flowers.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Myriophyllum heterophyllum

ELEMENT NATIONAL ID: 245090
SCIENTIFIC NAME: *Myriophyllum heterophyllum*
COMMON NAME: Broad-leaf Watermilfoil
I-RANK REVIEW DATE: 2006-03-21
EVALUATOR: Cordeiro, J. and K. Gravuer

I-RANK: High/Medium

I-RANK REASONS SUMMARY:
An aquatic species almost certainly exotic in eastern New York and New England (excluding Vermont), although potentially native to much of the remaining U.S. Especially when crossed with the native *Myriophyllum pinnatum* as *Myriophyllum heterophyllum* x *pinnatum*, this species produces dense large mats of vegetation on the water surface, intercepting sunlight leading to exclusion of other submerged plants. As plants die and sink, sediment levels increase and euthrophication may follow as available oxygen is depleted. The dense mats may interfere with water movement, and eutrophication can lead to fish kills. It is able to thrive in a wide variety of environmental conditions and is found in diverse aquatic habitats, such as lakes, ponds, swamps, rivers and mudflats. It appears to still be spreading in New England. Management methods, including drawdowns, herbicides, and benthic barriers, often require long-term effort and frequently cause negative impacts on co-occurring native species.

SUBRANK I - ECOLOGICAL IMPACT:	High/Medium
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Medium

OTHER CONSIDERATIONS:
There has been some debate regarding the boundary between the native and exotic range of this species in the United States. Some sources (USDA, 1999; Maine Center for Invasive Aquatic Plants, 2006) consider it native to parts of Florida only, and exotic in most states of the eastern two-thirds of the United States ranging westward to North Dakota and south to New Mexico. However, Benson et al. (2004) list the species as native to the central and eastern United States (likely also to western New York and Pennsylvania), but introduced in the New York metro area and in New England in all states except Vermont. For the purposes of this assessment, the species' exotic range was considered to be that on which the sources agreed: eastern New York and New England (excluding Vermont). In addition, note that the impacts ranked here include those attributable to both this species and to the hybrid of this species and *Myriophyllum pinnatum* (*Myriophyllum heterophyllum* x *pinnatum*).

NATIVE AND NON-NATIVE IN NATION
NATIVE RANGE: Europe and, for the purpose of this assessment, the central and eastern United States (incl. western New York and Pennsylvania) (Benson et al. 2004).

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SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Non-native at least in eastern NY and in CT, RI, MA, NH, and ME.

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: This plant is found in a variety of different aquatic habitats, such as lakes, ponds, swamps, rivers and mudflats (Crow and Hellquist, 2000).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This species, especially when crossed with *Myriophyllum pinnatum* as *Myriophyllum heterophyllum* x *pinnatum*, produces dense large mats of vegetation on the water surface, thus intercepting sunlight leading to exclusion of other submerged plants. As plants die and sink, sediment levels increase and euthrophication may follow as available oxygen is depleted.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This species, especially when crossed with *Myriophyllum pinnatum* as *Myriophyllum heterophyllum* x *pinnatum*, can be an aggressive plant in some situations and may interfere with water movement (Crow and Hellquist, 1983). Eutrophication from decaying plants can lead to fish kills and harm other aquatic organisms. It generally produces long stems that rise to the surface, spread out, and produce mats of vegetation (Capers et al., 2005).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B - MODERATE SIGNIFICANCE

COMMENTS: Dense growth degrades the native habitat of fish and other wildlife and may also provide breeding areas for mosquitoes (Mehrhoff et al., 2003).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Once established, this species, especially when crossed with *Myriophyllum pinnatum* as *Myriophyllum heterophyllum* x *pinnatum*, can outcompete native vegetation and species dependent on that native vegetation to survive must relocate or decline. Also, *Myriophyllum pinnatum* is a native species, so the hybridization itself creates negative impacts on *M. pinnatum*.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B - MODERATE SIGNIFICANCE

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COMMENTS: This plant is able to thrive in a wide variety of environmental conditions, growing well in still and flowing waters, and even under ice (Maine Center for Invasive Aquatic Plants, 2004). This plant is found in a variety of different aquatic habitats, such as lakes, ponds, swamps, rivers and mudflats (Crow and Hellquist, 2000). *Myriophyllum heterophyllum* can be found in water up to 1.8 m (6 ft.) deep (Mehrhoff et al., 2004). In Connecticut, it largely prefers water with lower pH and alkalinity than *Myriophyllum spicatum* (Capers et al., 2005).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

C - LOW SIGNIFICANCE

COMMENTS: There has been some debate regarding the boundary between the native and exotic range of this species in the United States. Some sources (USDA, 2006; Maine Center for Invasive Aquatic Plants, 2006) consider it native to parts of Florida only, and exotic in most states of the eastern two-thirds of the United States ranging westward to North Dakota and south to New Mexico. However, Benson et al. (2004) list the species as native to the central and eastern United States (likely also to western New York and Pennsylvania), but introduced in the New York metro area and in New England in all states except Vermont. For the purposes of this assessment, the species' exotic range was considered to be that on which the sources agreed: eastern New York and New England (excluding Vermont).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B - MODERATE SIGNIFICANCE

COMMENTS: Largely, it is the hybrid *Myriophyllum heterophyllum* x *pinnatum*, that has the greatest negative impacts. *M. pinnatum* occurs in eastern New York and southern New England (CT, RI, MA) only; it does not occur in NH or ME.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

C - LOW SIGNIFICANCE

COMMENTS: TNC (2001)

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: This plant is able to thrive in a wide variety of environmental conditions, growing well in still and flowing waters, and even under ice (Maine Center for Invasive Aquatic Plants, 2004). This plant is found in a variety of different aquatic habitats, such as lakes, ponds, swamps, rivers and mudflats (Crow and Hellquist, 2000). *Myriophyllum heterophyllum* can be found in water up to 1.8 m (6 ft.) deep (Mehrhoff et al., 2004). In Connecticut, it largely prefers water with lower pH and alkalinity than *Myriophyllum spicatum* (Capers et al., 2005).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B - MODERATE SIGNIFICANCE

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COMMENTS: This species is widely spreading in New York metro area and New England in all states except Vermont since the early 1930s when first documented in Connecticut; Massachusetts in 1940, New York in 1953, Rhode Island, New Hampshire, and Maine in 1983, and New Jersey in 2003 (Benson et al., 2004).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Already occupies much area in New England, but could potentially spread to Vermont.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Main method of dispersal is by vegetative parts being moved around by people. Ditches along highway corridors have been shown to serve as migration corridors for invasive wetland plants (Wilcox, 1989).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B - MODERATE SIGNIFICANCE

COMMENTS: This species is widely spreading in New York metro area and New England in all states except Vermont since the early 1930s when first documented in Connecticut; Massachusetts in 1940, New York in 1953, Rhode Island, New Hampshire, and Maine in 1983, and New Jersey in 2003 (Benson et al., 2004).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Molecular analysis reveals the New England populations are comprised of two distinct introduced entities, *Myriophyllum heterophyllum* and a newly described hybrid *M. heterophyllum* X *M. pinnatrum* (Moody and Les, 2002). *Myriophyllum heterophyllum* rarely exhibits invasive characteristics, generally growing in scattered stands interspersed with native plants, but the hybrid forms large, aggressive, dominating populations of management concern (Benson et al., 2004).

15. SIMILAR HABITATS INVADED ELSEWHERE

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No evidence was found that this species has escaped into additional habitat types in other regions and, given the wide range of habitats that it invades in the U.S., this possibility seems unlikely.

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: This species reproduces uncommonly by seed with flowers from June to September; and most commonly by budding asexually. It can also propagate (regrowth) by rhizome division in the hydrosoil (USDA, 2006). Main method of dispersal is by vegetative parts being moved around by people.

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SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: In most cases these plants have survived attempts at control (Mehrhoff et al., 2003). Although harvesting can greatly reduce the plant biomass in a water body, harvesting also causes fragmentation, and fragments are capable of producing new plants or drift downstream creating new infestations. Drawdowns can be effective control measures if the drawdown is extensive enough to prevent re-growth from seeds. Several herbicides have been used for control. Benthic barriers may be used in small areas including swimming beaches, boating lanes, and around docks.

18. MINIMUM TIME COMMITMENT

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Harvesting must be repeated regularly. Herbicides must be re-applied. Benthic barriers must be properly anchored and maintained.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Drawdowns may impact fish, aquatic invertebrates, reptiles, amphibians, and downstream conditions. Benthic barriers restrict light and upward growth but can have a negative impact on benthic organisms.

20. ACCESSIBILITY OF INVADED AREAS

A - HIGH SIGNIFICANCE

COMMENTS: Harvesting can cause fragmentation, and fragments are capable of producing new plants or may drift downstream creating new infestations.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Myriophyllum spicatum

ELEMENT NATIONAL ID: 218413
SCIENTIFIC NAME: *Myriophyllum spicatum*
COMMON NAME:
I-RANK REVIEW DATE: 2006-03-23
EVALUATOR: Heffernan, K., rev. J. Cordiero and K. Gravuer

I-RANK: High

I-RANK REASONS SUMMARY:
Myriophyllum spicatum has invaded many natural lakes (Jacono and Richerson 2003), where it forms dense mats that alter dissolved oxygen levels (Jacono and Richerson 2003), reduces light penetration (Johnson and Blossey 2002), and negatively impacts macrophytes, macroinvertebrates, and fish abundance and diversity (Jacono and Richerson 2003). It has negative impacts on a native congener, *Myriophyllum sibiricum*, through both hybridization and competition. It is present in most of the continental US (Kartesz and Meacham 1999), and listed as noxious in 15 states (USDA-NRCS 2004). Recent reports indicate it is increasing within its range (Jacono and Richerson 2003). In addition to lake habitat, it infests ponds, and pools and stagnant to slowing moving fresh to slightly brackish water (Johnson and Blossey 2002). As only limited control is achieved through current management methods, biological control agents such as the milfoil beetle (*Euhrychiopsis lecontei*) are being explored (Johnson and Blossey 2002).

SUBRANK I - ECOLOGICAL IMPACT: High
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE: High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE: High
SUBRANK IV - MANAGEMENT DIFFICULTY: High

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Eurasia (Randall 2004)

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Considered a major nusiance species in the Northeast, northern Midwest, and Pacific Northwest; also established in California, the Southwest and Southeast (Johnson and Blossey 2002; Couch and Nelson 1991; Jacono and Richerson 2003).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Native aquatic communities such as rivers and streams, brackish tidal creeks and bays (Johnson and Blossey 2002; Couch and Nelson 1991; Jacono and Richerson 2003).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

A - HIGH SIGNIFICANCE

COMMENTS: High densities reduce dissolved oxygen levels; reduces open-water habitat; reduced light penetration due to canopy formation (Johnson and Blossey 2002; Jacono and Richerson 2003).

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

A - HIGH SIGNIFICANCE

COMMENTS: Forms dense canopy and reduces light penetration (Johnson and Blossy 2002; Jacono and Richerson 2003). *Myriophyllum sibiricum x spicatum* hybrids also form dense, monospecific stands (Moody and Les, 2002).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A - HIGH SIGNIFICANCE

COMMENTS: Reduces macrophytes, macroinvertebrates, and fish abundance and diversity (Johnson and Blossy 2002; Jacono and Richerson 2003).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Competes with and hybridizes with the native *Myriophyllum sibiricum* (listed endangered in Pennsylvania). Hybrids with *M. sibiricum* occur in only a few localities in Wisconsin and Minnesota (Moody and Les, 2002; Roley and Newman, 2006) and possibly scattered in a few more in New England. Total proportion of *M sibiricum* threatened by *M. spicatum* unknown (Jacono and Richerson 2003).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

A - HIGH SIGNIFICANCE

COMMENTS: Has invaded many natural lakes: 53 in Vermont, 160 in Indiana (Jacono and Richerson 2003).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Present in all but ten continental states (Kartesz and Meacham 1999). Hybrids with *M. sibiricum* occur in only a few localities in Wisconsin and Minnesota (Moody and Les, 2002; Roley and Newman, 2006) and possibly scattered in a few more in New England.

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A - HIGH SIGNIFICANCE

COMMENTS: Classified as a noxious weed in 15 states (USDA-NRCS 2004).

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8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: Over 30 TNC ecoregions invaded (USDA-NRCS 2004; Slaats 1999).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Deep to very shallow lakes, ponds, and pools; stagnant to slowing moving fresh to slightly brackish water (Johnson and Blossey 2002).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Reported as recently expanding into many states (Jacono and Richerson 2003, Jordan 2005). In addition, it is surmised that the invasive hybridized *Myriophyllum sibiricum* x *spicatum* will likely continue to expand as *Myriophyllum spicatum* expands and parent plants cross with native *Myriophyllum sibiricum*.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Already widespread (Jacono and Richerson 2003).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Still commerically available (Johnson and Blossey 2002; Jacono and Richerson 2003). Also, ditches along highway corridors have been shown to serve as migration corridors for invasive wetland plants (Wilcox, 1989).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A - HIGH SIGNIFICANCE

COMMENTS: Abundance on the increase at many sites (Jacono and Richerson 2003). Recently reported spreading to new counties in New York and New England (Jordan 2005). In addition, it is surmised that the invasive hybridized *Myriophyllum sibiricum* x *spicatum* will likely continue to expand as *Myriophyllum spicatum* expands and parent plants cross with native *Myriophyllum sibiricum*.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

A - HIGH SIGNIFICANCE

COMMENTS: Glacial lakes in Indiana, for example (Jacono and Richerson 2003). Invades new habitat (Couch and Nelson 1991)

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15. SIMILAR HABITATS INVADED ELSEWHERE

U - UNKNOWN

COMMENTS: No data found.

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: Primarily by fragmentation; seed germination also reported (Johnson and Richerson 2002).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A - HIGH SIGNIFICANCE

COMMENTS: Expensive mechanical and chemical methods (2,4 D) provide only limited control for as long as treatment continues. Biocontol agents are under development. (White et al. 1993; Johnson and Blossey 2002). One promising agent is the milfoil beetle, *Euhrychiopsis lecontei*, an aquatic herbivorous weevil whose native host is *Myriophyllum sibiricum*, but has developed a preference for *Myriophyllum spicatum* since its introduction into the U.S. It has been used as a successful management tool for *M. spicatum*, and similar declines in *M. sibiricum* have not been observed except when it occurs in areas without *M. spicatum (*Tamayo and Grue, 2004; Roley and Newman, 2006). The milfoil beetle has also been found to be a successful management tool for controlling hybrid *Myriophyllum sibiricum* x *spicatum*. Resistance to weevil herbivory was found to be greatest for *Myriophyllum sibiricum*, intermediate for *Myriophyllum sibiricum* x *spicatum* and least for *Myriophyllum spicatum* (Roley and Newman, 2006).

18. MINIMUM TIME COMMITMENT

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Herbicide control requires continued treatement (White et al. 1993; Johnson and Blossey 2002).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A - HIGH SIGNIFICANCE

COMMENTS: May result in fish kills and increased algal growth (White et al. 1993; Johnson and Blossey 2002).

20. ACCESSIBILITY OF INVADED AREAS

D - INSIGNIFICANT

COMMENTS: Not mentioned as a concern in referenced literature (Johnson and Blossey 2002).

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Invasive Species Assessment Protocol:
U.S. National Assessments

Ornithogalum nutans

ELEMENT NATIONAL ID: 223924
SCIENTIFIC NAME: *Ornithogalum nutans*
COMMON NAME: Drooping Star-of-Bethlehem
I-RANK REVIEW DATE: 2006-06-27
EVALUATOR: J. Cordeiro, rev. K. Gravuer

I-RANK: Insignificant

I-RANK REASONS SUMMARY:
A widely cultivated horticultural plant with scattered establishment in the area including Mississippi and Missouri east through the Great Lakes states to the east coast from New York and Connecticut south to North Carolina as well as Washington and Oregon. Appears to establish primarily in disturbed habitats, including fields, waste places, abandoned gardens, roadsides, and edges. Very little information could be located to substantiate impacts on native biodiversity, and it was assumed for the time being that such impacts, if present, are relatively insignificant. However, the related *Ornithogallum umbellatum* is known to be somewhat invasive in woodland areas and along the edges of rivers and streams.

SUBRANK I - ECOLOGICAL IMPACT:	Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: This species is native to eastern Europe and western Asia (Turkey) (USDA, no date).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: The species has been naturalized and cultivated in temperate areas throughout the world including the U.S. (USDA, no date).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: This species has reported in native species habitat in the U.S. but escapes only rarely.

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

D - INSIGNIFICANT

COMMENTS: No reports of impacts on ecosystem processes or system-wide parameters were found. Therefore, assume impacts insignificant.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

COMMENTS: Effect on community structure has not been studied. Anecdotally, the related *Ornithogalum umbellatum* has the ability to form locally dense stands along the edges of the rivers and streams, allowing it to crowd out native riparian plants (Rhoades and Block, 2000). DeMars (1994) found *O. umbellatum* to be an actively invading species in older growth woodland stands near Wright State University in Ohio, but is lowered as forest succession occurs. Similar impacts for *Ornithogalum nutans*, however, have not been reported.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C - LOW SIGNIFICANCE

COMMENTS: Not much is known about the impacts of this species on community structure, composition, or native species in the U.S.. The related *Ornithogalum umbellatum* has the ability to form locally dense stands along the edges of the rivers and streams, allowing it to crowd out native riparian plants (Rhoades and Block, 2000). DeMars (1994) found *O. umbellatum* to be an actively invading species in older growth woodland stands near Wright State University in Ohio, but is lowered as forest succession occurs. Similar impacts for *Ornithogalum nutans*, however, have not been reported.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not significant.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C - LOW SIGNIFICANCE

COMMENTS: Invades fields, waste places, abandoned gardens, roadsides, and edges (Rhoads and Block 2000, Flora of North America Editorial Committee 2002), and no reports of impacts on at-risk species were found.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

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COMMENTS: USDA (2006) cites the distribution of this species in the U.S. as Mississippi and Missouri east through the Great Lakes states to the east coast from New York and Connecticut south to North Carolina; as well as Washington and Oregon. In all cases, USDA (2006) distribution maps show only 1 or 2 county spotty site records (with the exception of New York with 5 counties, Pennsylvania with 9, and Virginia with 7) for invasion of this species in each state where it occurs rather than widespread points of introduction.

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C - LOW SIGNIFICANCE

COMMENTS: Although this species is often grown as an ornamental plant, it has not become invasive in open niche situations, such as dormant turfgrass areas, like the related *Ornithogalum umbellatum* (Uva et al., 1997; Main et al., 2004). *O. umbellatum* is an emerging weed problem that will likely continue to spread into agricultural sites and turfgrass areas where spring control prior to bulb formation is not practiced, but even with this more invasive relativfe, introductions into natural areas has not been demonstrated to be a serious problem yet (Southern Illinois University Weed Research, 2005). Evidence of serious portions of the U.S. population of *Ornithogalum nutans* having negative impacts is currently absent.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: It is conservatively estimated that fewer than 20 of the 81 ecoregions have been invaded by *Ornithogalum nutans* (Cordeiro, pers. obs. June 2006 based on TNC, 2001), although many states have only single site occurrences (USDA, 2006).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Fields, waste places, abandoned gardens, roadsides, and edges (Rhoads and Block 2000, Flora of North America Editorial Committee 2002).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Although this species is often grown as an ornamental plant, it has not become invasive in open niche situations, such as dormant turfgrass areas, like the related *Ornithogalum umbellatum* (Uva et al., 1997; Main et al., 2004). *O. umbellatum* is an emerging weed problem that will likely continue to spread into agricultural sites and turfgrass areas where spring control prior to bulb formation is not practiced, but even with this more invasive relativfe, introductions into natural areas has not been demonstrated to be a serious problem yet (Southern Illinois University Weed Research, 2005). Ornithogalum nutans is primarily limited to single site occurrences except in New York with (5 counties), Pennsylvania (9 counties), and Virginia (7 counties) (USDA, 2006). Recent introductions have turned up far from the northeastern and eastern occurrences in Oregon and Washington (USDA, 2006).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

B - MODERATE SIGNIFICANCE

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COMMENTS: Because USDA (2006) cites the U.S. distribution as occurring in several eastern and northeastern states as well as Oregon and Washington, but not nearly as many as for *Ornithogalum umbellatum*, potential total range is at about half the available states at the state level but at the population level, there is certainly a great deal of room within states for expansion as almost all states of occurrence only have single (or very few) site introductions.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Information about long-distance dispersal is entirely derived from the related *Ornithogalum umbellatum*:
It can be dispersed via additional plantings as well as the bulbs being washed downstream (Rhoades and Block, 2000). Beam et al. (2004) found *O. umbellatum* strongly resists mowing as cultivation breaks up the bulblets and further spreads the plant. *O. umbellatum* disperses itself by means of its bulbs, which can be dispersed by water. It is likely also dispersed via additional plantings, as this plant continues to be used regularly as a spring flowering ornamental (Uva et al., 1997).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: This species, although commonly cultivated, rarely escapes and is not nearly as common as the related *Ornithogalum umbellatum*. A recent planting at a cemetery in Cape Girardeau Co., Missouri, in 2000 is spreading and the plants are locally abundant (Basinger, 2002). In all cases, USDA (2006) distribution maps show only 1 or 2 county spotty site records (with the exception of New York with 5 counties, Pennsylvania with 9, and Virginia with 7) for invasion of this species in each state where it occurs rather than widespread points of introduction.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: The related Star-of-Bethlehem (*Ornithogalum umbellatum*) has escaped cultivation and is a weed of turfgrass and landscapes, often found in and around flower gardens; less common in meadows, along roads, and in waste areas (Uva et al., 1997). Although invasions usually follow paths of disturbance, DeMars (1994) found *O. umbellatum* to be an actively invading species in older growth woodland stands near Wright State University in Ohio, but is lowered as forest succession occurs. Spread of *Ornithogalum nutans* has been much less successful. This can be interpreted as a lower inherent ability to invade than its relative, but other information is lacking.

15. SIMILAR HABITATS INVADED ELSEWHERE

B - MODERATE SIGNIFICANCE

COMMENTS: Also established in Canada, where it invades low wet woods, a habitat it does not yet appear to have invaded in the US (Scoggan 1978).

16. REPRODUCTIVE CHARACTERISTICS

A/B - HIGH/MODERATE SIGNIFICANCE

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COMMENTS: Information about reproductive characteristics is largely derived from the related *Ornithogalum umbellatum*:
This perennial plant has early season maturation, flowering from April to May and seeds rip from June to July (Southern Illinois University Fact Sheet, 2005). Flowering seedlings rarely occur as most plants develop from bulbs (DeMars, 1994; Uva et al., 1997). Flowers are hermaphroditic (and self-fertile) and are pollinated by insects (Huxley et al., 1999). *Ornithogalum umbellatum* disperses itself by means of its bulbs, which can be dispersed by water. The extent to which it is able to reproduce by seed in the New England region is unclear (Rhoades and Block, 2000). In Ohio, this species initiates growth in late February to early March with bulbs produced during the previous year sprouting roots, which grow quickly pushing the bulb upward and outward through the soil surface (DeMars, 1994). Beam et al. (2004) found this species strongly resists mowing as cultivation breaks up the bulblets and further spreads the plant.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Little information exists on management of this species. The following information pertains to the related *Ornithogalum umbellatum*:
Research on ornamental plantings for preemergence weed control found commonly used herbicides did not adversely affect flowering date, weight, and number of bulbs produced (Skroch et al., 1994) as this species is fairly non-responsive to several herbicides (USDA, 2006; USDA, no date). Post-emergence herbicides faired better (particularly bromoxynil, less so for halosulfuron, imazaquin, and metsulfuron especially when in combination with bromoxynil) (Main et al., 2004). Beam et al. (2004) found this species strongly resists mowing as cultivation breaks up the bulblets and further spreads the plant; but found paraquat controlled star-of-Bethlehem greater than 95% two years after initial treatment. Dicamba at 2.2 and 4.4 kg ai/ha controlled star-of-Bethlehem between 80 and 90% two years after initial treatment (but was expensive- $250/ha). Investigation of herbicides by Southern Illinois University (2005) showed control was less than 25% after one year for all herbicides except Gramoxone Max, which was 90-95%.

18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS: Little information exists on management of this species. Successful application of bromoxynil only required two applications each 1 year apart to control the related *Ornithogalum umbellatum* (Main et al., 2004).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Little information exists on management of this species. Successful application of the herbicide bromoxynil has little effect on other turfgrass, does not persist in soil, or volatilize and harm nontarget species (Main et al., 2004).

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: It appears most to all areas are easily accessible. Access to private lands may be an issue where this species is deliberately planted.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Ornithogalum umbellatum

ELEMENT NATIONAL ID: 197188
SCIENTIFIC NAME: *Ornithogalum umbellatum*
COMMON NAME: Common Star-of-Bethlehem
I-RANK REVIEW DATE: 2006-06-27
EVALUATOR: J. Cordeiro, rev. K. Gravuer

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:
The species is widely distributed in the United States except in the Rocky Mountain region and has become invasive in open meadow and grassland areas with a few occurrences in older growth woodland stands but decreasing with forest succession. The plant disperses easily and reproduces readily but control is not very difficult or impactfull. More research is needed on impacts at the ecosystem level and on native species/communities of concern.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Ornithogalum umbellatum is native to North Africa as well as Europe. In Europe, it is found from Portugal and Spain in the west, south to Italy, north to parts of France and east to Turkey (Rhoades and Block, 2000).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species has been planted as an ornamental in North America, Europe, and Australia, where it has become naturalized and invasive (DeMars, 1994).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Throughout the United States, it has escaped from gardens and become established in a variety of habitats including reoadsides, fields, and woodlands with naturalized populations in most states (DeMars, 1994).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No reports of impacts on ecosystem processes or system-wide parameters were found. Therefore, assume impacts are relatively insignificant.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Effect on community structure has not been studied. Anecdotally, it has the ability to form locally dense stands along the edges of the rivers and streams, allowing it to crowd out native riparian plants (Rhoades and Block, 2000). DeMars (1994) found this species to be an actively invading species in older growth woodland stands near Wright State University in Ohio, but is lowered as forest succession occurs.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: It has the ability to form locally dense stands along the edges of the rivers and streams, allowing it to crowd out native riparian plants (Rhoades and Block, 2000). DeMars (1994) found this species to be an actively invading species in older growth woodland stands near Wright State University in Ohio, but is lowered as forest succession occurs.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature. However, it has the ability to form locally dense stands along the edges of the rivers and streams, allowing it to crowd out native riparian plants (Rhoades and Block, 2000). Deam (1940, in DeMars, 1994) reported patches of an acre or more in Indiana forests and noted a tendency for the plant to grow in high densities and displace native plant species. DeMars (1994) found this species to be an actively invading species in older growth woodland stands near Wright State University in Ohio, but is lowered as forest succession occurs.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Invades along the banks of rivers and streams and into wetland habitats including floodplain forests and wet meadows (USDA, 1999).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: USDA (2006) cites the U.S. distribution as occurring in all the continental United States except the eastern Rocky Mountain states, Nevada, and Arizona (see also Main et al., 2004).

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7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C - LOW SIGNIFICANCE

COMMENTS: This species is often grown as an ornamental plant but can become invasive in open niche situations, such as dormant turfgrass areas (Uva et al., 1997; Main et al., 2004). Although it is not very prevalent, it is a significant management problem in fields, turfgrass, landscapes, and roadsides that are infested. It seems in the United States, Star-of-Bethlehem is an emerging weed problem that will likely continue to spread into agricultural sites and turfgrass areas where spring control prior to bulb formation is not practiced, but introductions into natural areas has not been demonstrated to be a serious problem yet (Southern Illinois University Weed Research, 2005).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: It is conservatively estimated that well over half of the 81 ecoregions have been invaded by *Ornithogalum umbellatum* as it occurs in nearly every state (Cordeiro, pers. obs. March 2006 based on TNC, 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: This plant prefers moist to wet habitats and can be found along the banks of rivers and streams, in disturbed situations, in early succession forest, forest edge, floodplain forest, wet meadows, yards and gardens (USDA, 1999). It can grow in light, medium, and heavy soils both acid and basic but requires moist soil.

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: It seems in the United States, Star-of-Bethlehem is an emerging weed problem that will likely continue to spread into agricultural sites and turfgrass areas where spring control prior to bulb formation is not practiced, but introductions into natural areas has not been demonstrated to be a serious problem yet (Southern Illinois University Weed Research, 2005).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Because USDA (2006) cites the U.S. distribution as occurring in all the continental United States except the eastern Rocky Mountain states, Nevada, and Arizona (see also Main et al., 2004), potential total range is nearly full at the state level but at the population level, there is certainly a great deal of room within states for expansion.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

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COMMENTS: It can be dispersed via additional plantings as well as the bulbs being washed downstream (Rhoades and Block, 2000). Beam et al. (2004) found this species strongly resists mowing as cultivation breaks up the bulblets and further spreads the plant. *Ornithogalum umbellatum* disperses itself by means of its bulbs, which can be dispersed by water. It is likely also dispersed via additional plantings, as this plant continues to be used regularly as a spring flowering ornamental (Uva et al., 1997).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This plant is used quite widely as an ornamental, despite it being poisonous if swallowed, thus recent expansion rate has been high. DeMars (1994) found this species to be an actively invading species in older growth woodland stands near Wright State University in Ohio, but is lowered as forest succession occurs. Beam et al. (2004) found this species strongly resists mowing as cultivation breaks up the bulblets and further spreads the plant.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: Star-of-Bethlehem has escaped cultivation and is a weed of turfgrass and landscapes, often found in and around flower gardens; less common in meadows, along roads, and in waste areas (Uva et al., 1997). Although invasions usually follow paths of disturbance, DeMars (1994) found this species to be an actively invading species in older growth woodland stands near Wright State University in Ohio, but is lowered as forest succession occurs.

15. SIMILAR HABITATS INVADED ELSEWHERE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Wallwork and others (in Beam et al., 2004) reported star-of-Bethlehem was proving difficult to control in South Australia and that it was responsible for outbreaks of barley leaf rust in the region, since star-of-Bethlehem looked to be an alternate host of this disease.

16. REPRODUCTIVE CHARACTERISTICS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This perennial plant has early season maturation, flowering from April to May and seeds rip from June to July (Southern Illinois University Fact Sheet, 2005). Flowering seedlings rarely occur as most plants develop from bulbs (DeMars, 1994; Uva et al., 1997). Flowers are hermaphroditic (and self-fertile) and are pollinated by insects (Huxley et al., 1999). *Ornithogalum umbellatum* disperses itself by means of its bulbs, which can be dispersed by water. The extent to which it is able to reproduce by seed in the New England region is unclear (Rhoades and Block, 2000). In Ohio, this species initiates growth in late February to early March with bulbs produced during the previous year sprouting roots, which grow quickly pushing the bulb upward and outward through the soil surface (DeMars, 1994). Beam et al. (2004) found this species strongly resists mowing as cultivation breaks up the bulblets and further spreads the plant.

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SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Little information exists on management of this species. Research on ornamental plantings for preemergence weed control found commonly used herbicides did not adversely affect flowering date, weight, and number of bulbs produced (Skroch et al., 1994) as this species is fairly non-responsive to several herbicides (USDA, 1999). Post-emergence herbicides faired better (particularly bromoxynil, less so for halosulfuron, imazaquin, and metsulfuron especially when in combination with bromoxynil) (Main et al., 2004). Beam et al. (2004) found this species strongly resists mowing as cultivation breaks up the bulblets and further spreads the plant; but found paraquat controlled star-of-Bethlehem greater than 95% two years after initial treatment. Dicamba at 2.2 and 4.4 kg ai/ha controlled star-of-Bethlehem between 80 and 90% two years after initial treatment (but was expensive- $250/ha). Investigation of herbicides by Southern Illinois University (2005) showed control was less than 25% after one year for all herbicides except Gramoxone Max, which was 90-95%.

18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS: Successful application of bromoxynil only required two applications each 1 year apart (Main et al., 2004).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Successful application of the herbicide bromoxynil has little effect on other turfgrass, does not persist in soil, or volatilize and harm nontarget species (Main et al., 2004).

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: It appears most to all areas are easily accessible. Access to private lands may be an issue where this species is deliberately planted.

REFERENCES:

Beam, J.B., W.L. Barker, S.D. Askew, and K.W. Bradley. 2004. Controlling star-of-bethlehem. Abstract of the Northeast Weed Science Society Conference, Cambridge, Massachusetts, January 7, 2004.

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Main, C.L., D.K. Robinson, T.C. Teuton, and T.C. Mueller. 2004. Star-of-Bethlehem (Ornithogalum umbellatum) control with post-emergence herbicides in dormant bermudagrass (Cynodon dactylon) turf. Weed Technology, 18: 1117-1119.

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Rhoads, A.F. and T.A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press: Philadelphia, Pennsylvania. 1061 pp.

Skroch, W.A., C.J. Catanzaro, A.A. DeHertogh, and L.B. Gallitano. 1994. Preemergence herbicide evaluations on selected spring and summer flowering bulbs and perennials. Journal of Environmental Horticulture, 12: 80-82.

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Uva, R.H., J.C. Neal, and J.M. DiTomaso. 1997. Weeds of the Northeast. Cornell University Press: Ithaca, New York. 397 pp.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Orobanche minor

ELEMENT NATIONAL ID: 237287
SCIENTIFIC NAME: *Orobanche minor*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-19
EVALUATOR: Oliver, L.

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:

Orobanche minor, small broomrape, is a parasitic plant that is mainly an agricultural weed, however, it does occur along roadsides in the southeastern United States. It does not appear to have infiltrated rare species habitat, however, it does have the ability to spread long distances given its tiny, wind-dispersed seeds. In addition to occurring the the southeast United States, it is also known north to New York and it also occurs in the Pacific Northwest in Washington and Oregon. In these western states, this non-native has infested red clover fields. While this species does represent a threat to agricultural crops, it isn't clear if it threatens native species.

SUBRANK I - ECOLOGICAL IMPACT:	Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Unknown

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Orobanche minor is native to Africa, Asia, and Europe (GRIN).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Small broomrape is scattered from New York south to Florida. It also known in Oregon and Washington (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: This species is known mostly as an agricultural weed, however, it does occur along roadsides in Georgia (Miller et al.).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: It is assumed that this species has little or no impact on the abiotic ecosystem processes given that it usually occurs along roadsides.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

COMMENTS: Given that this species is a parasitic herb (Mitich) it affects at least the herbaceous layer.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No documentation was found that explicitly states that this species is impacting the community composition of native species, however, given that it is parasitic and has the ability to spread via it's tiny seeds, it probably does affect the vegetation composition, at least minimally, where it occurs.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No information was found suggesting that this non-native species disproportionately affects any one particular native species.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

D - INSIGNIFICANT

COMMENTS: Small broomrape is known to occur mainly along highway rights-of-ways in Georgia and other southeastern states (Miller et al.). In the Pacific Northwest, Oregon and Washington, small broomrape is known to infest red clover fields (Ross et al. 2004). No mention of this species occurring in rare species habitat or high-quality ecological communities was found. It appears to be limited to human-disturbed habitats.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Hellroot is known from New York south to Florida, however, throughout this range it is spotty throughout. It is also in a few locations in Oregon and Washington (PLANTS).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

D - INSIGNIFICANT

COMMENTS: It isn't clear that this species is impacting biodiversity, since it occurs in human-disturbed habitats.

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8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Small broomrape is distributed in one to a few counties between New York and Florida, as well as Washington and Oregon, and is present in a few biogeographic regions (TNC 1999).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

D - INSIGNIFICANT

COMMENTS: This species is only reported from highway rights-of-ways, roadsides, or crop fields (Miller et al., Evans et al. 2005).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: It isn't clear if the generalized range of this species is widening. It may be and isn't detected yet. This species produces tiny seeds which can contaminate seed used for agriculture, and has been known to persist in soil for 13 years until germination (Mitich). The point being that it may be spreading, given its seeds are tiny and wind dispersed and that it can remain viable in the seed bank for many years.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

A - HIGH SIGNIFICANCE

COMMENTS: Given the very broad range this species already occurs across (Kartesz 1999), but the spottiness of its area of occupancy (PLANTS), the porportion of its potential range it currently occupies is low.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Long distance dispersal can occur given that the seeds of this species are tiny (0.2-0.3 mm) and are dispersed by wind, contaminated seed, soil, equipment, shoes, water, animals and clothing (Evans et al. 2005, Lins et al. 2005).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: 'Heavy infestations' was only found to refer to legume and leafy green vegetable crops (Evans et al. 2005, Lins et al. 2005) and not in natural areas or roadsides. This species is spreading rapidly in clover fields in Oregon (Lins et al. 2005). This species is probably spreading locally in other areas, but the lack of reports in areas outside of Oregon suggests that local spread might be a) unrealized yet or b) slow-moderate.

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14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: Reports only mention that this species has parasitized roadside weeds or crop plants, such as clover (Miller et al.), and not rare native species.

15. SIMILAR HABITATS INVADED ELSEWHERE

NR - NOT RANKED

COMMENTS:

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: The small broomrape produces tiny seeds (0.2-0.3mm) in prolific quantities (Mitich, Miller et al.). As mentioned before, this species is a parasite, meaning as a seedling it invades a host plant by producing a root that penetrates a root of a host plant. Further, it doesn't produce chlorophyll and relies on the host plant for nutrients and water (Mitich).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Studies on how to best manage this species have been conducted and one study determined that using preemergent herbicides along with other treatments will reduce, but not eliminate the species (Lins et al. 2005).

18. MINIMUM TIME COMMITMENT

NR - NOT RANKED

COMMENTS:

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

NR - NOT RANKED

COMMENTS:

20. ACCESSIBILITY OF INVADED AREAS

NR - NOT RANKED

COMMENTS:

REFERENCES:

Evans, C. W., C. T. Bargeron, D. J. Moorhead & G. K. Douce. 2005. Invasive Weeds in Georgia. The Bugwood Network, The University of Georgia. Accessed online on April 14, 2006 at: http://www.georgiainvasives.org/weeds.broomrape.html.

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Mitich, L. W. Orobanche - The Broomrapes. Accessed online on April 14, 2006 at: http://www-aes.tamu.edu/mary/brmrape/Br-iwwb.htm

USDA, NRCS. 2006. The PLANTS Database. Data compiled from various sources by Mark W. Skinner. National Plant Data Center (http://npdc.usda.gov), Baton Rouge, LA. Online. Available: http://plants.usda.gov (Accessed 2006).

Ross, K. C., J. B. Colquhoun, and C. A. Mallory-Smith. 2005. Small broomrape (Orobanche minor) germination and early development in response to plant species. Weed Science 52: 260-266.

The Nature Conservancy. 1999. Map: TNC Ecoregions of the United States. Modification of Bailey Ecoregions, January 1999.

USDA, ARS, National Genetic Resources Program. 2005. December 9 last update. Germplasm Resources Information Network (GRIN) Online Database. National Germplasm Resources Laboratory, Beltsville, Maryland. Available: http://www.ars-grin.gov2/cgi-bin/npgs/html/index.pl (Accessed 2006).

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Invasive Species Assessment Protocol:
U.S. National Assessments

Orobanche ramosa

ELEMENT NATIONAL ID: 206562
SCIENTIFIC NAME: *Orobanche ramosa*
COMMON NAME:
I-RANK REVIEW DATE: 2006-06-01
EVALUATOR: G. Davis

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:
Orobanche ramosa is reported in only a few places in the U.S., however, these reports are widely dispersed and occur in a wide range of climates. It has not yet been reported in intact natural areas, however it does invade crop and farmland and produces large numbers of small seeds which are easily transported by wind, equipment, or animals. While it hasn't yet shown itself to be an aggressive invader, it is listed as noxious in several states as well as federally and could be difficult to remove if it is able to invade natural communities, hence, it is a species to look out for.

SUBRANK I - ECOLOGICAL IMPACT:	Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Low/Insignificant
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Unknown

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Northern Africa, Europe, and western Asia (USDA, ARS 2006).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Orobanche ramosa is rarely introduced in the U.S. (Gleason and Cronquist 1991, Mohlenbrock 1986).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Unknown

COMMENTS: Orobanche ramosa is a plant parasite which has been largely collected parasitising crop plants (e.g., all specimens recorded in the University of California and Jepson Herbaria SMASCH database were collected growing on tomato plants (University and Jepson Herbaria 2006)), but according to the USDA (APHIS 2006) it is known to grow on the roots of a broad range of wild broadleaf plants including Engelmann daisy, burr clover, blue bonnet and wild geranium. It is not clear whether this species has escaped to intact natural areas, but it seems likely given the plant's biology.

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

D - INSIGNIFICANT

COMMENTS: The biology of Orobanche ramosa (as a parasite on roots of other plants) does not lend itself to alteration of abiotic ecosystem or system-wide parameters.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

COMMENTS: This species could affect the herbaceous layer by killing its host plants.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C - LOW SIGNIFICANCE

COMMENTS: There is no specific evidence showing that Orobanche ramosa affects species composition of communities, however, since it is a parasite with a preference for certain broadleaf species, it is likely that it would reduce the abundance of some species over others where it infests.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: There are no reports of this species directly impacting a particular native species, but it does appear to have some preference of host plant so it is possible that it could have a heavier impact on some species than others.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

D - INSIGNIFICANT

COMMENTS: Orobanche ramosa is a significant agricultural pest which can cause complete crop failure (USDA, APHIS), however, no evidence of Orobanche ramosa infesting high-quality or rare natural communities was found.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Orobanche ramosa has been reported in a few counties of California, Illinois, Kentucky, North Carolina, New Jersey, and Texas (Kartesz 1999, PLANTS 2006) so it has a very wide, but also extremely spotty range.

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

D - INSIGNIFICANT

COMMENTS: This species has not been reported as having a significant impact outside of agricultural crops.

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8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Orobanche ramosa has been collected in widely disparate states covering a number of ecoregions, however, it is not likely to be present in all of them.

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: So far, Orabanche ramosa has been reported only as a crop-pest (USDA, APHIS).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: There is no obvious indication that this species is expanding its generalized range, however, given the spottiness of it's distribution and the potential for the seeds to be distributed widely by wind, it is possible that its range is slowly expanding.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

A - HIGH SIGNIFICANCE

COMMENTS: Given the spottiness of reports of this species and the fact that these reports are from distinctly different climates, the species has a high probability for occupying a greater percentage of its range.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Orobanche ramosa has tiny seeds which are easily carried by farm and construction equipment, water, wind, or animal droppings (USDA, APHIS 2006).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

C - LOW SIGNIFICANCE

COMMENTS: There are no reports to suggest that the species is spreading rapidly to natural areas. It is listed as noxious in several states with rapid action taken to eradicate it when it is found in crops (USDA, APHIS 2006), reducing the likelihood of it colonizing natural areas from cropland.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: There are no reports of Orobanche ramosa establishing in intact natural areas, however, given its biology (colonizing existing vegetation as a parasite at ground level), there is no reason to believe it could not invade intact communities.

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15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: In other countries where Orobanche ramosa has invaded, it tends to act similar to how it does in the U.S. - being a crop pest. In Australia, the effect on native vegetation is unknown, but it is thought to affect only a small number of native species (Department of Environment and Heritage Environment Reporting 2004).

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: Orobanche ramosa matures to flowering in three days, has seed pods that mature in fourteen days, produces 50,000 or more seeds, and has seeds that can survive in the soil for more than ten years (USDA, APHIS 2006).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B - MODERATE SIGNIFICANCE

COMMENTS: Current control methods for crop infestations are a combination of mechanical removal, treating the area with low rates glyphosate, and planting false host crops (USDA, APHIS 2006). Australia has a program to eradicate Orobanche ramosa from the country through isolation and fumigation of known infested areas over a 70 km x 70 km area which is projected to cost $7.6 million over four years (Australian Senate 2004). There is little information available on how to remove the species from natural areas.

18. MINIMUM TIME COMMITMENT

U - UNKNOWN

COMMENTS:

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

U - UNKNOWN

COMMENTS:

20. ACCESSIBILITY OF INVADED AREAS

U - UNKNOWN

COMMENTS:

REFERENCES:

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Invasive Species Assessment Protocol:
U.S. National Assessments

Paspalum scrobiculatum

ELEMENT NATIONAL ID: 208986
SCIENTIFIC NAME: *Paspalum scrobiculatum*
COMMON NAME:
I-RANK REVIEW DATE: 2006-06-26
EVALUATOR:

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:
Paspalum scrobiculatum occurs in widely scattered locations in the southeastern United States (collections exist for single counties in Texas, Alabama, Georgia, Maryland, and New Jersey), and while it may occur in more locations than there are collections, it appears to have an extremely small distribution. In none of these locations has it been identified as a problem exotic in natural communities, although it is on the Federal Noxious Weed List and several state weed lists. This is likely because it is a problem weed for agricultural crops. The species does occur in Hawaii and it is uncertain whether it is indigenous there or it is an early aboriginal introduction. If it is exotic there, it is thought to be harmless and not increasing in abundance or range. There is little information available about how to control Paspalum scrobiculatum (other than chemically, in lawns), possibly because it has not been identified as a problem exotic.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Insignificant
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Unknown

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Paspalum scrobiculatum is native to Asia, Africa, and Australia (USDA, GRIN 2006). There is question of whether the species is native to parts of the Pacific or if it was an early aboriginal introduction there (PIER 2005). According to Wagner et al. (1990), it is "presumably indigenous or an early introduction" to Hawaii.

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Introduced sporatically in the U.S., including New Jersey, Maryland, Georgia, Alabama, Texas, and possibly Hawaii (USDA, NRCS 2006).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Occurs in widely scattered disturbed areas in the southeastern U.S. (Utah State University 2006, Flora North America 2003).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C - LOW SIGNIFICANCE

COMMENTS: This may be an important weed to agricultural crops - it is on the Federal Noxious Weed list and several state weed lists (USDA, PLANTS 2006), but there is no evidence that is seriously harms native plant ecosystem processes.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

COMMENTS: Paspalum scrobiculatum is a tuft or mat forming species (Clayton, et al. 2006) so it may affect the structure of the herbaceous layer where it colonizes, but there is no evidence that it has done so in intact, native plant habitat within the U.S.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C - LOW SIGNIFICANCE

COMMENTS: There is no evidence that Paspalum scrobiculatum replaces other species in intact, native plant communities in the U.S.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: There was no evidence found that Paspalum scrobiculatum invades a particular species' habitat.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: There was no evidence that Paspalum scrobiculatum invades a specific native, intact community.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

D - INSIGNIFICANT

COMMENTS: Paspalum scrobiculatum has been found growing in widely scattered disturbed areas of the southeastern U.S. (shown as collected from single counties in Texas, Georgia, Alabama, Maryland, and New Jersey), possibly as an escape from cultivation (Utah State University 2006, Flora North America 2003). Also occurs in Hawaii where it is thought to be indigenous but it could be an early introduction (Wagner et al. 1990).

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7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: There was no evidence that this species is impacting biodiversity where it occurs. In Hawaii, where it is thought to be indigenous but could be an early introduction, it is not very invasive (Joel Lau, personal communication 2006).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

C - LOW SIGNIFICANCE

COMMENTS: Paspalum scrobiculatum occurs as a non-native in five TNC ecoregions.

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Paspalum scrobiculatum occurs in poor, thin soil, swampy ground; wet, open cultivated places, pastures, and wasteland (Scher 2004).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: In Hawaii, if it is alien, it is not very invasive; it is not uncommon, but it is not increasing in abundance or range (Joel Lau, personal communication). There is no evidence that it is increasing significantly in range elsewhere in the U.S.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Since Paspalum scrobiculatum occurs as far north as New Jersey, it is possible that it could occupy a large portion of the U.S., however, it has been collected so far from only five counties (Utah State University 2006).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Paspalum scrobiculatum is propagated by grain (Scher 2004) which is unlikely to travel large distances.

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: There is no evidence that Paspalum scrobiculatum is expanding its range in intact communities locally.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: There is no evidence that Paspalum scrobiculatum invades intact communities.

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15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: The only other place this species is not listed as native (origin listed as "Other") is throughout the paleotropics (USDA, ARS 2006) where the habitats invaded are roadsides, waste places, pastures, and the like (Pacific Island Ecosystems at Risk 2005).

16. REPRODUCTIVE CHARACTERISTICS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Paspalum scrobiculatum is a perennial and is mat forming or caespitose (tuft forming) (Clayton, et al. 2006). It propagates by grain (Scher 2004). Other than forming vegetative mats, it is not described as having reproductive characteristics typical of invasive species.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

U - UNKNOWN

COMMENTS: No information is available on how to control Paspalum scrobiculatum specifically.

18. MINIMUM TIME COMMITMENT

U - UNKNOWN

COMMENTS:

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

U - UNKNOWN

COMMENTS:

20. ACCESSIBILITY OF INVADED AREAS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Exact locations of this species are not known, but given the habitat it invades (disturbed areas, agricultural fields) it is not likely that they would be difficult to access.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Pastinaca sativa

ELEMENT NATIONAL ID: 222021
SCIENTIFIC NAME: *Pastinaca sativa*
COMMON NAME:
I-RANK REVIEW DATE: 2006-05-18
EVALUATOR: G. Davis

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:
Pastinaca sativa is widespread throughout the U.S. and may continue to escape from cultivation, however, it rarely invades intact, healthy natural communities, is not very aggressive, and is relatively easy to control, especially if caught early. It should be watched locally because under favorable conditions it can colonize open patches and spread from there, replacing native species.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Throughout Europe into western, temperate Asia to Siberia (GRIN 2006).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS:

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Pastinaca sativa frequently invades and modifies open, disturbed habitats and is found in conditions including dry, mesic, and wet-mesic prairies, oak openings, and calcareous fens (Czarapata 2005). However, there is clear evidence of the species invading natural areas only in the northern prairies states; for example, it is primarily a problem in southeastern Minnesota in prairies and oak openings (Wisconsin DNR 2004, Minnesota DNR 2006). Pastinaca sativa is not likely to invade well-established prairies, but it can become abundant on edges and in disturbed patches within otherwise high quality prairies and it can persist in areas that remain disturbed or bare such as rocky areas, paths, or roadsides (Eckardt 1987).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No effect on system processes mentioned in literature.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No perceivable influence on community structure menioned in literature.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B - MODERATE SIGNIFICANCE

COMMENTS: In disturbed sites where Pastinaca sativa colonizes, it can invade in waves and once the population builds, it spreads rapidly, severely modifying the habitat (Wisconsin DNR 2006, Minnesota DNR 2006).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No known reports of disproportionate effects on a particular native species.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Pastinaca sativa is not likely to invade well-established prairies, but it can become abundant on edges and in disturbed patches within otherwise high quality prairies and it can persist in areas that remain disturbed or bare such as rocky areas, paths, or roadsides (Eckardt 1987). It is found in dry, mesic, and wet-mesic priries, oak openings, and calcareous fens (Czarapata 2001).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Pastinaca sativa occurs throughout the U.S., except in the most southeastern states, ranging north into Canada and Alaska (Kartesz 1999).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C - LOW SIGNIFICANCE

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COMMENTS: Although Pastinaca sativa appears to have naturalized throughout the U.S. (e.g., Cronquist et al. 1997, Gleason and Cronquist 1991, Correll and Johnston 1970), it appears to be a problem to intact natural areas only in the northern midwest. For example, the Wisconsin DNR describes it as occurring in dry, mesic, and wet-mesic prairies; oak openings; and calcareous fens (Wisconsin Department of Natural Resources 2004) and in Minnesota
it is not likely to invade well established prairies, but it readily moves into disturbed habitats along edges and or in disturbed patches; it invades slowly, but once population builds it spreads rapidly and can severely modify open dry, moist, and wet-moist habitats; it is primarily a problem in southeastern Minnesota in prairies and oak openings (Minnesota Department of Natural Resources 2006). The species is reported as invasive in Michigan, Ohio, Pennsylvania, Tennessee, Virginia, and Wisconsin (Swearingen 2006).However, in Tennessee it is considered a "lesser threat...not presently a threat to native plant communties" (Tennessee Exotic Pest Plant Council 2004); in Virginia it is listed as an "Occasionally Invasive Species" (Occasionally invasive species generally do not affect ecosystem processes but may alter plant community composition by outcompeting one or more native plant species. They often establish in severely disturbed areas. The disturbance may be natural or human origin, such as icestorm damage, windthrow, or road construction. These species spread slowly or not at all from disturbed sites.) (Virginia Native Plant Society and Virginia Department of Conservation & Recreation 2003);

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS:

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: The species occurs in dry, mesic, and wet-mesic prairies; oak openings; and calcareous fens (Wisconsin Department of Natural Resources 2004).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: The species already occupies most of the region.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

D - INSIGNIFICANT

COMMENTS: Pastinaca sativa could expand its range in the central plains states and Texas.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: Seeds are not noted for natural long distance dispersal, however the species is commonly cultivated and may escape (Gleason and Cronquist 1991).

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13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS:

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: Pastinaca sativa is not likely to invade well-established prairies, but it can become quite abundant on prairie edges and in disturbed patches within otherwise high quality prairies; it is also highly persistent on sites that remain disturbed or bare such as rocky areas, paths, or roadsides (Eckardt 1987).

15. SIMILAR HABITATS INVADED ELSEWHERE

U - UNKNOWN

COMMENTS: Also naturalized in southern Africa, temperate Asia, Australia, New Zealand, southern South America, and Canada (USDA 2006). In western Australia it occurs in black peaty sand on edges of swamps and drains (Western Australian Herbarium 2006). No other information found regarding habitat types invaded.

16. REPRODUCTIVE CHARACTERISTICS

C - LOW SIGNIFICANCE

COMMENTS: The species spends one or more years as a rosette, it then flowers once before it dies; a single plant can produce hundreds of flowers, each of which produces many seeds which take three weeks to ripen (Wisconsin DNR 2004) and can remain in the seedbank up to four years (Minnesota DNR 2006). The species reproduces only from seed.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

C - LOW SIGNIFICANCE

COMMENTS: The best way to control Pastinaca sativa is to maintain the health of the prairie, however if it does colonize it can be mechanically removed after flowering and before seed set by digging out just below-ground; it can also be mowed or chemically controlled over larger areas, although repeated treatments and careful timing are necessary to achieve eradication and mowing has been shown to increase populations, possibly by decreasing native competitors (Eckardt 1987, Schaefer 2005). Extreme caution must be used in mechanical removal because plant juices contain a phototoxic chemical which causes blistering and rash when contacted skin is exposed to sunlight (Wisconsin Department of Natural Resources 2004).

18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS:

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19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Mowing and herbicides used to control Pastinaca sativa can impact native species; individual plant removal can be performed with limited impact (Eckardt 1987).

20. ACCESSIBILITY OF INVADED AREAS

D - INSIGNIFICANT

COMMENTS: Pastinaca sativa is usually found in open areas.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Paulownia tomentosa

ELEMENT NATIONAL ID: 210948
SCIENTIFIC NAME: *Paulownia tomentosa*
COMMON NAME:
I-RANK REVIEW DATE: 2005-12-21
EVALUATOR: Maybury, K.

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:
An aggressive invader of many types of disturbed areas in the eastern U.S. that is apparently able to infest some some high-quality native species habitats.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: China, Japan, Korea (IPANE 2004).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS:

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes
COMMENTS:

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No significant abiotic alterations known.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B - MODERATE SIGNIFICANCE

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COMMENTS: Can establish in disturbed areas and very quickly grow to the size of a large tree; its rapid growth rate---up to 15 feet in one year (Starbuck 2002)----and ability for form a quick canopy has led to its designaton as a "miracle tree" or "super tree" (Starbuck 2002; Paulownia.org, not dated). However, it does not typically form a dense thickets or canopies (PIER, not dated).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: May establish in previously burned areas and forests defoliated by pests or landslides (Remaley 1998), presumably supressing seedlings of native species, at least for a time (Paulownia is a short-lived tree). "Can crowd out native trees" (IPANE 2004).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No evidence of disproportionate impacts on particular species.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Typically, this is a species of disturbed areas such as roadsides and other rights-of-way, vacant lots and other very open disturbed areas (IPANE 2004, Invasive.org 2005). However, it has also been reported growing on cliffs and in scoured riparian zones where "it *may* compte with rare plants in these marginal habitats" (Remaley 1998, emphasis added). Invasive.org (2005) notes that this species "usually invades roadsides, stream banks, forest edges, and other disturbed areas, but has the ability to invade a wide variety of places."

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Much of the eastern U.S. from Massachusetts to Texas (Kartesz 1999, IPANE 2004).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Some negative impacts in most parts of range presumed.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS:

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9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Widely adapatable and found in many site conditions (NBII and ISSG 2005).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Assumed not expanding rapidly in all directions nor decreasing.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Introduced to the U.S. in the mid-1800s (Remaley 1998) but some range expansion still seems possible. Not reported escaped in Hawaii thus far but considered "likely to be invasive in Hawaii and on other Pacific Islands" by PIER (not dated) using a screening process based on species biology and behavior. It also seems at least possible that this species could escape in parts of the western U.S. warmer than USDA Zone 4 or 5. Most sources report that this tree is quite tolerant of dry (as well as moist), exposed conditions. So far, in New England, this plant has remained near the coast in its distribution (IPANE 2004).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Widely sold and promoted as an ornamental, a timber crop, and for revegetating very disturbed areas such as surface mines. The seeds are also easily transported long distances by wind and water (Remaley 1998)

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: At least some expansion or increase in abundance is inferred given increasing levels of disturbance in general across most landscapes and the active promotion of this species as a fast-growing timber crop by many U.S. silvacultural sites. Such tree plantations "could serve as focal points for dispersal" (IPANE 2004).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: A pioneer species that needs bare soil and direct sunlight for good seedling establishment (NBII and ISSG 2005). Relies greatly on disturbance to move into a natural habitat (IPANE 2004).

15. SIMILAR HABITATS INVADED ELSEWHERE

U - UNKNOWN

COMMENTS:

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16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: Has extremely agressive characteristics. Fast growth rate with seedlings starting to flower in as little as 8 years (Remaley 1998). President Jimmy Carter reportedly once said of this tree "don't put your face over it or you may get a mouthful of leaves." Worse, a single tree is capable of producing an estimated 20 million seeds per year (2,000-2,500 seeds in each capsule) (IPANE 2004, NBII and ISSG 2005). Can spread by suckering as well as by seed (Remaley 1998) and resprouts vigorously from root fragments as well as stumps (Tu 2002). Remaley (1998) said: "its ability to sprout prolifically from adventitious buds on stems and roots allows it to survive fire, cutting, and even bulldosing in construction areas."

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B - MODERATE SIGNIFICANCE

COMMENTS: Can be contolled by cutting and immediately applying a herbicide to the stumps or by repeated cutting for several years (Tu 2002). New seedlings can be hand-pulled, preferably when the soil is moist because the entire root must be removed (see Remaley 1998).

18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS: Existing trees can be eliminated but new seedlings must be removed until growth of other vegetation prevents new establishment.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Cutting and targeted herbicide applciation the the cut should minimize non-target impacts.

20. ACCESSIBILITY OF INVADED AREAS

A - HIGH SIGNIFICANCE

COMMENTS: Planted on private lands for ornamental or commercial purposes and will reinvade from these sources.

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Invasive Plant Atlas of New England [IPANE]. 2004. Paulownia tomentosa. Available: http://webapps.lib.uconn.edu/ipane/browsing.cfm?descriptionid=83. Accessed 2005.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Perilla frutescens

ELEMENT NATIONAL ID: 212641
SCIENTIFIC NAME: *Perilla frutescens*
COMMON NAME:
I-RANK REVIEW DATE: 2006-03-15
EVALUATOR: K. Maybury

I-RANK: Low

I-RANK REASONS SUMMARY:
This is a ruderal species in the eastern U.S. It escapes and naturalizes in pastures, roadsides, disturbed urban and suburban areas, and other lower quality habitats. It does not appear to seriously impact any higher quality native species habitats.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low

OTHER CONSIDERATIONS:
Toxic to livestock.

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: India, southeast and east Asia to Japan.

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS:

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes
COMMENTS:

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: There is no evidence of significant alteration of abiotic processes.

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2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: This herbaceous plant may change the density of the herbaceous layer somewhat where it occurs but should not otherwise alter vegetation structure.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C - LOW SIGNIFICANCE

COMMENTS: Probably reduces the abundance of native species somewhat but does not appear to significantly alter composition.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No reports of disproportionate impacts found.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: This is not a species that is able to actively invade high quality native species habitats. Throughout its naturalized range in the U.S. this is described as a plant of disturbed areas (especially moist disturbed areas) such as waste places, pastures (livestock avoid this plant so it survives in pastures), fencerows, and roadsides (e.g., Mohlenbrock 1986; Gleason and Cronquist 1991; Wunderlin and Hansen 2003; Jones 2005; Weakley 2006; Virginia Tech, not dated). Various state and regional weed lists categorize this plant as only occassionally invasive and/or only of local concern. For example, the Missouri Prairie Foundation treats this as a Class 2 - obligate ruderal, as opposed to a plant that is a persistent ruderal or one that weakly or aggressively invades natural Missouri grasslands (Ladd and Churchwell 1999). The U.S. Forest Service Eastern Region considers this a Category 4 plant, i.e., one that occurs only locally in the region (USFS 2004); the Virginia DCR and VNPC (2003) indicates that this is "Occasionally Invasive Species" in Virginia and describes that category as made up of plants that often establish in severely disturbed areas and spread slowly or not at all from these disturbed sites.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Throughout the eastern U.S. except northern New England (Kartesz 1999).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: At least some negative impacts presumed in most of the generalized range.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS:

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9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Along streams and in various disturbed habitats such as pastures, roadsides (e.g., Ladd and Churchwell 1999; Virginia Tech, not dated).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: Presumed not decreasing or rapidly expanding in terms of the generalized range.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

D - INSIGNIFICANT

COMMENTS: Probably not suited to the drier parts of the West nor well adapted to extreme cold.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Widly sold and planted as a garden herb.

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

C - LOW SIGNIFICANCE

COMMENTS: Some local expansion is assumed simply due to increased human-caused disturbance in most areas and due to the relatively new and seemingly increasing popularity of this as a medicinal and a culinary herb.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: Throughout its naturalized range in the U.S. this is described as a plant of disturbed areas such as waste places, pastures, fencerows, and roadsides (e.g., Mohlenbrock 1986; Gleason and Cronquist 1991; Wunderlin and Hansen 2003; Jones 2005; Weakley 2006; Virginia Tech, not dated). Similarly, the Missouri Prairie Foundation considers this as an obligate ruderal (Ladd and Churchwell 1999).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: In Canada but presumably in similar habitats.

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16. REPRODUCTIVE CHARACTERISTICS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Matures quickly and reseeds prolifically (pers. obs.).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

C - LOW SIGNIFICANCE

COMMENTS: Inferred.

18. MINIMUM TIME COMMITMENT

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Inferred.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Unknown but assumed no serioius impacts nor completely insignficant.

20. ACCESSIBILITY OF INVADED AREAS

A - HIGH SIGNIFICANCE

COMMENTS: Wildely planted for culinary, medicinal, and sometimes ornamental uses (similar to coleus in its dark leaves).

REFERENCES:

Virginia Department of Conservation and Recreation, Division of Natural Heritage, and Virginia Native Plant Society [DCR and VNPS]. 2003. Invasive alien plant species of Virginia. Online: http://www.state.va.us/dcr/dnh/invlist.pdf. Accessed 2006.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Phalaris arundinacea

ELEMENT NATIONAL ID: 228755
SCIENTIFIC NAME: *Phalaris arundinacea*
COMMON NAME: Reed Canarygrass
I-RANK REVIEW DATE: 2006-06-26
EVALUATOR: J. Cordeiro

I-RANK: High

I-RANK REASONS SUMMARY:
This species can form dense, persistent, monotypic stands of creeping rhizomes in a thick sod layer in wetlands, moist meadows and riparian areas. In a study on the St. Lawrence River, this species (as well as a few other aquatic wetland invasive plant species) was found to expand aggressively to a point of almost monospecific dominance during periods of low water levels. Populations can dominate wetlands outcompeting and eliminating native species, often in undisturbed areas on nature preserves. Although distributed in nearly every U.S. state it is particularly invasive in the northeast where it has spread over the last 200 years and more recently, in the west. Almost any moist, fertile habitat is suitable including wetlands and riparian areas. A combination of management strategies works best although management is somewhat difficult but can be rapid if invasions are caught in time. Unfortunately, control often has deleterious impacts on native species.

SUBRANK I - ECOLOGICAL IMPACT:	High
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Medium

OTHER CONSIDERATIONS:
It is generally thought that invasive populations of reed canarygrass, however, are descendents of non-native cultivars or ecotypes (Apfelbaum and Sams, 1987; Czarapata, 2005; Hutchinson, 1992) or the vigorous result of crosses between cultivated varieties and native strains (Barnes, 1999; Barrett, 1983; Gilford et al., 2002; Merigliano and Lesica, 1998) with native and non-native strains coexisting in the U.S. since the 1800s. Therefore, for the purposes of this invasiveness ranking assessment only, all U.S. populations of reed canarygrass will be treated as invasive.

NATIVE AND NON-NATIVE IN NATION

NATIVE RANGE: Reed canarygrass is the only member of the genus Phalaris that is circumboreal, and it may be the precursor to all New World taxa of the genus (Anderson, 1961 cited in Lyons, 1998). Clearly native to Europe, some authors view it as native to Asia and North America as well but the present day range extends throughout the Old and New Worlds, where it is found primarily in northern latitudes (Lyons, 1998).

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SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: There is some debate as to whether Phalaris arundinacea is native to North America (Merigliano and Lesica, 1998) as collections from the inland Pacific Northwest predate settlement of the area by Europeans. Modern Phalaris populations in this region may be a mixture of cultivars and "native" material. It is widely regarded as non-native in more southern latitutes. The invasive character of some populations may be the result of agronomic breeding for vigorous growth and drought tolerance. It is generally thought that invasive populations of reed canarygrass, however, are descendents of non-native cultivars or ecotypes (Apfelbaum and Sams, 1987; Hutchinson, 1992) or the vigorous result of crosses between cultivated varieties and native strains (Barnes, 1999; Barrett, 1983; Gilford et al., 2002; Merigliano and Lesica, 1998) with native and non-native strains coexisting in the U.S. since the 1800s. Several subspecies and cultivars have been planted throughout the United States since the 1800s for forage and erosion control (Czarapata, 2005).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: There is some debate as to whether Phalaris arundinacea is native to North America (Merigliano and Lesica, 1998) as collections from the inland Pacific Northwest predate settlement of the area by Europeans. Modern Phalaris populations in this region may be a mixture of cultivars and "native" material. It is widely regarded as non-native in more southern latitutes. It is considered an aggressive, rhixomatous, colony-forming perennial common in wet areas of the U.S. (Uva et al., 1997).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

B - MODERATE SIGNIFICANCE

COMMENTS: Reed canarygrass promotes silt deposition and consequent constriction of waterways (Hodgson, 1968).

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

A - HIGH SIGNIFICANCE

COMMENTS: Reed canarygrass can form dense, persistent, monotypic stands of creeping rhizomes in a thick sod layer (over 0.5 meters thick) in wetlands, moist meadows and riparian areas (Czarapata, 2005; Lyons, 1998; Tu et al., 2004; Randall and Marinelli, 1996). In a study on the St. Lawrence River, this species (as well as a few other aquatic wetland invasive plant species) was found to expand aggressively to a point of almost monospecific dominance during periods of low water levels (be they natural or artificial) as the plants monopolize light and space better than less aggressive species (Hudon, 2004).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A - HIGH SIGNIFICANCE

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COMMENTS: Reed canarygrass can form dense, persistent, monotypic stands in wetlands, moist meadows and riparian areas that exclude and displace desirable native plants and animals (Lyons, 1998; Tu et al., 2004; Randall and Marinelli, 1996). It usually forms monotypic stands and is highly competitive with timothy (*Phleum pratense*), Kentucky bluegrass (*Poa pratensis*), and redtop (*Agrostis alba*), often invading these grasslands to become the dominant cover type (Apfelbaum and Sams, 1987). Barnes (1999) documented formerly abundant herbs and grasses in western Wisconsin displaced following reed canarygrass invasion. A few native plants may be survive within a thick infestation (*Eleocharis palustris*, *Typha latifolia*, *Veronica scutellata*, *Carex aperta*), but wetlands without *Phalaris arundinacea* tend to have a much higher diversity of native species (Tu et al., 2004). Similarly, Green and Galatowitsch (2002) found that if *P. arundinacea* is present during restoration of sedge meadow communities, the restored community will not achieve levels of abundance that are possible when it is not present.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

A - HIGH SIGNIFICANCE

COMMENTS: Stewards of the Nature Conservancy indicated reed canarygrass may threaten populations of many species including *Zygadenus glaucus* (northeast, central Ohio Herrick Fen, beck Fen, Brownslake Bog), *Carex lyngbuei*, *Scirpus acutus*, *Equisetum fluviatile* (Blind Slough Preserve, Oregon) (Lyons, 1998). A few native plants may be survive within a thick infestation (*Eleocharis palustris*, *Typha latifolia*, *Veronica scutellata*, *Carex aperta*), but wetlands without *Phalaris arundinacea* tend to have a much higher diversity of native species (Tu et al., 2004). Miller and Zedler (2003) determined that reed canarygrass comes to dominate wetlands at the expense of native *Spartina* due to its high ratio of total shoot length: biomass and its adaptable morphology.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

A - HIGH SIGNIFICANCE

COMMENTS: On TNC's Swan River Oxbow Preserve in Montana, reed canarygrass poses a threat to the federally endangered annual aquatic plant *Howellia aquatilis* causing an extensive decrease in patch size (Lesica, 1997). Akerson and Gounaris (2000) list this species as a serious threat as an invasive and one of the most difficult plants to control in Colonial National Park, Yorktown, Virginia.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: *Phalaris arundinacea* is distributed in every U.S. state except Texas, Hawaii, and the extreme southeastern states (Louisiana, Mississippi, Georgia, Florida, South Carolina) (USDA, 2006). Crow and Hellquist (2000b) list distribution in North America as Newfoundland wet to Manitoba, southwest to Northwest Territories and Alaska, south to Virginia, west to North Carolina, Kentucky, Illinois, Missouri, Oklahoma, New Mexico, Arizona, and northeast California.

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A/B - HIGH/MODERATE SIGNIFICANCE

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COMMENTS: *Phalaris arundinacea* is particularly abundant in the west and northeast (Lyons, 1998). It is listed as an invasive (though not banned) species in Connecticut and a Class C noxious weed in Washington (USDA, 2006). Of late, it has become particularly invasive in western states although has been well established in the northeast as an invasive for almost 200 years (Czarapata, 2005). It grows successfully in northern latitudes and can be invasive in wet habitats (Lyons, 1998). There is some debate as to whether *Phalaris arundinacea* is native to North America (Merigliano and Lesica, 1998) as collections from the inland Pacific Northwest predate settlement of the area by Europeans. Modern *Phalaris* populations in this region may be a mixture of cultivars and "native" material. It is widely regarded as non-native in more southern latitutes. The invasive character of some populations may be the result of agronomic breeding for vigorous growth and drought tolerance.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: *Phalaris arundinacea* is distributed in every U.S. state except Texas, Hawaii, and the extreme southeastern states (Louisiana, Mississippi, Georgia, Florida, South Carolina) (USDA, 1999). It is conservatively estimated that well over half of the U.S. ecoregions have been invaded by the either invasive strains of this species or native x invasive crosses (Cordeiro, pers. obs. March 2006 based on TNC, 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Almost any moist, fertile habitat is suitable for this species as it invades and dominates wetland and riparian areas but is valued as a forage grass and for revegetating denuded ditchbanks (Lyons, 1998; Crow and Hellquist, 2000b). This includes wet meadows, wetlands, marshes, fens, old fields, floodplains, wet prairies, roadsides, ditchbanks, streambanks, lake shores, and shore swales (Ohio Department of Natural Areas and Parks, 2001; Snyder, 1992). The species has a high tolerance for varying nutrient and oxygen levels and can live in fluctuating and submerged water successfully (Brix and Sorrell, 1996; Figiel et al., 1995; Green and Galatowitsch, 2002; Kao et al., 2003).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Of late, *Phalaris arundinacea* has become particularly invasive in western states although has been well established in the northeast as an invasive for almost 200 years (Czarapata, 2005). It has been spreading considerably throughout the United States (and the world) for the last 200 years and has occupied many habitats (Lyons, 1998).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Reed canarygrass has a long agronomic history in the U.S. with forage cultivation occurring as early as the 1830s in New England and continuing actively today (Lyons, 1998). Most of its potential range is likely occupied.

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12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Seeds inherently have no adaptation for long-distance dispersal. Both rhizome fragments and seeds may are dispersed via flowing water, resulting in rapid colonization of unvegetated sediment deposits. Because reed canarygrass has been planted widely for forage and erosion control, potential to spread by human activity is high.

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: A study by Barnes (1999) on a small river island in western Wisconsin showed rapid expansion over a 15 year period from a single small population in 1981 to becoming the dominant plant at elevations of <1 m above the normal high water level in 1996. Reed canarygrass is considered an undesirable invader in oak savannahs of south-central Wisconsin (Henderson, 1990). Akerson and Gounaris (2000) list this species as a serious threat as an invasive and one of the most difficult plants to control in Colonial National Park, Yorktown, Virginia.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: This species is listed as an "invasive plant of major concern" in Czarapata (2005). Reed canarygrass invasion is promoted by disturbances such as ditching of wetlands, stream channelization, deforestation of swamp forests, sedimentation, overgrazing, and intentional planting (Lyons, 1998; Barnes, 1999), but natural disturbances such as scouring floods and low water conditions also promote invasion. Miller and Zedler (2003) suggested *P. arundinacea* will grow in balance with native wetland vegetation without becoming dominant until there is a nutrient input from anthropogenic sources that shifts that balance and allows it to dominate the natives. They further noted it has a high ratio of total shoot length: biomass and an adaptable morphology. Raven (1986) reported *P. arundinacea* proliferated along the unidisturbed portion of riverbank (below the excavated portion) on the River Roding, Essex, United Kingdom, following excavation of flood berms to create a two-stage channel in 1980-82. The excavation apparently caused favorable habitat for this species. Reinhardt and Galatowitsch (2004) found *P. arundinacea* grew rapidly compared to other wetland species, producing 132 g/ plant of aboveground biomass and 333 g/ plant of below ground biomass in just two growing seasons. Also, root to shoot ratios revealed that *P. arundinacea* produced proportionally more aboveground biomass during the first 2 months of establishment and proportionally more belowground biomass for the rest of their study. This morphologic plasticity may explain why *P. arundinacea* is so successful at first preempting establishment of other species and then spreading rapidly.

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: It appears this species has maximized all potential habitats in the United States such that is similarly considered a widespread invader circumboreal in distribution, and it may be the precursor to all New World taxa of the genus (Anderson, 1961 cited in Lyons, 1998). No occupied habitats outside the U.S. are not yet colonized within the U.S.

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16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: Reed canarygrass spreads within sites by creeping rhizomes and forms dense and impenetrable mats of vegetation and new sites are colonized by seeds (Lyons, 1998; Snyder, 1992). There are two periods of growth, one prior to seed maturation and one after (Lyons, 1998). Seeds germinate immediately after ripening with no known dormancy requirements (Apfelbaum and Sams, 1987). Growth occurs vegetatively by rhizomes (most often) and sexually by seeds (less common) with a transition from the former to the latter occurring in the shoot tips in early to mid-April with inflorescence development continuing into May. Most plants and recurring populations are likely from rhizomes (Czarapata, 2005; Tu et al., 2004; Uva et al., 1997). Estimated total net productivity was found to be 2028 g/sq. m/year, higher than other species such as *Typha* and *Scirpus* (Klopatek and Stearns, 1978). Reinhardt and Galatowitsch (2004) found *P. arundinacea* grew rapidly compared to other wetland species, producing 132 g/ plant of aboveground biomass and 333 g/ plant of below ground biomass in just two growing seasons. Also, root to shoot ratios revealed that *P. arundinacea* produced proportionally more aboveground biomass during the first 2 months of establishment and proportionally more belowground biomass for the rest of their study. Nodes can spread at rhizomes. Seed banking can occur in soil for years (Leck, 1996) with an extensive seedbank (Czarapata, 2005) but survival in water is limited to 1-2 years only.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/B - HIGH/MODERATE SIGNIFICANCE

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COMMENTS: A combination of management strategies over several years will yueidl the best results (Lyons, 1998). Control is generally difficult due to the rhizomatous nature of the species and may require herbicide treatment for several years (Lyons, 1998; chemical treatment information provided) and because selective control is extremely difficult (Czarapata, 2005), but depending on available time and resources, even highly infested arreas can be restored to more desirable vegetation (Tu et al., 2004; summarizes treatment options). Removal by hand-pulling is practical only for small stands and requires a large time commitment (e.g. > 5 years) (Hutchinson, 1992). Grazing and cutting may be effective controls (again, long-term) but only in fields and croplands. Non-selective herbicides like glyphosate are most effective (Lyons, 1998; Randall and Marinelli, 1996) for small infestations, although commercial glyphosate-based herbicides are often enhanced by surfactants to help the chemical cling to plant leaves which are themselves potentially more harful thean the glyphosate itself (Apfelbaum and Sams, 1987). Lowering of water levels followed by restoration of water levles may control this species because the seeds are generally short-lived (1 or 2 years max.) when inundated (Lyons, 1998). Fire is effective in highly productive wetlands but should only be used for sites with a healthy seed bank of fire-adapted native spedcies that will readily colonize the area after a burn (Hutchinson, 1992). Generally, however, fire is only effective root-burn occurs, and this is unlikely because water or mud often covers the rhizomes (Marks et al., 1994; Snyder, 1992). Currently, there are no biological control methods (Ohio Department of Natural Areas and Parks, 2001). Because most control methods have negative impacts on native wetlands, Johnson (2005) investigated alternative control methods for small, incidental invasions (used AFTER mowing)` and found solarization with black plastic (cost $40/ 2000 sq. ft.; equals $2150/ha) was most effective (100% reduction of stems) and woodchip mulch somewhat effective (85% stem reduction but later regrowth through the mulch leading to reclamation), both with minimal impact on native wetlands and minimum time and cost.
Recent control efforts were summarized in Reinhardt and Galatowitsch (2004): Herbicide applications significantly reduced *P. arundinacea* biomass, and the effectiveness of the herbicide hinged on the timing of the herbicide application. When measured in the growing season after treatment, the mid-May herbicide application reduced *P. arundinacea* to 25% of control levels, but both late August and late September herbicide applications were significantly more effective, and reduced *P. arundinacea* to 10% of control levels. Further, spring burn does not reduce *P. arundinacea* biomass in the long term, nor does it enhance the effectiveness of subsequent herbicide applications.

18. MINIMUM TIME COMMITMENT

B/C - MODERATE/LOW SIGNIFICANCE

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COMMENTS: A combination of management strategies over several years will yueidl the best results (Lyons, 1998). Control is difficult due to the rhizomatous nature of the species and may require herbicide treatment for several years (Lyons, 1998) and because selective control is very difficult (Czarapata, 2005). It can be controlled with glyphosate, followed by covering treated areas with black plastic. This method is successful if done for 3 years, and then the treated area seeded with desirable species. Selective hand-pulling is also successful but must be carried out two to three times a year for 5 years (Henderson, 1990). Other chemicals, such as Dalapon and Amitrol, are effective in fall or early winter (Apfelbaum and Sams, 1987). Hodgson (1968) found consecutive, yearly chemical treatments were required to control reed canarygrass. A mixed strategy (e.g. disking mowing, early and late treatments with glyphosate herbicide, late glyphosate treatment alone, and ealry glyphosate treatment plus disking) seems most effective providing effective control in 1-2 years in some cases (Paveglio and Kilbride, 1996). Removal by hand-pulling is practical only for small stands and requires a large time commitment (e.g. > 5 years) (Hutchinson, 1992). Fire is effective in highly productive wetlands but should only be used for sites with a healthy seed bank of fire-adapted native spedcies that will readily colonize the area after a burn and requires a 2-3 year burn rotation cycle for up to 6 years (Hutchinson, 1992). Because most control methods have negative impacts on native wetlands, Johnson (2005) investigated alternative control methods for small, incidental invasions (used AFTER mowing)` and found solarization with black plastic (cost $40/ 2000 sq. ft.; equals 2150/ha) was most effective (100% reduction of stems) and woodchip mulch somewhat effective (85% stem reduction but later regrowth through the mulch leading to reclamation), both with minimal impact on native wetlands and minimum time and cost.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A - HIGH SIGNIFICANCE

COMMENTS: Few herbicides may be used in wetlands or near running water, where reed canarygrass is usually most troublesome; plus selective control in these areas is nearly impossible (Czarapata, 2005). In such cases, non-selective herbicides like glyphosate are most effective (Lyons, 1998; Czarapata, 2005), although commercial glyphosate-based herbicides are often enhanced by surfactants to help the chemical cling to plant leaves which are themselves potentially more harful than the glyphosate itself (Apfelbaum and Sams, 1987) so wick application (more selective) works best. However, many sources believe that the impact of common control techniques are so severe that removal of the species from wetlands with those techniques would result in overall net loss to the wetland (Johnson, 2005). Fire is effective in highly productive wetlands but should only be used for sites with a healthy seed bank of fire-adapted native spedcies that will readily colonize the area after a burn (Hutchinson, 1992). Because most control methods have negative impacts on native wetlands, Johnson (2005) investigated alternative control methods for small, incidental invasions (used AFTER mowing) and found solarization with black plastic was most effective (100% reduction of stems) and woodchip mulch somewhat effective (85% stem reduction but later regrowth through the mulch leading to reclamation), both with minimal impact on native wetlands. Currently, there are no biological control methods (Ohio Department of Natural Areas and Parks, 2001). When reed canarygrass is eliminated, there may be a danger of soil erosion if other species fail to cover the area quickly.
Most recently from control efforts outlined in Reinhardt and Galatowitsch (2004): In the context of a newly restored wetland, results indicated that a high density of native seeds suppressed *P. arundinacea* growth, and the effect was more pronounced at high seed densities of *P. arundinacea* (>100 seeds/ sq. m). However, higher densities of native seeding did not suppress recruitment from seed, even when *P. arundinacea* was present at 10 seeds/ sq. m and native species were present at 15,000 seeds/ sq. m. Although native species in high propagule density can suppress early growth of *P. arundinacea*, they do not suppress recruitment of *P. arundinacea* individuals from seed.

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20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: It appears most to all areas are easily accessible, as for most aquatic plants outside unusual habitats such as caves or high elevation streams or ponds. Because reed canarygrass has been planted widely for forage and erosion control, a few areas may not be accessible, particularly on private lands.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Phleum pratense

ELEMENT NATIONAL ID: 228300
SCIENTIFIC NAME: *Phleum pratense*
COMMON NAME: Meadow Timothy
I-RANK REVIEW DATE: 2006-06-27
EVALUATOR: J. Cordeiro, rev. K. Gravuer

I-RANK: Medium

I-RANK REASONS SUMMARY:
This species can cause declines in and competetively exclude native grasses and may occur in national and state park areas. It currently occurs in every U.S. state and is considered noxious in many. Because it is so widespread and common, continued invasive potential is only local within existing range. The species is capable of invading early to mid-successional grasslands and early seral mixed forests. Seeds are easily dispersed by wind and have spread widely via agriculture. Various control measures have met with moderate success although control in areas of conservation concern is difficult as most control methods negatively affect native species.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Timothy is Eurasian in origin but was first cultivated in the United States and was found growing as an invasive in New England in the 1700s (Hoover et al., 1948).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species has become naturalized as a non-native throughout most of the United States and southern Canada (Uva et al., 1997).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: This species was once widely used for hay production and has hence been spread widely via agriculture in the U.S. (Hitchcock, 1951).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C - LOW SIGNIFICANCE

COMMENTS: Because of the vast invasive potential of this species and because it comes to dominate areas it invades, it is assumed that some negative impacts on ecosystem processes are present.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Timothy often dominates the area it occupies (Weaver et al., 1990). This species has been found to decrease both cover and diversity of native species in various national parks in the U.S. (Tyser, 1992; Tyser and Worley, 1992).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B - MODERATE SIGNIFICANCE

COMMENTS: Timothy often dominates the area it occupies (Weaver et al., 1990). This species has been found to decrease both cover and diversity of native species in various national parks in the U.S. (Tyser, 1992; Tyser and Worley, 1992). Timothy seedlings can be detrimental or beneficial in young conifer plantations. They may hinder conifer seedling establishment by preemption of resources, allelopathy, attraction of insects and animals, and increased fire potential. They can be beneficial by excluding other competitive plant species. Timothy seedlings compete strongly with conifer seedlings, especially when conifer seedlings are not fully established. After establishment of conifer seedlings, approximately 5 years, timothy seeds may aid conifer seedling growth by excluding shrub competition (McDonald, 1986).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Little evidence of disproportionate impacts on particular native species was found in the literature. However, timothy competes successfully with native grasses where moisture and soil are favorable (Sampson et al., 1951). *Phleum pratense* also appears to exclude other grass species in abandoned pastures (> 20 years after abandonment) in Japan through interspecific competition (Tsuyuzake and Kanda, 1996). Similarly, this species has been found to decrease both cover and diversity of native species in various national parks in the U.S. (Tyser and Worley, 1992; Tyser, 1992). Murphy and Aarssen (1989; 1995a) found that pollen extract from *P. pratense* drastically reduced pollen germination in 37 (of 40 tested) other species with germination count falling to zero for some species tested. Similarly, Murphy and Aarssen (1995b) found that *P. pratense* pollen extract also decreased mean seed set in sympatric grassland species, as well.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

A/B - HIGH/MODERATE SIGNIFICANCE

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COMMENTS: Exotic grasses are one of the most disruptive factors in native fescue grasslands in Glacier National Park. Timothy is the most widely distributed exotic in the park, where it is associated with substrate disturbed by post-1980 underground utility construction. Timothy was intentionally seeded by outfitters in the 1940's and by park personnel in the 1980's. Extensive tiller mats of timothy limit cryptogam colonization sites and reduce native graminoid colonization (Tyser, 1992). Until about 1980, revegetation efforts in national parks (including Glacier National Park) commonly included seeding primary and secondary roadsides, with alien seed mixes of species such as *Phleum pratense*, and plants have successfully spread into backcountry areas of these parks away from roads (Tyser and Worley, 1992). Similar intentional plantings to feed horses and cows ware now well established and considered beyond control in other North American National Parks (e.g. Waterton Lakes National Park in Alberta, Canada; see Coleman, 1994). The species also occurs in other National Parks including Grand Canyon National Park, Indiana Dunes National Lakeshore, Pipestone National Monument, and Wind Caves National Park (APRS, 2001).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Timothy is currently distributed in every U.S. state as well as much of southern Canada (USDA, 2006; NRCS, 2002).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This species is considered an invasive throughout the U.S. with negative impacts throughout its introduced range.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: It is conservatively estimated that well over half of the 81 ecoregions have been invaded by *Phleum pratense* as it occurs in every U.S. state (Cordeiro, pers. obs. June 2006 based on TNC, 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Timothy is cultivated for hay but may occur as a weed of low-maintenance turfgrass, as well as nursery, orchard, agricultural and forage crops. It also grows in roadsides and abandoned fields but generally requires nutrient rich soils (Uva et al., 1997). Timothy has escaped cultivation and has become established at medium to high elevations in the mountains where it grows in moist grasslands, in aspen and conifer stands, and along roadways. It has become naturalized on sites ranging from warm, dry grasslands to cool, moist supalpine forests (Forcella and Harvey, 1983).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: This species has expanded across the United States into every state and continues to expand within most states (Esser, 1993).

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11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

D - INSIGNIFICANT

COMMENTS: This species has expanded across the United States into every state and continues to expand within most states (Esser, 1993).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: This species was once widely used for hay production and has hence been spread widely via agriculture (Hitchcock, 1951). It also spreads by seed into surrounding areas when used for reclamation. Until about 1980, revegetation efforts in national parks (including Glacier National Park) commonly included seeding primary and secondary roadsides, with alien seed mixes of species such as *Phleum pratense*, and plants have successfully spread into backcountry areas of these parks away from roads (Tyser and Worley, 1992; Tyser, 1992). It can also be spread by equine activities as well as activities of wild animals such as deer, mule deer, and mountain sheep (Esser, 1993; Hobbs et al., 1981; Hungerford, 1970). Timothy can be used with legumes and/or other grasses in a mix for cover purposes, filter strips, waterways, and other critical area applications (NRCS, 2002).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

C - LOW SIGNIFICANCE

COMMENTS: Since much of the United States has invasive occurrences of this species where it has reached nearly its fullest potential, local expansions are limited to select sites within states where the species has not yet been introduced.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: Timothy usually occurs in early to mid seral stages, although it can also dominate in self-perpetuating grasslands. It is an intermediate competitor. It colonizes disturbed areas via seed. Timothy has been observed in early seral mixed forests (Esser, 1993). In southwest Ohio, it was found in fields up to 50 years of age but not in fields 90 years of age (Vankat and Carson, 1991). Timothy does better following disturbance of sites in early successional stages compared with those in later successional stages.
Timothy thrives best on rich, moist bottomlands and on finer textured soils, such as clay loams. It does not do well on coarser soils. It prefers a pH of 5.5 to 7.0. Timothy will grow for a time on soils low in fertility, but it is better adapted to a high fertility soil. It is not well adapted to wet, flat land where water stands for any considerable time, though it can withstand somewhat poorly-drained soils. Under limited moisture conditions, it makes a poor recovery and it does not tolerate drought or prolonged high temperatures (NRCS, 2002). Plants establish quickly, spread vigorously, and usually escape early detection. Timothy has the highest ability of 34 exotics tested to invade closed vegetation areas. Constancy values in forest, meadow, and alpine tundra is 99, 99, and 36 percent, respectively. Numbers and frequency of timothy increases from undisturbed sites to regularly disturbed sites. More resources are available at the latter sites because competition is greatly reduced. Taylor and Aarson (1990) found that this grass species had greater competetive abilities than two other invasive grass species, including *Agropyron repens* and *Poa pratensis*.

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15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Habitats invaded elsewhere are similar to in the U.S.

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: Propagation is generally by seed and the root system is fibrous and predominates from short rhizomes and occasionally short stolons (Uva et al., 1997). It is a prolific seeder (vigorous and fast-growing) with maximum germination usually occuring about 3 or 4 weeks after it is harvested, when nearly 100 percent should germinate. Germination rates remain high for 1 to 2 years. Timothy seed remains viable for 4 to 5 years if kept in a dry, cool place (Esser, 1993). Timothy reproduces vegetatively through tillering. When timothy plants are plowed under, many become reestablished through rooting stems which develop and grow upwards to the surface. Vegetative reproduction occurs through buds in the axils of the leaves, at nodes which may or may not be adjacent to the corms (Anderson et al., 1989). The species is relatively short-lived, however (NRCS, 2002). Seed banking capability is also high for this species (Tsuyuzaki and Kanda, 1996).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B - MODERATE SIGNIFICANCE

COMMENTS: Control should include both elimination and simultaneous introduction of a desirable competitor (Weaver et al., 1990). Fire has also been shown to reduce flowering and yield (Richards and Landers, 1973). Moderately severe fires will top-kill timothy, and severe fires may cause damage to or kill the root crown, killing the plant (Anderson and Romme, 1991). However, fire stimulates the production of reproductive tillers in timothy (Esser, 1993; Cornely et al., 1983; Ehrenreich and Aikman, 1963).

18. MINIMUM TIME COMMITMENT

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: In a study of revegetation patterns in abandoned pastures in northern Japan, Tsuyuzake and Kanda (1996) found that introduced grasses including *Phleum pratense*, were abundant even > 20 years after pasture abandonment, indicating these exotic species could persist and affect revegetation for a few decades. When a single spring (mid-April) headfire under moist litter conditions was applied to an Iowa tallgrass prairie site flowering was significantly inhibited for creeping bentgrass (*Agrostis stolonifera*) and timothy (*Phleum pratense*) (Richards and Landers, 1973).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Reduction of timothy is not a realistic option in Glacier or other natural areas; the most reasonable recommendation for resource managers is not to use it for revegetating disturbed sites (Tyser, 1992). Grasses should be eliminated from plantations until conifer seedlings have become established; the limiting resource is soil moisture (McDonald, 1986).

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20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: It appears most to all areas are easily accessible. Access to private lands may be an issue where this species is deliberately planted.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Phragmites australis

ELEMENT NATIONAL ID: 211196
SCIENTIFIC NAME: *Phragmites australis*
COMMON NAME: Common Reed
I-RANK REVIEW DATE: 2006-06-26
EVALUATOR: J. Cordeiro

I-RANK: High

I-RANK REASONS SUMMARY:

Phragmites invasions increase the potential for marsh fires, form dense mats that discourage competitors in a layering effect, and alter the wetlands they colonize, eliminating habitat for other species. Rhizomes and roots form dense mats and monotypic stands. The species can become nearly monospecific in areas and negatively affect native plants and wildlife. *Phragmites* occurs in disturbed areas as well as pristine sites and is known to negatively affect several rare plants throughout its range. Although the species itself is indigenous to North America and extremely widespread, new, more invasive genotype(s) were introduced from the Old World and it is these that are of the greatest concern as invasives. *Phragmites* is not considered a threat in the West or most areas in the Gulf states. It is a problem when and where stands appear to be spreading while other species typical the of the community are diminishing. The portion of the native population that has become invasive (particularly in brackish coastal marshes of the northeastern U.S. and along streambanks and roadside ditches in inland wetlands, including alkaline swamps; also brackish marshes and freshwater tidal marshes in the Chesapeake Bay) may have become hybridized with a non-native genotype (perhaps from Eurasia) to form the highly invasive and problematic variety currently degrading native wetlands. Long distance dispersal potential is high as this species has adapted to disperse along human utilized water corridors including those inhospitable to many plants such as roadside ditches. Many reproductive characters assist this species in being highly invasive. Areas invaded by *Phragmites* often have excellent potential for recovery but a combination of control measures is often necessary over several years. Negative impacts on native species can be high even when control is properly monitored.

SUBRANK I - ECOLOGICAL IMPACT:	High
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Medium

OTHER CONSIDERATIONS:

Assessment of the invasiveness of *Phragmites australis* is based on the non-native strains of the species introduced in the United States only.

NATIVE AND NON-NATIVE IN NATION

NATIVE RANGE: Phragmites australis is found on every continent except Antarctica and may have the widest distribution of any flowering plant (Tucker, 1990).

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SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: The portion of this native species that has become invasive (particularly in brackish coastal marshes of the northeastern U.S. and along streambanks and roadside ditches in inland wetlands, including alkaline swamps; also brackish marshes and freshwater tidal marshes in the Chesapeake Bay) may have become hybridized with a non-native genotype (perhaps from Eurasia) to form the highly invasive and problematic variety currently degrading native wetlands (Chambers et al., 1999; Marks et al., 1994; Richburg et al., 2001; Saltonstall, 2003). A low-cost restriction fragment length polymorphism (RFLP) assay was recently developed (Saltonstall, 2003) to distinguish native, non-native, and Gulf Coast type populations of Phragmites from each other.

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Phragmites is especially common in alkaline and brackish (slightly saline) environments (Haslam 1972, 1971b), and can also thrive in highly acidic wetlands (Rawinski, pers. comm. 1985). However, Phragmites does not require, nor even prefer these habitats to freshwater areas. Its growth is greater in fresh water but it may be outcompeted in these areas by other species that cannot tolerate brackish, alkaline or acidic waters. It is widespread in the United states, typically growing in marshes, swamps, fens, and prairie potholes, usually inhabiting the marsh-upland interface where it may form continuous belts (Roman et al. 1984).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

B - MODERATE SIGNIFICANCE

COMMENTS: *Phragmites* invasions increase the potential for marsh fires during the winter when the above ground portions of the plant die and dry out (Reimer, 1973). Rhizomes and roots form dense mats that discourage competitors in a layering effect (Marks et al., 2001) and pushing out other species to form monotypic stands. Stands may alter the wetlands they colonize, eliminating habitat for other species. Dense colonies produce a large litter biomass that increases sediment accretion and bottom aggradation, leading to progressive drying out of littoral zones.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

A - HIGH SIGNIFICANCE

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COMMENTS: *Phragmites* occurs in disturbed areas as well as pristine sites. Rhizomes and roots form dense mats that discourage competitors in a layering effect (Marks et al., 2001) and pushing out other species to form monotypic stands. Because of its wide impacts on ecological systems and communities, it is assumed that when *Phragmites* invades a natural area with species or communities of conservation concern, alteration of the habitat will have a trickle down effect in terms of impact. *Phragmites* invasions may threaten wildlife because they alter the structure and function (wildlife support) of relatively diverse *Spartina* marshes (Roman et al. 1984). This is a problem on many of the eastern coastal National Fish and Wildlife Refuges including: Brigantine in NJ; Prime Hook and Bombay Hook in DE; Tinicum in PA; Chincoteague in VA; and Trustom Pond in RI. Richburg et al. (2001) found a population of *Phragmites* that had invaded an adjacent highway bog in Massachusetts sometime after the 1950s had recently become very dense and highly invasive dominating at the expense of other species in most plots surveyed. Impacts to several state listed rare plant and animal species is unknown but likely deleterious. Richburg et al. (2001) demonstrated that *Phragmites* negatively impacts the graminoid fen as indicated by lower cover valued for many of the previously common fen plant species; thereby impacting impacts on both the species themselves and the structure of the community. Because individual plants reach 1 to 5 meters in height, *Phragmites* is one of the tallest marsh plants, conferring at a competetive advantage for light over other platns (Lindsay, 2000; Hudon, 2004). In a study on the St. Lawrence River, this species (as well as a few other aquatic wetland invasive plant species) was found to expand aggressively to a point of almost monospecific dominance during periods of low water levels (be they natural or artificial) as the plants monopolize light and space better than less aggressive species (Hudon, 2004).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A - HIGH SIGNIFICANCE

COMMENTS: *Phragmites* is frequently regarded as an aggressive, unwanted invader in the East and Upper Midwest. It has also earned this reputation in the Mississippi River Delta of southern Louisiana, where over the last 50 years, it has displaced species that provided valuable forage for wildlife, particularly migratory waterfowl (Hauber 1991). In other parts of coastal Louisiana, however, it is feared that *Phragmites* is declining as a result of increasing saltwater intrusion in the brackish marshes it occupies. Phragmites is apparently decreasing in Texas as well due to invasion of its habitat by the alien grass *Arundo donax* (Poole, pers. comm. 1985). Similarly, *Phragmites* is present in the Pacific states but is not regarded as a problem there. In fact, throughout the western U.S. there is some concern over decreases in the species' habitat and losses of populations. *Phragmites* often grows in near monotypic stands and effectively out-competes other vegetation (Marks et al., 2001). It also offers poor-quality habitats for larval and juvenile fish (Meyer et al., 2001). It further reduces avian diversity by limiting available nesting and feeding habitat for waterfowl (Chambers et al., 1999). Because it has lower nutritive value than other aquatic wetland plants, it unifies faunal food quality and thus the structure of food webs that may be supported by wetlands.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

A - HIGH SIGNIFICANCE

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COMMENTS: *Phragmites* is often found in association with other wetland plants including species from the following genera: *Spartina*, *Carex*, *Nymphaea*, *Typha*, *Clyceria*, *Juncus*, *Myrica*, *Triglochin*, *Calamagrostis*, *Galium*, and *Phalaris* (Howard et al. 1978).
Dense congregations of redwing blackbirds, which nest in *Phragmites* stands preferentially, increase chances of airplane accidents nearby. The monitoring and control of mosquito breeding is nearly impossible in dense *Phragmites* stands (Hellings and Gallagher 1992). Phragmites often grows in near monotypic stands and effectively out-competes other vegetation (Marks et al., 2001).
Richburg et al. (2001) found a population of *Phragmites* that had invaded an adjacent highway bog in Massachusetts sometime after the 1950s had recently become very dense and highly invasive dominating at the expense of other species in most plots surveyed. Impacts to several state listed rare plant and animal species is unknown but likely deleterious. Richburg et al. (2001) demonstrated that *Phragmites* negatively impacts the graminoid fen as indicated by lower cover valued for many of the previously common fen plant species; thereby impacting impacts on both the species themselves and the structure of the community. Negative impacts on marsh nekton animals (*Fundulus heteroclitus*, *Palaemonetes pugio*, *Callinectes sapidus*, *Uca minax*) have not been demonstrated as these animals are using *Phragmites* dominated wetlands in the Huydson River, New York (Hanson et al., 2002).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: *Phragmites* occurs in disturbed areas as well as pristine sites. Because of its wide impacts on ecological systems and communities, it is assumed that when *Phragmites* invades a natural area with species or communities of conservation concern, alteration of the habitat will have a trickle down effect in terms of impact. Some plant species and communities threatened by *Phragmites* include:
1. Massachusetts, a brackish pondlet near Horseneck Beach supports the state rare plant *Myriophyllum pinnatum* (Walter) BSP, which *Phragmites* is threatening by reducing the available open water and shading aquatic vegetation (Sorrie, pers. comm. 1985).
2. Maryland, at Nassawango Creek, a rare coastal plain peatland community is threatened by *Phragmites* (Klockner, pers. comm. 1985).
3. Ohio, at the Arcola Creek wetland, phragmites is threatening the state endangered plant *Carex aquatilis* Wahlenb. (Young, pers. comm. 1985).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Crow and Hellquist (2000b) list western hemisphere range as Quebec west to British Columbia, south to Florida, Texas, California, and Mexico; and in Central America, but it is found on every continent except Antarctica and may have the widest distribution of any flowering plant (Marks et al., 2001). Because *Phragmites* has invaded and formed near-monotypic stands in some North American wetlands only in recent decades there has been some debate as to whether it is indigenous to this continent or not. Convincing evidence that it was here long before European contact is now available from at least two sources. Niering and Warren (1977) (cited in Marks et al., 2001) found remains of *Phragmites* in cores of 3000 year old peat from tidal marshes in Connecticut. Identifiable *Phragmites* remains dating from 600 to 900 A.D. and constituting parts of a twined mat and other woven objects were found during archaeological investigations of Anasazi sites in southwestern Colorado (Kane and Gross, 1986; Breternitz et al., 1986; both cited in Marks et al., 2001). Although the species itself is indigenous to North America, new, more invasive genotype(s) were introduced from the Old World and it is these that are of the greatest concern as invasives (see under Prop. Having Negative Impacts).

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7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: *Phragmites* is not considered a threat in the West or most areas in the Gulf states. *Phragmites* can be regarded as a stable, natural component of a wetland community if the habitat is pristine and the population does not appear to be expanding. Many native populations of *Phragmites* are "benign" and pose little or no threat to other species and should be left intact. Recent studies suggest *Phragmites* marshes may function as viable wetland habitat (Marks et el., 2001; Warrent et al., 2001; Hanson et al., 2001). Examples of areas with stable, native populations include sea-level fens in Delaware and Virginia and along Mattagota Stream in Maine (Rawinski 1985, pers. comm. 1992). In Europe, a healthy reed belt is defined as a "homogeneous, dense or sparse stand with no gaps in its inner parts, with an evenly formed lakeside borderline without aisles, shaping a uniform fringe or large lobes, stalk length decreasing gradually at the lakeside border, but all stalks of one stand of similar height; at the landside edge the reeds are replaced by sedge or woodland communities or by unfertilized grasslands" (Ostendorp 1989).
Phragmites is a problem when and where stands appear to be spreading while other species typical the of the community are diminishing. Disturbances or stresses such as pollution, alteration of the natural hydrologic regime, dredging, and increased sedimentation favor invasion and continued spread of *Phragmites* (Roman et al. 1984). The portion of the native population that has become invasive (particularly in brackish coastal marshes of the northeastern U.S. and along streambanks and roadside ditches in inland wetlands, including alkaline swamps; also brackish marshes and freshwater tidal marshes in the Chesapeake Bay) may have become hybridized with a non-native genotype (perhaps from Eurasia) to form the highly invasive and problematic variety currently degrading native wetlands (Amsberry et al., 2000; Chambers et al., 1999; Marks et al., 1994; Richburg et al., 2001; Saltonstall, 2002; 2003). A low-cost restriction fragment length polymorphism (RFLP) assay was recently developed (Saltonstall, 2003) to distinguish native, non-native, and Gulf Coast type populations of *Phragmites* from each other.
Stable populations are difficult to distinguish from invasive ones but factors such as site disturbance and earliest collection dates should be utilized to arrive at a determination. Different invasive gentotypes are known from the Mississippi River Delta and Gulf Coast region (Hauber et al., 1991; Saltonstall, 2003), New England (where native genotypes are likely extinct) and the northeast Atlantic coast (Saltonstall, 2002; 2003), the tidal marshes of the upper Chesapeake Bay region (Rice et al., 2000) and the U.S. and Canadian Great Lakes (Hudon et al., 2005). Saltonstall (2002) demonstrated rapid replacement of native lineages by invasive ones in marshes of Connecticut and Massachusetts by 1940. This invasion is on a scale comparable (if not greater than) other known wetland invaders such as purple loosestrife and salt ceader, but appears to still be in a phase of expansion into new areas.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: It is conservatively estimated that over 25 ecoregions have been invaded by the invasive strain of *Phragmites* with almost all ecoregions having some form (either native or non-native) strains present (Cordeiro, pers. obs. March 2006 based on TNC, 2001). Different invasive gentotypes are known from the Mississippi River Delta and Gulf Coast region (Hauber et al., 1991; Saltonstall, 2003), New England (where native genotypes are likely extinct) and the northeast Atlantic coast (Saltonstall, 2002; 2003), the tidal marshes of the upper Chesapeake Bay region (Rice et al., 2000) and the U.S. and Canadian Great Lakes (Hudon et al., 2005).

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9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: *Phragmites* is especially common in alkaline and brackish (slightly saline) environments (Haslam 1972, 1971b), and can also thrive in highly acidic wetlands (Rawinski, pers. comm. 1985). However, *Phragmites* does not require, nor even prefer these habitats to freshwater areas. Its growth is greater in fresh water but it may be outcompeted in these areas by other species that cannot tolerate brackish, alkaline or acidic waters. It is often found in association with other wetland plants including species from the following genera: *Spartina*, *Carex*, *Nymphaea*, *Typha*, *Clyceria*, *Juncus*, *Myrica*, *Triglochin*, *Calamagrostis*, *Galium*, and *Phalaris* (Howard et al. 1978).
Phragmites occurs in disturbed areas as well as pristine sites. It is especially common along railroad tracks, roadside ditches, and piles of dredge spoil, wherever even slight depressions hold water (Ricciuti 1983). Penko (pers. comm. 1993) has observed stunted *Phragmites* growing on acidic tailings (Ph 2.9) from an abandoned copper mine in Vermont. Various types of human manipulation and/or disturbance are thought to promote *Phragmites* (Roman et al. 1984). For example, restriction of the tidal inundation of a marsh may result in a lowering of the water table, which may in turn favor *Phragmites*. Likewise, sedimentation may promote the spread of *Phragmites* by elevating a marsh's substrate surface and effectively reducing the frequency of tidal inundation (Klockner, pers. comm. 1985).
A number of explanations have been proposed to account for the recent dramatic increases in *Phragmites* populations in the northeastern and Great Lakes States. As noted above, habitat manipulations and disturbances caused by humans are thought to have a role. In some areas *Phragmites* may also have been promoted by the increases in soil salinity which result when de- icing salt washes off roads and into nearby ditches and wetlands (McNabb and Batterson 1991). On the other hand, bare patches of road sand washed into ditches and wetlands may be of greater importance. *Phragmites* seeds are shed from November through January and so may be among the first propagules to reach these sites. If the seeds germinate and become established the young plants will usually persist for at least two years in a small, rather inconspicuous stage, resembling many other grasses. Later, perhaps after the input of nutrients, they may take off and assume the tall growth form that makes the species easily identifiable. Increases in soil nutrient concentrations, may come from runoff from farms and urban areas. It has also been suggested increases in nutrient concentrations, especially nitrates, are primarily responsible for increases in *Phragmites* populations. Ironically, eutrophication and increases in nitrate levels are sometimes blamed for the decline of *Phragmites* populations in Europe (Den Hartog et al. 1989).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A - HIGH SIGNIFICANCE

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COMMENTS: *Phragmites* range is increasing dramatically overall in North America in the past 150 years (Saltonstall, 2002), although locally decreasing at some sites (much like some Eurasian populations). A portion of the native population that has become invasive (particularly in brackish coastal marshes of the northeastern U.S. and along streambanks and roadside ditches in inland wetlands, including alkaline swamps; also brackish marshes and freshwater tidal marshes in the Chesapeake Bay) may have become hybridized with a non-native genotype (perhaps from Eurasia) to form the highly invasive and problematic variety currently degrading native wetlands (Chambers et al., 1999; Marks et al., 1994; Richburg et al., 2001; Saltonstall, 2002; 2003). This introduced type has displaced native types as well as expanded to regions previously not known to have *Phragmites*. Different invasive gentotypes are known to be increasing in the Mississippi River Delta and Gulf Coast region (Hauber et al., 1991; Saltonstall, 2003), New England (where native genotypes are nearly extinct) and the northeast Atlantic coast (Saltonstall, 2002; 2003), and the tidal marshes of the upper Chesapeake Bay region (Rice et al., 2000). Great Lakes populations have also increased dramatically recently (Hudon et al., 2005; Marks et al., 2001). Hudon et al. (2005) documented tremendous increase in the number of colonized sites along the St. Lawrence River since 1980.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Approximately 11 native North American strains have shown little change in their distribution between historic and modern samples from the Midwest to the Pacific Coast, but the 3 native haplotypes found in historical samples from southern and central New England appear to be extirpated in that area since the introduction of the non-native strains leaving only non-native strains today (Saltonstall, 2002; 2003). Similar extinctions have appeared locally along the Atlantic coast southwards from New England. Saltonstall (2002) demonstrated rapid replacement of native lineages by invasive ones in marshes of Connecticut and Massachusetts by 1940. This invasion is on a scale comparable (if not greater than) other known wetland invaders such as purple loosestrife and salt ceader, but appears to still be in a phase of expansion into new areas.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Long distance dispersal potential is high as this species has adapted to disperse along human utilized water corridors including those inhospitable to many plants such as roadside ditches. Rivers of all sizes (including temporary creeks) allow for dispersal across large distances, particularly through disturbed areas. Farnsworth et al. (2003) demonstrated that this species, when compared to other common native wetland species as well as three other invasive species, shows a high degree of invasiveness in terms of height growth and emergence time, biomass per ramet, standing leaf area, total leaf area per plant, standing crop, and total foliar chlorophyll. Ditches along highway corridors have been shown to serve as migration corridors for invasive wetland plants (Richburg et al., 2001; Wilcox, 1989).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A - HIGH SIGNIFICANCE

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COMMENTS: *Phragmites* is a problem when and where stands appear to be spreading while other species typical the of the community are diminishing. Disturbances or stresses such as pollution, alteration of the natural hydrologic regime, dredging, and increased sedimentation favor invasion and continued spread of *Phragmites* (Roman et al. 1984). Certain factors that may have favored recent invasion and spread of *Phragmites* include increases in soil salinity (from fresh to brackish) and/or nutrient concentrations, especially nitrate, and the introduction of a more invasive genotype(s) from the Old World (McNabb and Batterson 1991; Metzler and Rosza 1987). Many Atlantic coast wetland systems have been invaded by *Phragmites* as a result of tidal restrictions imposed by roads, water impoundments, dikes and tide gates. Tide gates have been installed in order to drain marshes to harvest salt hay, to control mosquito breeding and, most recently, to protect coastal development from flooding during storms. This alteration of marsh systems may favor *Phragmites* invasion by reducing tidal action and soil water salinity and lowering water tables. Farnsworth et al. (2003) demonstrated that this species, when compared to other common native wetland species as well as three other invasive species, shows a high degree of invasiveness in terms of height growth and emergence time, biomass per ramet, standing leaf area, total leaf area per plant, standing crop, and total foliar chlorophyll.
This portion of the native population that has become invasive (particularly in brackish coastal marshes of the northeastern U.S. and along streambanks and roadside ditches in inland wetlands, including alkaline swamps; also brackish marshes and freshwater tidal marshes in the Chesapeake Bay) may have become hybridized with a non-native genotype (perhaps from Eurasia) to form the highly invasive and problematic variety currently degrading native wetlands (Chambers et al., 1999; Marks et al., 1994; Richburg et al., 2001; Saltonstall, 2003). A low-cost restriction fragment length polymorphism (RFLP) assay was recently developed (Saltonstall, 2003) to distinguish native, non-native, and Gulf Coast type populations of *Phragmites* from each other.
Different invasive gentotypes are known from the Mississippi River Delta and Gulf Coast region (Hauber et al., 1991; Saltonstall, 2003), New England (where native strains are extirpated) and the northeast Atlantic coast (Saltonstall, 2002; 2003), and the tidal marshes of the upper Chesapeake Bay region (Rice et al., 2000). Saltonstall (2002) demonstrated rapid replacement of native lineages by invasive ones in marshes of Connecticut and Massachusetts by 1940.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: This species is listed as an "invasive plant of major concern" in Czarapata (2005). Disturbances or stresses such as pollution, alteration of the natural hydrologic regime, dredging, and increased sedimentation favor invasion and continued spread of *Phragmites* (Roman et al. 1984). Certain factors that may have favored recent invasion and spread of *Phragmites* include increases in soil salinity (from fresh to brackish) and/or nutrient concentrations, especially nitrate, and the introduction of a more invasive genotype(s) from the Old World (McNabb and Batterson 1991; Metzler and Rosza 1987).
Farnsworth et al. (2003) demonstrated that this species, when compared to other common native wetland species as well as three other invasive species, shows a high degree of invasiveness in terms of height growth and emergence time, biomass per ramet, standing leaf area, total leaf area per plant, standing crop, and total foliar chlorophyll. Ditches along highway corridors have been shown to serve as migration corridors for invasive wetland plants (Richburg et al., 2001; Wilcox, 1989). Salinity tolerance is a limiting factor in distribution of this species although it has a fairly high tolerance (12 ppt in Britain, 29 ppt in New York, 40 ppt on the Red Sea Coast) (Hocking et al., 1983) because air spaces in above ground stems and rhizomes assure underground parts have a fresh water supply. Under favorable conditions, germination begins 1 day after sowing and may reach nearly 100 percent (Ekstam and Forseby, 1999). Saltonstall (2002) demonstrated rapid replacement of native lineages by invasive ones in marshes of Connecticut and Massachusetts by 1940. This invasion is on a scale comparable (if not greater than) other known wetland invaders such as purple loosestrife and salt ceader, but appears to still be in a phase of expansion into new areas.

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15. SIMILAR HABITATS INVADED ELSEWHERE

B - MODERATE SIGNIFICANCE

COMMENTS: Ironically, eutrophication and increases in nitrate levels are sometimes blamed for the decline of *Phragmites* populations in Europe (Den Hartog et al. 1989). *Phragmites* can be found in tropical wetlands but is absent from such habitats in the U.S. and the Amazon basin, thus far (Marks et al., 2001). Recently, it has developted a tolerance for invading lowland marsh habitats by initially establishing itself in the high marsh then expanding into the less favorable lower marsh habitat (Amsberry et al., 2000).

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: *Phragmites* is capable of vigorous reproduction forming monospecific stands and newly opened sites may be colonized by seed (uncommon) or rhizome fragments carried by humans in soils or on machinery or naturally in floodwaters. Once *Phragmites* has colonized a site, new stands spread predominantly through vegetative reproduction rather than by seed (Hudon et al., 2005). *Phragmites* seeds are shed from November through January and so may be among the first propagules to reach certain sites. If the seeds germinate and become established the young plants will usually persist for at least two years in a small, rather inconspicuous stage, resembling many other grasses. Under favorable conditions, germination begins 1 day after sowing and may reach nearly 100 percent (Ekstam and Forseby, 1999). Later, perhaps after the input of nutrients, they may take off and assume the tall growth form that makes the species easily identifiable. *Phragmites* colonization typically is driven mainly be vegetative growth of rhizomes as seedlings are rarely observed in the field despite the annual flowering, large seed production, and germination potential. Alvarez et al. (2005) confirmed this attributing it to rare occurrence of the regeneration window of the reed, but found that when suitable conditions were created, reed could efficiently colonize empty space sexually by seedling establishment. Examining reedbed dynamics in a marsh in southern France over 25 years, Alvarez et al. (2005) determined reedbed dynamics were a combination of slow (long-term) vegetative growth (esp. during stable water levels) with a few phases of seedling establishment (esp. during spring drawdown events). Note that in most systems, spring drawdowns are very rare so sexual colonization during such times usually does not occur.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/B - HIGH/MODERATE SIGNIFICANCE

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COMMENTS: Invasive populations of *Phragmites* must be managed in order to protect rare plants that it might outcompete, valued animals whose habitat it might dominate and degrade, and healthy ecosystems that it might greatly alter. Areas invaded by *Phragmites* often have excellent potential for recovery but a combination of control measures is often necessary, such as spraying followed by burning followed by spraying over 3-5 years (Rice, 2005).
Various control measures (chemical- spraying, wicking, sulfide treatments; mechanical- water management, disking, bulldozing, dredging, seasonal mowing, cutting, plastic barriers, perimeter ditching, burning, shading; biological- various insects) have been reviewed and their merits and shortcomings outlined (see Czarapata, 2005; Perry and Stanhope, 2002; Marks et al., 2001; Norris et al., 2002). For most, management is difficult and time consuming often requiring repeated effort and a combination of different management actions. Some management actions utilized in the past have been shown to actually benefit renewed *Phragmites* growth and colonization. For example, common reed (*Phragmites australis*) comprised 91% of the biomass in a marsh along Lake Manitoba (Thompson and Shay, 1989). Portions of the marsh were burned by headfires in August at peak growth, in October after dormancy was established, or in May before growth began; and all three burn dates increased shoot density in the summer after the burns. Aboveground biomass of common reed declined on the summer burns, was unchanged by the fall burns, and was increased by the spring burning.

18. MINIMUM TIME COMMITMENT

B - MODERATE SIGNIFICANCE

COMMENTS: Areas invaded by *Phragmites* often have excellent potential for recovery but a combination of control measures is often necessary, such as spraying followed by burning followed by spraying over 3-5 years (Rice, 2005). Management programs have proven that *Phragmites* can be controlled, and natural vegetation will return. However, monitoring is imperative because *Phragmites* tends to reinvade and control techniques may need to be applied several times or, perhaps, in perpetuity. It is also important to note that some areas have been so heavily manipulated and degraded that it may be impossible to eliminate *Phragmites* from them. For example, it may be especially difficult to control *Phragmites* in freshwater impoundments that were previously salt marshes. For most, management is difficult and time consuming often requiring repeated effort and a combination of different managment actions. Some management actions utilized in the past have been shown to actually benefit renewed *Phragmites* growth and colonization (see Perry and Stanhope, 2002; Marks et al., 2001; Norris et al., 2002).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Various control measures (chemical- spraying, wicking, sulfide treatments; mechanical- water management, disking, bulldozing, dredging, seasonal mowing, cutting, plastic barriers, perimeter ditching, burning, shading; biological- various insects) have been reviewed and their merits and shortcomings outlined (see Czarapata, 2005; Perry and Stanhope, 2002; Marks et al., 2001; Norris et al., 2002). Impacts on native species vary by control measure but most impact non-target plant and animal species to varying degrees. For example, control by flooding followed by burning to remove will affect all species in an area. Using a wick applicator herbicide treatment is more appropriate in areas with native vegetation persisting within a common reed grass clone as it allows for selective treatment, particularly when colored dye is added to the herbicide (Czarapata, 2005). Biological control seems to have the most promising potential for *Phragmites* control as there are over 100 insect species known to attack *Phragmites* in Europe and about 50% of these are *Phragmites* specialists (Norris et al., 2002; Perry and Stanhope, 2002).

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20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: It appears most to all areas are easily accessible, as for most aquatic plants outside unusual habitats such as caves or high elevation streams or ponds. Because this species occurs in a wide variety of aquatic wetland habitats, some areas may have access problems.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Pinus sylvestris

ELEMENT NATIONAL ID: 237091
SCIENTIFIC NAME: *Pinus sylvestris*
COMMON NAME:
I-RANK REVIEW DATE: 2005-11-16
EVALUATOR: Gravuer, K.

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:
Pinus sylvestris is an important commercial species in the United States, being planted for Christmas trees (30% of the market), pulpwood, erosion control, windbreaks, and as an ornamental. It has been planted across the country for at least 130 years and has escaped and naturalized in the northeastern and lake states. The naturalized range is likely stable due to its long history of use. Where it does escape, it invades predominantly upland, relatively open areas, but has also been reported from several forest/woodland habitats and from forest edges. Primary impacts are on ecological community structure, where it can convert open habitats to woodlands. Management by girdling or shearing and herbiciding may require a reasonably long-term effort.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low/Insignificant

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Native to Europe and temperate Asia.
Temperate Asia: Turkey, Russian Federation - Eastern and Western Siberia, Kazakhstan, Mongolia, China - Heilongjiang, Jilin. Europe: Finland, Norway, Sweden, United Kingdom - Scotland, Austria, Czechoslovakia, Germany, Hungary, Poland, Switzerland, Belarus, Estonia, Latvia, Lithuania, Russian Federation - European part, Ukraine [incl. Krym], Albania, Bulgaria, Greece, Italy [n.], Romania, Yugoslavia, France, Spain. (GRIN 2001)

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

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COMMENTS: Pinus sylvestris invades predominantly upland, relatively open areas, such as fields, old fields, and lakeshores. It has also been reported from several forest/woodland habitats, including mostly relatively open woodlands, but also deciduous forests, mixed forests and mature conifer stands. In addition, it is often found on roadsides or upland forest edges (Sullivan 1993, Haines and Vining 1998, Rhoads and Block 2000, Wisconsin State Herbarium 2005).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C - LOW SIGNIFICANCE

COMMENTS: *Pinus sylvestris* trees generate significant litter (Gilman and Watson 1994). Because this species often invades open habitats which did not previously contain pine trees, this addition of litter likely alters nutrient cycling to some extent.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

A - HIGH SIGNIFICANCE

COMMENTS: This species is a large pine tree that predominantly invades relatively open areas. By converting previously open habitats to woodlands, it can cause substantial structural changes.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: When Scotch pine and native white pine (*Pinus strobus*) compete for establishment in a freshly disturbed area, the more aggressive early growth of Scotch pine gives it a competitive advantage, often allowing it to dominate the white pine (Skilling 1990). *Pinus sylvestris* trees also generate significant litter (Gilman and Watson 1994) and seedlings can form dense mats in some areas (Skilling 1990), which may affect regeneration or growth of other community components.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Impacts on white pine (*Pinus strobus*) were noted, in that when Scotch pine and white pine compete for establishment in a freshly disturbed area, the more aggressive early growth of Scotch pine gives it a competitive advantage, often allowing it to dominate the white pine (Skilling 1990). There were no other reports of impacts on particular native species.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: *Pinus sylvestris* invades predominantly upland, relatively open areas that often have experienced previous disturbance, such as fields, old fields, and roadsides (Sullivan 1993, Haines and Vining 1998, Rhoads and Block 2000, Wisconsin State Herbarium 2005). It can also invade woodlands and forests, but does not appear to threaten any rare types of these and often invades along disturbance corridors, such as trails or edges (Wisconsin State Herbarium 2005).

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SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: The current range includes the northeastern states (ME, VT, NH, MA, RI, CT, NY, PA, NJ, DE, MD), the lake states (OH, IN, IL, MI, WI, IA, MN) (Kartesz 1999), and Hawaii (Sullivan 1993, Swearingen 2005). This comprises about 20% of the land area of the contiguous U.S., but, as the species is sporadically established throughout this range (Gleason and Cronquist 1991), its actual range size is likely somewhat less.

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: In Wisconsin, where *P. sylvestris* has invaded several native forest types, the species has been designated ecologically invasive (Wisconsin State Herbarium 2005). Wisconsin represents approximately 10% of the current generalized range of the species. National Park Service surveys (Swearingen 2005) have found reports of invasiveness in approximately 50% of the species' range (HI, IA, MA, ME, NJ, NY, OH, PA, VT, WI), but this figure seems to conflict with local floras, which report it as only occasionally escaped from cultivation (Gleason and Cronquist 1991). Therefore, negative impacts on biodiversity likely occur in something between 10 and 50% of the range.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: Approximately 16 ecoregions are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Scotch pine prefers full sun and well-drained, somewhat acidic soil, and can grow on low-fertility, relatively dry sites. It invades predominantly upland, relatively open areas, such as fields, old fields, and lakeshores. It has also been reported from several forest/woodland habitats, including mostly relatively open woodlands, but also deciduous forests, mixed forests and mature conifer stands. In addition, it is often found on roadsides or upland forest edges (Sullivan 1993, Haines and Vining 1998, Rhoads and Block 2000, Wisconsin State Herbarium 2005).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

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COMMENTS: It is known that a Scotch pine plantation was planted in New York state as early as 1879, and some authors have speculated that the species was introduced earlier, perhaps even in colonial times (Skilling 1990). Therefore, it has been present for at least 130 years. It appears to have been planted throughout the country, including many apparently climatically suitable areas such as the Central States, the Pacific Northwest, and the northern Southeast (Skilling 1990, Redman 2003). One source indicated that economic use of the species may be declining due to pest problems such as the pine wilt nematode (Gilman and Watson 1994). The fact that it has not escaped into additional regions despite a history of plantings, and a possible decline in the future number of plantings, suggests that the naturalized range is likely stable.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Hardiness limits for this species have been assessed as zone 2 or 3 in the north, which should not restrict northward spread in the U.S., and as zone 7 or 8a in the south, which eliminates parts of the southern southeast, parts of the southern southwest (particularly in AZ), much of California, and potentially parts of the OR and WA coast (Gilman and Watson 1994, Redman 2003, Evans 2005). Precipitation should not present a major constraint, since the species adapted to dry habitats and occurs over a large precipitation range where it is native (GRIN 2001). Strictly in terms of climate, then, the species currently occupies approximately 20% of its potential range. However, given its history of planting in other apparently climatically suitable regions and its failure to escape there thus far, it may be restricted from these areas for other reasons (e.g. insufficient reproduction, Sullivan 1993), and the proportion currently occupied may in fact be higher.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: This species is readily commercially available (NRCS 2005), and is planted for Christmas trees (accounting for 30% of the 35 million Christmas trees harvested annually in the U.S.), pulpwood, erosion control, windbreaks, and as an ornamental across a variety of U.S. regions (Skilling 1990, Sullivan 1993, Gilman and Watson 1994). Its wind-dispersed seeds often land close to the parent tree (about 50-100 inches away), but dispersal distances of 1 km are not uncommon (Skilling 1990).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: In New England, it has been reported as spreading (Seymour 1989). However, as the species usually establishes by escaping from cultivation, the potential decline in its economic use in some regions due to pest problems (Gilman and Watson 1994) could reduce its potential for spread.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

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COMMENTS: This species was ranked 8th out of 12 known invasive (= known as spontaneously spreading on at least two continents) pine species for invasiveness based on its biological traits (mean seed mass, mean interval between large seed crops, and minimum juvenile period) (Rejmánek and Richardson 1996). All sources reported it as shade intolerant (Skilling 1990, Sullivan 1993, Gilman and Watson 1994, Simberloff et al. 2002, NRCS 2005), and it was noted that field germination is best under full or partial sunlight (Skilling 1990). It does invade forests (Wisconsin State Herbarium 2005), but usually does so by establishing in gaps, along trails, along edges, or following disturbance (Sullivan 1993).

15. SIMILAR HABITATS INVADED ELSEWHERE

B - MODERATE SIGNIFICANCE

COMMENTS: *P. sylvestris* also invades in Canada, New Zealand, Australia, Chile, and Argentina (Randall 2002, Richardson and Rejmánek 2004). Some sources report it as invasive in England and Ireland, but it may have once been native there and have become extirpated due to over-exploitation (Wikipedia contributors 2005). In general, it appears to invade similar habitats in these areas. However, in Ontario, it has been reported as invasive in bog habitats (CBCN no date, Richardson and Rejmánek 2004), which do not yet appear to be invaded in the U.S. In addition, if it is indeed exotic in England, the heathland habitats it is invading there (Sullivan 1993) do not yet appear to be invaded in the U.S.

16. REPRODUCTIVE CHARACTERISTICS

C - LOW SIGNIFICANCE

COMMENTS: *P. sylvestris* can attain reproductive maturity in 5 years, which is fairly rapid compared to other trees and has been mentioned as a factor contributing to its spread (Skilling 1990, Rejmánek and Richardson 1996). It also appears to have some resprouting ability (NRCS 2005), and a few sources noted high seed abundance or abundant reproduction (Skilling 1990, NRCS 2005).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Recommended control methods include girdling and shearing-herbiciding (CBCN, no date). In girdling, the bark and phloem layer is removed from a 10 cm band around trunk. Additional investment may be required if bark redevelops (CBCN, no date). In shearing and herbiciding, stems are cut with shears or a chain saw and herbicide is then applied with a squirt bottle. Additional monitoring and re-treatment is often necessary with this method (CBCN, no date).

18. MINIMUM TIME COMMITMENT

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: This species has only a transient seed bank (3-12 months), so persistence via resprouting from the seed bank should not be an issue (Peat and Fitter 2005). However, the follow-up treatment requiring for either the girdling or shearing-herbiciding technique may extend the treatment period beyond 2 years.

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19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Both girdling and shearing-herbiciding are fairly selective methods, so impacts on native should be low. Felling of trees as a result of these methods may to some extent mimic natural processes in forest environments, but may introduce a novel disturbance in more open habitats.

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Escape onto privately-owned lands may occur from plantations in a small number of cases. Other than this, given the habitats invaded, treatment should present no accessibility problems.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Poa trivialis

ELEMENT NATIONAL ID: 226850
SCIENTIFIC NAME: *Poa trivialis*
COMMON NAME:
I-RANK REVIEW DATE: 2006-06-28
EVALUATOR: K. Maybury

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:
This is a widespread weed of lawns/turfs and moist disturbed areas with little documentation of serious impacts to native species and ecosystems. It could easily be I-ranked 'Low' but there is some indication that it may be somewhat overlooked in terms of its impacts---or at least its presence--- in higher quality habitats, especially in portions of the eastern U.S. At this time, the calculated I-rank of Medium/Low seems appropriate.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Low

OTHER CONSIDERATIONS:
Additional information regarding impacts in natural habitats would be very useful.

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Europe (Hitchcock 1951).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS:

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes
COMMENTS:

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

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COMMENTS: No significant impacts reported. Lacks rhizomes and does not form sods as dense as does *Poa pratensis*, to which it is sometimes compared (Kemper Center, no date).

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No serious impacts reported. Lacks rhizomes and does not form sods as dense as does *Poa pratensis*, to which it is sometimes compared (Kemper Center, no date).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: Unknown but presumed not high as bluegrasses rarely produce pure stands (Alaska Natural Heritage Program 2005) and no evidence of significant impacts were found in the literature consulted.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No disproportionate impacts noted.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: In many floras and other sources *Poa trivialis* is reported from disturbed areas, waste places, and lawns (e.g., Hulten 1968, Hickman 1993) and there is a large body of information regarding this species in terms of it being an undesirable component of turf grasses for golf courses, etc. However, this may obscure the fact that this species also appears to be impacting higher quality habitats, at least in some areas. Heffernan et al. (2001) noted that that it occurred in 20 of 1994 vegetation plots (1 percent of plots) in Virginia where plot selection had been deliberately biased toward pristine vegetation. Its relatively high frequency in these plots is "certainly a warning sign" (Heffernan, pers. comm., 2006).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Naturalized throughout most of the U.S. with only Hawaii and a few southern states (and North Dakota) lacking confirmed reports (Kartesz 2006, unpublished data).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A - HIGH SIGNIFICANCE

COMMENTS: Some negative impacts assumed in at least 20 percent or more of the U.S. distribution. Possibly most negative impacts are in the Mid-Atlantic and lower New England? It is noted as being common in the Southeast by Weakley (2006) but "very local" in Michigan (Voss 1985), "uncommon" in Maine (Haines and Vining 1998), and generally much more sporadically distributed elsewhere according to county distribution information (Kartesz, 2006 unpublished data).

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8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS:

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Moist places, both open and shaded including meadows/praries, open woodlands, moist forests, bottomlands, disturbed sites (Hitchcock 1951, Hulten 1968, Voss 1985, Hickman 1993, Weakley 2006).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: This species is already occuring nearly throughout the generalized range and is assumed to be stable.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

D - INSIGNIFICANT

COMMENTS: Long planted (intentionally and unintentionally) as a turfgrass and now assumed to have occupied most of its potential range.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: This is widely sold and planted in seed mixes as a turfgrass for golf courses and other grassy areas. It is also a common contaminate of commercial grass seed in general (Liskey 1999). Dispersal by humans aside, this grass does not appear to have obvious adaptations for long-distance dispersal (Alaska Natural Heritage Program 2005).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: Unknown but presumed not expanding extremely rapidly.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Requires light to germinate (Froud-Williams and Ferris 1987 as cited in Alaska Natural Heritage Program 2005) and appears to require some level of substrate disturbance for successful invasion (Alaska Natural Heritage Program 2005).

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15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Naturalized in Australia (Weiller et al. 1995) and Canada (Kartesz 1999) but presumably in similar habitats.

16. REPRODUCTIVE CHARACTERISTICS

C - LOW SIGNIFICANCE

COMMENTS: Can produce over 1000 seeds per plant (Froud-Willaims and Ferris 1987 as cited in Alaska Natural Heritage Program 2005) but lacks the potential for aggressive spread by rhizomes that *Poa pratensis* has.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Unknown but assumed not insignficant.

18. MINIMUM TIME COMMITMENT

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Unknown but assumed not insignficant.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Most information on reducing or controlling this species is directed at lawn and turf situations were the only options are non-selective herbicides that kill all associated species as well (Liskey 1999). Presumably, in native grassland/forb situations a similar lack of options would exist. In other natural situations, control without damage to native species may be much easier.

20. ACCESSIBILITY OF INVADED AREAS

A - HIGH SIGNIFICANCE

COMMENTS: Widely planted on private lands.

REFERENCES:

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Invasive Species Assessment Protocol:
U.S. National Assessments

Polygonum aviculare

ELEMENT NATIONAL ID: 216467
SCIENTIFIC NAME: *Polygonum aviculare*
COMMON NAME:
I-RANK REVIEW DATE: 2006-01-11
EVALUATOR: K. Maybury

I-RANK: Low

I-RANK REASONS SUMMARY:
This species is extremely widespread and common but is almost wholly restricted to croplands, yards, and other highly disturbed sites; impacts on native biodiversity is farily minimal.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Europe (Agricultural Research Service 1970)

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS:

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes
COMMENTS:

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No evidence that it alters abiotic processes.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

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COMMENTS: A prostrate herb, but one that can grow in otherwise sparsely vegetated area such as very hard-packed ground; some changes in herbaceous-layer density possible.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: This very common ruderal species probably causes some reductions in common native species where it occurs.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No reports of disproportionate impacts.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Unlikely to impact rare natives or high quality ecological systems; found in heavily human-disturbed places. Considered an "obligate ruderal" (not a plant that can invade native grassland habitats) in Missouri by Ladd and Churchwell (1999). Noted as a species of compacted soils, such as pathways and sportsfields, in Virginia (Virginia Coop. Extension, no date). Haines and Vining (1998) described the habitat as "dooryards and sidewalks" in Maine. Similarly noted from cultivated fields and other "weedy" and disturbed places in the Great Plains (Great Plains Flora Association 1986), Kentucky (Jones 2005), Michigan (Voss 1985), and Florida (Wunderlin and Hansen 2003). In Hawaii, naturalized sparingly in pastures and other disturbed habitats (Wagner et al. 1990).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Throughout or virtually throughout (Agricultural Research Service 1970, Kartesz 1999, FNA 2005)

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A - HIGH SIGNIFICANCE

COMMENTS: At least some negative impacts assumed in most or the range.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS:

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

U - UNKNOWN

COMMENTS:

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SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: Already ubiquitous.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

D - INSIGNIFICANT

COMMENTS: Already ubiquitous.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: In Europe and Australia seeds frequently eaten by small birds (Weed ID / Management, no date; Rothamsted Research, no date) and undoubtedly that is the case in the U.S.

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: FNA (2005) notes that distribution is influenced greatly by humans. At least some local increases are expected given general increase in human-impacted habitats.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

D - INSIGNIFICANT

COMMENTS: This is a species of heavily human-disturbed habitats. Considered an "obligate ruderal" (not a plant that can invade native grassland habitats) in Missouri by Ladd and Churchwell (1999). Noted as a species of compacted soils, such as pathways and sportsfields, in Virginia (Virginia Coop. Extension, no date). Haines and Vining (1998) described the habitat as "dooryards and sidewalks" in Maine. Similarly noted from cultivated fields, gardens, yards, roadsides, and other "weedy" and disturbed places in the Great Plains (Great Plains Flora Association 1986), Kentucky (Jones 2005), Michigan (Voss 1985), and Florida (Wunderlin and Hansen 2003). In Hawaii, naturalized sparingly in pastures and other disturbed habitats (Wagner et al. 1990).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Has escaped in other areas (e.g., Australia) but presumably a ruderal species everywhere. In Australia it is a major weed of paddocks and pastures, and occasional in pavment cracks, roadsides, gardens, lawns (Weed ID / Management, no date).

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16. REPRODUCTIVE CHARACTERISTICS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Inferred.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

C - LOW SIGNIFICANCE

COMMENTS: Primarily managed in agricultural situations where some challenges have been documented. For example, wiry stems and small leaves provide little surface area for herbicide interception (Hager and Sprague 2001). Low stature probably also provides resistance to mowing as a control. However, outside of croplands, the assumption is that management efforts would only be warranted in certain rare situations where rare native species were being impacted.

18. MINIMUM TIME COMMITMENT

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Inferred.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Sources for management information are largely written for agricultural contexts and emphasize herbicide control. It is unclear if herbicides could effectively be spot applied in settings, such as roadsides and other rights-of-way, where native species may be present.

20. ACCESSIBILITY OF INVADED AREAS

A - HIGH SIGNIFICANCE

COMMENTS: Common in yards and other private areas and will reinfest.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Polygonum cuspidatum

ELEMENT NATIONAL ID: 205909
SCIENTIFIC NAME: *Polygonum cuspidatum*
COMMON NAME:
I-RANK REVIEW DATE: 2006-01-12
EVALUATOR: K. Maybury

I-RANK: High/Medium

I-RANK REASONS SUMMARY:
Polygunum cuspidatum is an extremely competitive and aggressive invader of significant riparian and wetland habitats, as well as lower-quality sites. Infestations can replace native species and degrade aquatic habitat. Once established, control can be labor-intensive.

SUBRANK I - ECOLOGICAL IMPACT:	High/Medium
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: China, Japan, Korea (IPANE, no date).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS:

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes
COMMENTS:

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

A/B - HIGH/MODERATE SIGNIFICANCE

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COMMENTS: Over the winter, the standing dead stems of this plant may create a fire hazard (Czarapata 2005; Adirondack Park Invasive Program, no date; Alaska Natural Heritage Program, no date). This material decomposes very slowly, and can form a deep soil organic layer (Alaska Natural Heritage Program, no date). Thickets can clog waterways causing local flooding (Czarapata 2005) and altering fish habitat (Alaska Natural Heritage Program, no date). The mass of dead stems may make the area more vulnerable to erosion as well as to flooding (Child et al. 1992 as cited in Shaw and Seiger 2002; Alaska Natural Heritage Program, no date). Flooding in turn spreds the plant by distributing stem and root pieces that can establish new colonies (K. Johnson, pers. comm. to B. Meyers-Rice, 2000; Shaw and Seiger 2002; Tu and Soll 2004; Adirondack Park Invasive Program, no date; Alaska Natural Heritage Program, no date).

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Forms dense, tall thickets, up to 10 feet in height (IPANE, no date); can become even taller in the Pacific Northwest, reaching 15 feet by June (Soll 2004, Tu and Soll 2004). Thickets can be so dense that human access to waterways can be severely impeded (Czarapata 2005; K. Sewak, pers. comm. to M. Esch, 2004).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A - HIGH SIGNIFICANCE

COMMENTS: This plant's early emergence in the spring, combined with extremely vigorous growth, allows it to shade out other vegetation and prevent regineration (Sukopp and Sukopp 1988 as cited in Seiger 1991; Soll 2004; Adirondack Park Invasive Program, no date). Forms nearly pure (monospecific) stands (Seiger 1991) and has displaced native flora in many riparian areas, e.g., along streambanks in western Pennsylvania (K. Sewak, pers. comm. to M. Esch, 2004).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

B - MODERATE SIGNIFICANCE

COMMENTS: In Alaska, reduces the food supply for juvenile salmon in the spring (Alaska Natural Heritage Program, no date). Hybridizes with other knotweeds. Zika and Jacobson (2003) pointed out that many formerly misidentified plants were actually hybrids of this species and another non-native, *Polygonum sachalinense*; the resulting hybrid is fertile (Bailey et al. 1996 as cited in FNA 2005).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Often found in disturbed sites and waste places (FNA 2005) but also a serious concern in high quality riparian areas and wetlands, e.g. in the Adirondacks (Adirondack Park Invasive Plant Program, no date; in Great Smoky Mountains National Park (K. Johnson, pers. comm. to B. Meyers-Rice, 2000); in the Tongass National Forest (Alaska Natural Heritage Program, no date); and in Oregon's Sandy River (Tu and Soll 2004). Tu and Soll (2004) note that the Sandy River provides habitat for federally listed steelhead trout and chinook salmon.

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SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Found in most of the eastern half of the U.S. and the West Coast (Alaska to California); some areas in the interior West (Kartesz 1999, FNA 2005).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A - HIGH SIGNIFICANCE

COMMENTS: Impacting the Northeast (IPANE, no date), Midwest (Czarapata 2005), Pacific Northwest (Soll 2004), and Alaska (Alaska Natural Heritage Program). A state noxious weed in California, Oregon, and Washington (Kartesz 1999). Apparently uncommon in parts of the Southeast (Weakley 2005) but still having negative impacts (a state noxious weed in North Carolina [Kartesz 1999]). Fewer serious impacts probable in the Great Plains and other parts of the interior West as escapes not reported common there and generally in roadside ditches, irrigation canals, etc. (Great Plains Flora Association 1986, Welsh et al. 2003).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: Based on widespread distribution.

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Varied habitats; tolerant of high temperatures, dry soil and salt (IPANE, no date). Tolerates a wide variety of soils and moisture conditions; found in riparian areas, pond edges, woodland edges, as well as roadsides and yards (Czarapata 2005).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Unknown but presumed not expanding extremely rapidly nor declining.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Inferred.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

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COMMENTS: In riparian areas, the plants fragment and are spread by flood waters to new areas (K. Johnson, pers. comm. to B. Meyers-Rice, 2000; Shaw and Seiger 2002; Tu and Soll 2004; Adirondack Park Invasive Program, no date; Alaska Natural Heritage Program, no date). Root fragments as small as 1/2 inch can establish new plants (Soll 2004). Dispersal across marine waters has been documented as well (Beerling et al. 1994). Although this speices lost favor as a landscaping plant by the early 1900s because of its invasive qualities (IPANE, no date), it is occassionally still planted for screening and erosion control (Czarapata 2005).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: In 1991 noted as spreading, particularly in the eastern U.S. (Seiger 1991). Degree of current spread uncertain.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: The degree of disturbance needed for establishment is somewhat unclear but most sources indicate that sunlight is critical. P. Dunwiddie (pers. comm. to B. Meyers-Rice, 1999) inidicated that it readily invades established vegetation of many sorts provided the area is reasonable sunny. Seiger (1991) says that it does not appear to be a threat in undisturbed forest and other low-light areas and notes that it requires high light conditions (effectively competing for light in these environments through early emergence in the spring and extremely rapid growth to great height). Alaska Natural Heritage Program (no date) indicates that this species can establish with little or no observable disturbance. However, Shaw and Seiger (2002) indicate that when the plants are found in interior forests, they represent colonies that established in sunlight and persisted as the forest canopy closed.

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: A major problem in the British Isles and Europe in riparian areas and wetlands (Beerling et al. 1994).

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: Grows faster than most other plant species---both natives and other exotics (Soll 2004), with growth rates exceeding 8 cm per day (Locandro 1973 as cited in Seiger 1991). Rhizomes can grow at least to 23 feet long and penetrate at least 7 feet into the soil (Soll 2004). Fragments easily during storms and fragments become established as new infestations (K. Johnson, pers. comm. to B. Meyers-Rice, 2000; Shaw and Seiger 2002; Tu and Soll 2004; Adirondack Park Invasive Program, no date; Alaska Natural Heritage Program, no date). Hybrid plants, at least, are fertile, so reproduction by seed can also occur.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A - HIGH SIGNIFICANCE

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COMMENTS: Difficult to eradicate or control once established. See Soll (2004) for a description of the extremely time-, labor-, and money-intensive processes needed for mechanical removal. Various herbicide and herbicide application techniques are also discussed by Soll (2004) but all involve trade-offs between time/money, degree of non-target damage, and efficacy. Some (stem injection of herbicides in particular) show promise but the author notes that this is time/labor intensive and that large patches will often require treatment with a combination of methods over several years.

18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS: Information based on Soll (2004): Large established patches will almost certainly require foliar herbicidal treatments over two or more years. Mechanical methods like cutting must be done assiduously over 3 consecutive field seasons. Injections of herbicide into the stems may control patches in only 1-2 treatments, although this is a labor-intensive process. A combination of treatments over several years may be needed.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Foliar herbicide application has a high risk of drift and is especially deliterious (and sometimes restricted) in riparian and wetland areas because of the risk to aquatic organisms. However, the stem-injection method and other direct-application methods will presumably be feasible in many of these situations and do not have this drawback.

20. ACCESSIBILITY OF INVADED AREAS

B - MODERATE SIGNIFICANCE

COMMENTS: Infestations are on private property although many landowners may be willing to cooperate in removal as this species is generally not planted any longer or viewed as desirable.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Polygonum perfoliatum

ELEMENT NATIONAL ID: 242948
SCIENTIFIC NAME: *Polygonum perfoliatum*
COMMON NAME:
I-RANK REVIEW DATE: 2006-01-05
EVALUATOR: Maybury, K.

CALCULATED I-RANK: Medium/Low
I-RANK: Medium

I-RANK ADJUSTMENT JUSTIFICATION:
This speices is often compared to kudzu, which is solidly ranked Medium. While at this time mile-a-minute weed is not nearly as widspread as kudzu in the U.S, it is rapidly spreading and could present as great a threat to native biodiversity as kudzu in the near- to medium-term. It is true that these assessments are designed to evaluate current impacts, but I am broadly interpreting "current" given the unknown frequency with which these assessments will be reevaluated and the rapidity with which this particular species is infesting new areas.

I-RANK REASONS SUMMARY:
This agressive vine spread rapidly from its initial introduction site in the 1930s and is continuing to expand its range. It primarily infests relatively low quality disturbed habitats but also may threaten some rare species and higher quality native habitats. Large infestations can essentially outcompete, cover, and smother all vegetation below.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low

OTHER CONSIDERATIONS:
See Kumar and DiTommaso (2005) for a general review of the key aspects of the history, biology, impact, and managment of this plant.

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: From India to eastern Asia including islands from Japan to the Philippines; primarily in temperate areas (Mountain 1995).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS:

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S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS:

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No reports of significant changes in abiotic processes found.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

A - HIGH SIGNIFICANCE

COMMENTS: In more open areas and forest edges this vine can form a dense mat that covers everything, including small trees (Wu et al. 2002).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Large infestations can cover and block light from all plants below, weakening and eventually killing them; will eventually reduce native plant species in natural areas (Gerlach Okay 2005). Overgrows and outcomptetes native vegetation (Oliver and Coile 1994; IPANE, not dated).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No reports of disproportionate impacts on a particular species found.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: This species is commonly found in roadsides, ditches, rights-of-way, vacant lots, clearcuts and young tree farms, and other disturbed habitats (Gerlach Okay 2005'; Weakley 2005; IPANE, not dated). It may also be found in wet meadows that may support rare wetland plants (DCR and VNPS, not dated) and in natural riparian and floodplain areas (Wu et al. 2002, Gerlach Okay 2005). Fire-adapted rare native plants that have remnant populations in rights-of-way and other areas that mimic natural disturbance could be at risk.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Currently escaped in the East from Virginia north to Rhode Island and west to Ohio. Oregon report is historic (long since eradicated). Reports from Mississippi are erroneous (Heather Sullivan, pers. comm.); apparently based on a SIDA paper reporting on the "Mississippi Drainage."

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7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A - HIGH SIGNIFICANCE

COMMENTS: At least some negative impacts assumed everywhere.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

C - LOW SIGNIFICANCE

COMMENTS: Eight to twelve ecoregions estimated.

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Inferred.

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Since it escaped a nursery in York County, PA the 1930s, this species has been steadily expanding its range (Oliver and Coile 1994, Mountain 1995, Gerlach Okay 2005) and there is no reason to assume range expansion is not continuing. It has so far expanded 300 miles out from its initial escape (Gerlach Okay 2005).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

B - MODERATE SIGNIFICANCE

COMMENTS: Gerlach Okay (2005) estimates that the current range is only about 20 percent of the estimated possible range for this species. In its native range it is widely distributed but is primarily a temperate species: Wu et al. (2002) note that it is distributed widely in southern China, becomes less frequent in northern China, and is found, but is not abundant in, tropical areas. The plant is a tender annual and dies at the first frost but has seeds that must undergo a minimum 8 week period of temperatures 10 degrees C or below in order to break dormancy and germinate (Gerlach Okay 2005); however, in milder areas in Asia, this species is observed to act as a perennial, persisting all year (Wu et al. 2002). Mountain (1995) indicates a "subarctic to subtropical" range. According to Gerlach Okay (2005) the species demonstrates a preference for high soil moisture (although it can survive "relatively low" soil moisture levels) and can grow in extremely wet areas. Similarly, DCR and VNPS (not dated) note that it generally grows in areas with an abundance of leaf litter which keeps the soil moist and may aid in germination. Given these temperature and moisture paramenters, it seems likely that the species could easily spread into much of the southeastern U.S., as well as farther into the Midwest and New England. Some riparian areas in the West could conceivably be at risk as well.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Birds can disperse the seeds moderately long distances as can water (fruit can remail buoyant for 7-9 days per Gerlach Okay [2005]). Seeds are also inadvertently transported in nursery stock (e.g., IPANE, not dated).

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13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A - HIGH SIGNIFICANCE

COMMENTS: Many sources note that this species is spreading rapidly (e.g., Hartwig 1995, Weakley 2005).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: Generally colonizes open, disturbed areas (e.g., Wu et al. 2002, Gerlach Okay 2005). Light---at least 63% of the available sunlight---is required for this species to successfully colonize a site (Okay 2005). Areas that have "little canopy cover, sparse vegetation, a good moisture regime, a protective leaf mulch, and continual disturbance... are vulnerable" (Gerlach Okay 1995).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Introduced into Turkey (Guner 1984 as cited in Mountain 1995) but assumption is that habitat(s) invaded is similar.

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: Extremely agressive with many ruderal characteristics. Prolific seed production (not quantified) over a long season (Gerlach Okay 2005) and seeds remain viable for as long as 4 years (Johnson 1996 as cited in Wu et al. 2002). As the common name indicates, has a very fast growth rate, widely estimated a 6 inches per day. Can reach reproductive maturity very early in the season and can alter the allocation of energy from vegetative growth to earlier reproduction when intraspecific competition is high (Gerlach Okay 1995).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Plants have a shallow root system and can be hand-pulled (using protective clothing to avoid the recurved barbs) (Gerlach Okay 2005; DCR and VNPS, not dated). Repeated mowing or cultivation can also prevent seed set (Okay 2005). Herbicides with a surfactant can be repeatedly applied where necessary (see Gerlach Okay 2005).

18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS: If plants were ever allowed to set seed, seed is said to remain viable for up to 4 years (Johnson 1996 as cited in Wu et al. 2002) and new plants should be assiduously looked for and removed each year prior to reproductive maturity.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

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COMMENTS: If glyphosphate is resorted to, as recomended by some, this non-selective herbicide will affect all vegetation tangled up with mile-a-minute vine (DCR and VNPS, not dated). However, less harmful herbicidal soaps can be effective if reapplied throughout the growing season (Gerlach Okay 2005).

20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: Accessibility issues assumed to be reasonably low. Even on private lands, few would want this unattractive, skin-shredding weed to spread and would presumably take steps to eradicate it. Tree farms, young forest plantations, orchards, and and areas where reforestation/restoration is taking place are especially at risk and would presumably agressively combat any infestation.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Populus nigra

ELEMENT NATIONAL ID: 218017
SCIENTIFIC NAME: *Populus nigra*
COMMON NAME:
I-RANK REVIEW DATE: 2006-03-14
EVALUATOR: K. Maybury

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:
Widely planted and long-persisting where planted due to vigorous sprouting, but not invading except in very localized areas.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low/Insignificant

OTHER CONSIDERATIONS:
Nearly all the naturalized North American material of *Populus nigra,* the European black poplar, is called *Populus nigra* var. *italica* but is perhaps better treated taxonomically as a cultivar [Populus nigra 'Italica'], since it represents a one-time variant (with columnar growth form) of the species, found as a single tree in the Lombardy region of Italy several centuries ago, and propagated as cuttings. Exclusive of this Lombardy mutant, the European black poplar is very rarely cultivated in North America, but nonetheless has been reported as an escape at least in Pennsylvania (L. Morse, pers. comm., 2006).

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Europe

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS:

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes
COMMENTS:

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C - LOW SIGNIFICANCE

COMMENTS: No evidence of significant alterations in most systems; some disruption of natural dune migration in Michigan is possible as exotic plants in general in these areas have caused dune stabilization (Albert 1999).

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: This tree suckers freely from the base and roots and so can persist near where it is planted but it does not produce seeds and cannot "migrate" to establish itself elsewhere (Little 1979, Gilman and Watson 1994). Therefore, it is unlikely that it has much impact on the structure of native vegetation. An exception may be in some dune systems, at least in Michigan (Albert 1999, Choberka et al. 2001), but as this species is probably persisting and spreading from residential development---allowed only on the forested portions of the dunes---it is unlikey that its presence represents substantial changes in vegetation structure. In dune systems on Long Island, in contrast, *Populus nigra* does not seem to have become widely established (E. Lamont, pers. comm. to L. Morse 2006).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: As this species is mainly persisting from former cultivation significant alterations in composition are not expected.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No disporportionate impacts reported; however, intraspecific hybridization is possible between *P. nigra* and the native *P. deltoides* at least in controlled conditions. In Europe, introgression of genes from the hybrid (*P. x canadensis* or *P. x euramericana*), and from *P. nigra* var. *italica,* into their native stands of pure *P. nigra* is of concern (see Van den Broeck et al. 2001, Benetka et al. 2002) but it is unclear whether any spontaneous crossing of European material with native poplar in the U.S. has occurred.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C - LOW SIGNIFICANCE

COMMENTS: Typically this species becomes established only locally where planted at homesites and along roadsides (Little 1979). However, It has established due to residential development on dune systems in the Great Lakes, which provide habitat for several animals and plants of conservation significance such as piping plover (*Charadrius melodus*) and Pitcher's thistle (*Cirsium pitcher*i) (Albert 1999).

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SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: The generalized range includes most of the United States (Kartesz 1999).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C - LOW SIGNIFICANCE

COMMENTS: Established outside of cultivation in extremely spotty, localized areas; most common in New England and the Midwest (J. Kartesz, draft county distribution data, 2006). Apparently seriously impacting biodiversity only in a few areas such as the Great Lakes dunes system.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS:

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Coastal dunes, roadsides/urban areas, persisting at old homesites, windbreaks (Little, 1979, Voss 1985, Albert 1999).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: Generalized range is already nearly throughout.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

D - INSIGNIFICANT

COMMENTS: Generalized range is already nearly throughout.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Still widely sold and planted despite being prone to disease and very short-lived. Once planted, poplar sprouts can be long persisting but will rarely spread beyond the immediate vicinity (Little 1979). The Lombardy cultivar is all-male; seeds are not produced (Little 1979).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

U - UNKNOWN

COMMENTS:

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14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

D - INSIGNIFICANT

COMMENTS: Primarily persists from former cultivation and does not spread significantly on its own (see Little 1979, Great Plains Flora Association 1986).

15. SIMILAR HABITATS INVADED ELSEWHERE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Escaped in riparian areas in South Africa (Nel et al. 2004) Also escaped in Canada (Kartesz 1999) and in Australia (Australian Weeds Committee 2003), presumably in similar habitats.

16. REPRODUCTIVE CHARACTERISTICS

C - LOW SIGNIFICANCE

COMMENTS: Agressive and prolific resprouter but otherwise not reproductively aggressive. All male; no seeds produced.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Inferred. Several online gardening discussion pages are devoted to killing the the root system of this tree to stop the constant resprouting. Most indicate that herbicide applied to freshly cut stumps, plus treating the suckers as they appear will work with repeat applications usually necessary. Removing the bark and cambium from a 2" circumference of the tree or other types of girdling is also recomended.

18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS: Inferred.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

D - INSIGNIFICANT

COMMENTS: Selective herbicide application should not harm nearby vegetation.

20. ACCESSIBILITY OF INVADED AREAS

A - HIGH SIGNIFICANCE

COMMENTS: Still widely planted on private lands despite advice against it from most gardening experts. Eradication from non-private lands should pose few accessibility problems, however.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Pueraria montana

ELEMENT NATIONAL ID: 241913
SCIENTIFIC NAME: *Pueraria montana*
COMMON NAME:
I-RANK REVIEW DATE: 2004-03-28
EVALUATOR: Lu, S.

I-RANK: Medium

I-RANK REASONS SUMMARY:
This species is notorious for forming dense canopies that smother and shade out all vegetation underneath it. It also fixes nitrogen, and therefore may alter nutrient dynamics. Although widespread throughout southeastern U.S., and also found in parts of the northeast and in Hawaii, kudzu is rarely significant in areas of high conservation value. It is typically but, not exclusively, found in low quality disturbed areas, such as roadsides and abandoned fields. Its impacts in natural riparian areas, forest edges, and its ability to spread into areas such as the Everglades should continue to be monitored. Kudzu's ability to spread is currentlly somewhat limited by lack of pollinators. This species is very hard to manage, but repeated herbicide application or mechanical controls can control it.

SUBRANK I - ECOLOGICAL IMPACT:	Medium
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Low

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Native to southeastern Asia from India, China, and Japan, perhaps also Malesia (Starr et al. 1999).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Invades natural areas in Florida (Langeland and Craddock Burks 1998).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Fixes nitrogen (Weber 2003).

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

A - HIGH SIGNIFICANCE

COMMENTS: Forms mats that may be more than 2 m thick (Weber 2003). Blankets trees with a dense canopy through which little light can penetrate (Van Driesche et al. 2002).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A - HIGH SIGNIFICANCE

COMMENTS: Can quickly cover shrubs and trees with a dense tangle of stems, smothering and shading out the other vegetation. Able to smother trees up to 35 m tall. (Weber 2003) Kills or degrades other plants by smothering them under a solid blanket of leaves, girdling woody stems and tree trunks, and breaking branches or uprooting entire trees and shrubs through the sheer force of its weight (Bergmann and Swearingen 1997).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No reported impacts.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C - LOW SIGNIFICANCE

COMMENTS: Usually inhabits low quality disturbed areas, such as forest edges, abandoned fields, roadsides, and disturbed areas where sunlight is abundant (Bergmann and Swearingen 1997). It is found in many old, collapsed southern homesteads, in ravines, in former cotton fields and pasture lands (Van Driesche et al. 2002), agricultural areas, disturbed areas, planted forests, and urban areas (ISSG 2004). However, it also impacts natural riparian areas, natural forests, range/grasslands, scrub/shrublands (ISSG 2004).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Common throughout the southeastern US and has been found as far north as Pennsylvania (Bergmann and Swearingen 1997). Rarely occurs in the northeastern US, but is occasionally found from Connecticut to Illinois. (Van Driesche et al. 2002) Estimated to infest at least two million acres in the eastern US (ISSG 2004). Recently found in southern Florida where it has begun to invade the Everglades (VNPS and VDCR 2003).

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7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A - HIGH SIGNIFICANCE

COMMENTS: The most severe infestations occur in the piedmont regions of Mississippi, Alabama, and Georgia (Van Driesche et al. 2002). Extremely invasive in the southeastern US (Starr et al. 1999). Recently found in South Florida where it has begun to invade the Everglades (VNPS and VDCR 2003).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: Established in at least 35 TNC ecoregions (Inference using data from Kartesz 1999 and TNC Ecoregion 2001 map).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Invades riparian habitats, forest edges, and woodland (Weber 2003). Preferred habitats include forest edges, abandoned fields, roadsides, and disturbed areas where sunlight is abundant (Bergmann and Swearingen 1997). Found in many old, collapsed southern homesteads, in ravines, in former cotton fields and pasture lands (Van Driesche et al. 2002). Infests natural forests, range/grasslands, riparian zones, scrub/shrublands, agricultural areas, disturbed areas, planted forests, and urban areas (ISSG 2004).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Most spread is slow (Van Driesche et al. 2002). Introduced into the US in 1976, planted by farmers to control erosion from 1935 to the mid-1950s, and the Civilian Conservation Corps planted it widely for many years. USDA recognized this plant as a pest weed in 1953 and removed it from its list of permissable cover plants. (Bergmann and Swearingen 1997) Kudzu colonies in southern Illinois were found producing large numbers of viable seed in the summer of 1997. If kudzu begin to seed more often, it could begin to spread much more rapidly (Starr et al. 1999).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: May spread further in New England (Mehrhoff et al. 2003). Grows well under a wide range of conditions and in most soil types. Grows best where winters are mild, summer temperatures are above 80 degrees F, and annual rainfall is 40 inches or more. (Bergmann and Swearingen 1997) Inhabits temperate zones or higher altitudes in the tropics, and can be found growing in almost all eco-types from the dryest flatwoods to the margins of permanent bodies of water, but not in periodically flooded soils (ISSG 2004).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B - MODERATE SIGNIFICANCE

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COMMENTS: Seeds are dispersed by birds and mammals (Weber 2003). Slow spread through local movement of infested soil (Van Driesche et al. 2002). Long-distance dispersal mechanisms include internet sales and road vehicles, while local dispersal includes translocation of machinery, road vehicles, digest/excretion, and water currents (ISSG 2004).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B - MODERATE SIGNIFICANCE

COMMENTS: Recently found in southern Florida where it has begun to invade the Everglades (VNPS and VDCR 2003). In Maui, should kudzu begin to set seed, it could begin to spread much more rapidly (Starr et al. 1999).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: Mostly invades habitats with disturbance. Invades riparian habitats, forest edges, and woodland (Weber 2003). Preferred habitats include forest edges, abandoned fields, roadsides, and disturbed areas where sunlight is abundant (Bergmann and Swearingen 1997). Because it was formerly planted as an ornamental and for erosion control, it is now found in many old, collapsed southern homesteads, and in ravines (Van Driesche et al. 2002). Infests natural forests, range/grasslands, riparian zones, scrub/shrublands, agricultural areas, disturbed areas, planted forests, and urban areas (ISSG 2004).

15. SIMILAR HABITATS INVADED ELSEWHERE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Invasive in southern Europe, southern Africa, and Mexico (Weber 2003). Established as a non-native in Australia, South America, and Switzerland, however only considered a serious pest in the US (Van Driesche et al. 2002).

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: Fast-growing, stems easily root at nodes, resprouts when cut (Weber 2003). Grows rapidly (about one foot a day), spreads mainly by vegetative growth, but does have some seed spread in areas where a pollinator, the giant resin bee, occurs. (Bergmann and Swearingen 1997; Swearingen et al. 2002) Seeds are low in viability (ISSG 2004). Kudzu colonies in southern Illinois were found producing large numbers of viable seed in the summer of 1997 (Starr et al. 1999).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B - MODERATE SIGNIFICANCE

COMMENTS: Once established, this plant is difficult to control. Control includes grazing by goats, persistent weeding or mowing, and chemical control. (Weber 2003) To control this species, the extensive root system must be destroyed and no root crowns left. This can be accomplished through using systemic herbicides, cutting vines, or close mowing every month for two growing seasons (Bergmann and Swearingen 1997; Swearingen et al. 2002). Also can be controlled by flaming to defoliate the plant (Starr et al. 1999).

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18. MINIMUM TIME COMMITMENT

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Can take up to ten years to control well-established stands of this plant. Herbicide use can take up to five years to control this plant. (VNPS and VDCR 2003). Close mowing every month for two growing seasons can also control this plant (Bergmann and Swearingen 1997).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Glyphosphate is the recommended herbicide to control kudzu, however it is non-selective and may harm native plants if not applied carefully (VNPS and VDCR 2003).

20. ACCESSIBILITY OF INVADED AREAS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Difficult access in some areas.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Robinia pseudoacacia

ELEMENT NATIONAL ID: 211424
SCIENTIFIC NAME: *Robinia pseudoacacia*
COMMON NAME:
I-RANK REVIEW DATE: 2006-03-22
EVALUATOR: K. Maybury

I-RANK: High/Medium

I-RANK REASONS SUMMARY:
This is often a species of low-quality disturbed sites but it also invades some important, high-quality prairie and savanna ecosystems where it can significantly alter community structure and species composition. In addition, its ability to fix nitrogen may have significant impacts on some ecosystems, including facilitating invasion by other non-native species. The legacy of these impacts may persist, even long after the locust trees have been removed. Removal is considered difficult, with monitoring and re-treatment over several years necessary.

SUBRANK I - ECOLOGICAL IMPACT:	High/Medium
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium

NATIVE AND NON-NATIVE IN NATION
NATIVE RANGE: Although the exact native range cannot be determined (Isley 1998), most sources consider this species native to the central and southern Appalachians and the Ozarks.

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS: Widely established in the U.S. outside its native range.

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes
COMMENTS:

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

A - HIGH SIGNIFICANCE

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COMMENTS: This is a nitrogen-fixing species that may have long-persisting effects on some ecosystems. In Massachusetts, in a nutrient-limited and generally invasion-resistant landscape, this species has been found to facilitate invasion by other non-native plants, probably through increasing soil nitrogen (Von Holle et al. 2005). Further, elevated soil nitrogen, especially ammonium, has been found to continue for many years after the locust trees are removed (Von Holle 2005). These former locust stands (now generally with native black cherry in the overstory) continue to have higher non-native species richness than native pine-oak stands in the same area (Von Holle 2005). Where black locust has shaded out (eliminated) the ground layer vegetation, fire regimes may also be altered (Wieseler 2005).

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

A - HIGH SIGNIFICANCE

COMMENTS: This species can form dense stands of trees in areas that were formerly prairie or savanna (Converse 1984). Dense stands of locust can create shaded 'islands' with little ground vegetation (Wieseler 2005).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B - MODERATE SIGNIFICANCE

COMMENTS: The dense clonal stands that this species forms can be harmful to native plants as they shade out most understory vegetation (Wisconsin DNR 2004, Wieseler 2005); forms single-species stands (Minnesota DNR 2006). May also significantly influence the insect community: fewer arthropod speices were found on *Robinia pseudoacacia* than on a native locust, *Robinia neomexicana*, in a 2-year study in Arizona, and only 12 species (out of 251 found on the native) were also found on *Robinia pseudoacacia* (Degomez and Wagner 2001).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: The fragrant blossoms may compete with native plants for pollinating bees (Wieseler 2005).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Although this species is very commonly associated with low-quality disturbed habitats (degraded woodlots, roadsides, etc.), it poses a serious threat to high quality prairie and oak savanna ecosystems in the Midwest (Converse 1984, Wieseler 2005). These systems have been dramatically reduced in size and the remaining fragments are endangered (Wieseler 2005). It was also one of several species listed as a severe threat to a unique and very high quality native floodplain woodland in California (Meyers-Rice 2001). Wieseler (2005) notes: "black locust clones easily spread in [good] quality and restorable natural areas."

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Established widely outside of its native range per Kartesz (1999).

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7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B - MODERATE SIGNIFICANCE

COMMENTS: Uncommon in parts of the West, especially the Great Plains (Isely 1998, Kartesz 2006 draft county distribution data) and perhaps not problematic there, but with some negative impacts assumed in most of the non-native range.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS:

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Dry, upland prairies, sand prairies, oak savannas (Converse 1984, Wisconsin DNR 2004, Minnesota DNR 2006), as well as disturbed areas such as degraded woods/woodlots, woodland margins pastures, old fields, roadsides, urban areas (Isely 1998, Wisconsin DNR 2004, Minnesota DNR 2006).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: Inferred; already widespread in terms of generalized range.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

D - INSIGNIFICANT

COMMENTS: Inferred.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Formerly sold and planted extensively and still used for erosion control, mine reclamation, etc.

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: Unknown, but there is no reason to think that extreme increases are occurring. Significant declines in landcover over the last 30 years were documented on Cape Cod (Von Holle 2005) but many areas are probably experiencing increases simply due to increased human disturbance.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

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COMMENTS: This is an early successional species (Wieseler 2005). It does not grow well in competition with other plants (trees, vines, or grasses) and some plantings have failed in grassy areas because of competing grasses (Converse 1984). However, this species can invade *undisturbed* sand prairies (Anderson and Brown 1980 as cited in Converse 1984; R. Henderson, pers. comm. to C. Converse 1984), which are somewhat dry and open. It may be able to invade these dry prairies and savannas as its extensive root system allows it to tolerate dry sites and it grows vigorously in full sun where herbaceous vegetation is sparse (Converse 1984).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: This is a problematic plant in woodlands in many countries (Sabo 2000). It has naturalized in disturbed lands, grasslands, and woodlands in Europe (Sabo 2000; Weeds Australia, not dated) and in Australia (Weeds Australia, not dated).

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: Stongly exhibits two characteristics typical of invasive plant species:
1. Vegetative reproduction via root suckering and stump sprouting is vigorous (Wisconsin DNR 2004, Minnesota DNR 2006).
2. Early height growth exceeds that of most other trees, and can average as much as 4 feet per year on good sites (Converse 1984). (Although this species produces copius seeds these do not readily germinate without disturbance that penetrates the thick seed coat [Wisconsin DNR 2004] so the high seed production was not considered.)

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B - MODERATE SIGNIFICANCE

COMMENTS: This species is generally considered fairly difficult to manage once established. Chemical, rather than mechanical, controls are needed (see Wisconsin DNR 2004).

18. MINIMUM TIME COMMITMENT

B - MODERATE SIGNIFICANCE

COMMENTS: Plants apparently killed by herbicide can resprout several years after treatment (R. Henderson, pers. comm. to C. Converse, 1984, Wieseler 2005).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Foliar spray can be used on small, low patches of trees (Wisconsin DNR 2004) but there is the potential for non-target damage. Even basal stem application of herbicide to individual trees can be somewhat harmful as the chemicals need to be disolved in substances that release volatile organic compounds into the atmosphere (Wisconsin DNR 2004).

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20. ACCESSIBILITY OF INVADED AREAS

B - MODERATE SIGNIFICANCE

COMMENTS: There are many plantings on private lands.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Rorippa sylvestris

ELEMENT NATIONAL ID: 224521
SCIENTIFIC NAME: *Rorippa sylvestris*
COMMON NAME: Creeping Yellowcress
I-RANK REVIEW DATE: 2006-06-27
EVALUATOR: J. Cordeiro, rev. K. Gravuer

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:
In and of itself, this species does not appear to have highly significant impacts, although it is expanding and becoming more noxious in the northeast (e.g. Hudson River basin) as well as in the Great Lakes where it is considered an invasive aquatic species in some areas. Recently, the species has begun showing up in the Pacific northwest as well. In Germany, native *Rorippa sylvestris* hybridizes with non-native *R. austriaca*, forming *Rorippa* x *armoracioides* hybrids which appear to be more competitive/invasive than either of the parent species. Although both parents are present in the US and are likely to hybridize where they form contact zones, this potentially invasive hybrid has not yet been confirmed present. Management of *R. sylvestris* is possible by hand-removal several times a year.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Low

OTHER CONSIDERATIONS:
Particularly invasive crosses between *Rorippa sylvestris* and *Rorippa austriaca*, termed *Rorippa* x *armoracioides*, have been found at several sites in northern Germany and the Netherlands, particularly in areas where the putative parent species are absent, leading to the hypothesis that hybridization may play an important role in invasiveness in *Rorippa* (Bleeker, 2003; 2005; in press; Hurka et al., 2003). This new, much more invasive taxon has not been confirmed as present in the United States but no studies have yet been undertaken on existing *R. sylvestris* and *R. austriaca* populations and these two species are likely to hybridize wherever they form contact zones. *R. sylvestris* is also highly self-incompatible. Natural populations of self-incompatible *Rorippa* species are often characterized by a low seed set and may be vulnerable to hybridization with much more invasive species of *Rorippa* if they occur together (Bleeker, 2005; in press). For example, a single individual of *Rorippa austriaca* invading a large clone of *R. sylvestris* would result in the intraspecific *R. sylvestris* being unable to compete with the interspecific *R. austriaca* pollen and also vice versa since *R. austriaca* is a self-incompatible species too. This could lead to a potentially highly invasive hybrid (see Bleeker, in press).

NON-NATIVE THROUGHOUT NATION

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NATIVE RANGE: This species is native to Europe (Crow and Hellquist, 2000; Murley, 1951). USDA ARS (National Genetic Resources Program) cites native range as western Asia, Caucasus, Northern Europe, Middle Europe, east Europe, East Europe, Southeastern Europe, Southwestern Europe.

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species is now found as an invasive throughout most U.S. states (USDA, 2006). It has been in the U.S. since about 1818 (Elmore, 1998).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: This species is now found as an invasive throughout most U.S. states (USDA, 2006). It has become more common in ornamental plantings over the years and has spread widely since introduction, probably through repeated introductions (Elmore, 1998).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No reports of impacts on ecosystem processes or system-wide parameters were found. Therefore, assume impacts are relatively insignificant.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B - MODERATE SIGNIFICANCE

COMMENTS: Rhizomes can create a thick mat of weed which completely smothers pasture and low-lying side rivers. Similar creeping rhizomous mats have been found in California and the Pacific northwest where it has been determined that this species has the potential to become a serious weed in greenhouse, container and field ornamentals (Elmore, 1998). A related species (*Rorippa nasturtium-aquaticum*; syn. *Nasturtium officinale*), like other *Rorippa* species, forms dense, tangled masses of stems and intertwining rhizomes floating in water or creeping over mud; rooted at several points, that may be several yards long (Czarapata, 2005). See Proportion Having Negative Impacts section for information on a particularly invasive hybrid, *Rorippa* x *armoracioides*, not yet found in the United States with large-scale invasiveness impacts.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Rhizomes can create a thick mat of weed which completely smothers pasture and low-lying side rivers. Similar creeping rhizomous mats have been found in California and the Pacific northwest where it has been determined that this species has the potential to become a serious weed in greenhouse, container and field ornamentals (Elmore, 1998). Creeping weed mats have also been found in select areas of the northeast where Rorippa sylvestris is considered somewhat invasive (Uva et al., 1997), such as the Hudson River basin (Mills et al., 1997). See Proportion Having Negative Impacts section for information on a particularly invasive hybrid, *Rorippa* x *armoracioides*, not yet found in the United States with large-scale invasiveness impacts.

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4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species were found in the literature. However, this species appears to hybridize easily with at least one other *Rorippa* species in Europe (Bleeker, 2003; 2005; in press; Hurka et al., 2003), so it may have the potential to impact native US *Rorippa*. See Proportion Having Negative Impacts section for information on a particularly invasive hybrid, *Rorippa* x *armoracioides*, not yet found in the United States with large-scale invasiveness impacts.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Crow and Hellquist (2000) list habitat as wet meadows, shores, and roadsides. In the Hudson River basin, it grows in low grounds, waste places, meadows, shores, and along roadsides (Mills et al., 1997). See Proportion Having Negative Impacts section for information on a particularly invasive hybrid, *Rorippa* x *armoracioides,* not yet found in the United States with large-scale invasiveness impacts.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: This species is now found as an invasive throughout most U.S. states (USDA, 2006; Crow and Hellquist, 2000). Notable exceptions include Texas, Oklahoma, Florida, Georgia, South Carolina, Nevada, South Dakota, and Wyoming, although this may reflect inadequate sampling effort (USDA, 2006).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C - LOW SIGNIFICANCE

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COMMENTS: Particularly invasive crosses between *Rorippa sylvestris* and *Rorippa austriaca*, termed *Rorippa* x *armoracioides*, have been found at several sites in northern Germany and the Netherlands, particularly in areas where the putative parent species are absent, leading to the hypothesis that hybridization may play an important role in invasiveness in *Rorippa* (Bleeker, 2003; 2005; in press; Hurka et al., 2003). Natural populations of self-incompatible *Rorippa* species are often characterized by a low seed set and may be vulnerable to hybridization with much more invasive species of *Rorippa* if they occur together (Bleeker, 2005; in press). *Rorippa* x *armoracioides* has been found to outcompete native *R. sylvestris* in Germany in part because *R. sylvestris* allocates higher amounts of assimilates to the below ground organs reducing assimilation area in compared to the hybrid (Bleeker, 2005) and also because molecular diversity and seed set was high for the hybrid but very low outside the hybrid zone (Bleeker, in press). This is particularly true in environments where hybrid parents suffer from suboptimal habitat conditions (i.e. edge effect areas, disturbed areas). Outcome of hybridization in central Europe may largely be determined by ploidy level of the hybridizing *R. sylvestris*, which may be tetraploid, hexaploid, and rarely pentaploid (Bleeker and Matthies, 2005). This new, much more invasive taxon has not been confirmed as present in the United States but no studies have yet been undertaken on existing *R. sylvestris* and *R. austriaca* populations and these two species are likely to hybridize wherever they form contact zones. Currently, *R. sylvestris* is spreading and becoming increasingly important as a noxious exotic in the northeast (Uva et al., 1997). It was first recorded in the Hudson River basin in 1896 and is considered an invasive aquatic species there (Mills et al., 1997).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: It is conservatively estimated that more than half of the 81 ecoregions have been invaded by *Rorippa sylvestris* in the United States (Cordeiro, pers. obs., June 2006, based on TNC, 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: This species occurs along river embankments and seasonally flooded grasslands (Bleeker, 2005; in press) in its native Germany and in industrial and urban ruderal sites (Hurka et al., 2003). Crow and Hellquist (2000) list habitat as wet meadows, shores, and roadsides. In the Hudson River basin, it grows in low grounds, waste places, meadows, shores, and along roadsides (Mills et al., 1997).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: The species first invaded the northeast then spread into the Great Lakes states and now is showing up in the midwest and west with the most recent new occurrences arriving in the Pacific northwest (USDA, 2006; Elmore, 1998).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: This species is listed as a noxious weed in California, Oregon, and North Carolina (USDA, 2006) and is becoming increasingly more invasive in the northeast (Uva et al., 1997).

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12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Tiny seeds can probably float on water or blow about in the wind. *Rorippa sylvestris* is believed to spread rapidly at times of fast creek flow in autumn and winter in South Australia when rhizomes can fragment and spread downstream Woldendorp and Bomford, 2004). In the United States, Emore (1998) has documented vegetative
material (rhizomes) of the weed being shipped interstate with vegetatively propagated herbaceous ornamentals.

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B - MODERATE SIGNIFICANCE

COMMENTS: Many midwestern and western states occurrences in only one to three counties; while northeastern states (Connecticut, Maine, Massachusetts, New Hampshire, Vermont, New York, New Jersey, Virginia), and Great Lakes states (Wisconsin, Indiana, Illinois, Michigan, Ohio, Pennsylvania) as well as some southern Mississippi drainage states (Missouri, Kentucky, Louisiana) show widespread invasions (USDA, 2006). It was first recorded in the Hudson River basin in 1896 and is considered an invasive aquatic species there (Mills et al., 1997). In California and the Pacific northwest, this species has recently emerged as an invasive pest with potential to invade natural systems through creeks when rhizome pieces (which can occur at depths up to 3 feet) fragment (Elmore, 1998).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: In California and the Pacific northwest, this species has recently emerged as an invasive pest with potential to invade natural systems through creeks when rhizome pieces (which can occur at depths up to 3 feet) fragment (Elmore, 1998). In Germany, where *Rorippa sylvestris* is native, plants occur naturally in various habitats of river systems and also colonize man made habitats (Bleeker, in press). The related species, *Rorippa nasturtium-aquaticum* (syn. *Nasturtium officinale*), is listed as an "invasive plant of lesser concern" in Czarapata (2005). Rhizomes easily fragment and can spread downstream (Woldendorp and Bomford, 2004).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: In New Zealand and Australia, this species is particularly invasive and rhizomes can create a thick mat of weed which completely smothers pasture and low-lying side rivers. This problem has been amplified there by rapid spread through horticulture sale through wholesale bulb nurseries (Woldendorp and Bomford, 2004).

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

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COMMENTS: *Rorippa sylvestris* seems to set seed sparingly, but spreads rapidly from rhizomes with many buds. Rhizomes also easily fragment and each fragment is capable of founding a new plant (Elmore, 1998). *Rorippa sylvestris*, *R. austriaca*, and *R. austriaca* x *sylvestris* are perennials that are able to propagate vegetatively by lateral root rhizomess as well as sexually (Czarapata, 2005; Bleeker, in press; Uva et al., 1997). *Rorippa sylvestris* blooms from May to August (Nice, 2004) and has a high fruit/seed abundance (USDA, 2006). *R. sylvestris* is also highly self-incompatible. Natural populations of self-incompatible *Rorippa* species are often characterized by a low seed set and may be vulnerable to hybridization with much more invasive species of *Rorippa* if they occur together (Bleeker, 2005; in press).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B - MODERATE SIGNIFICANCE

COMMENTS: Czarapata (2005) sites successful control of related *Rorippa* species by hand removal, several times a year. Control of *Rorippa sylvestris* is mainly based on measures preventing mechanical distribution of root parts and on treatments with a combination of the herbicides 2-methyl-4-chlorophenoxyacetic acid (MCPA) and 2,4-dichlorophenoxyacetic acid (2,4-D) (Koster et al., 1997). In a report from England, this species was controlled with triclopyr (Garlon, Turfion) when established from rhizome pieces in pots, in the field, ar rates of 1 to 3 pounds per acre. Clopyralid (Stinger) was not effective at rates of 0.12 to 0.5 pounds per acre. Glyphosate (Roundup) was effective in killing the top growth, but regrowth occurred. Amitrole, fluroxypur (Starane), paraquat and MCPB did not give effective control. The post emergence herbicides 2,4-D, triclopyr, clopyralid and glyphosate were also evaluated in California. The 2,4-D or high rates of triclopyr were effective for control in California. Glyphosate controlled the top growth but did not kill the plants. In California tests, trifluralin, oryzalin and isoxaben suppressed the top growth by inhibiting new shoots and roots, however the rhizome piece remained alive and would regrow when the herbicide degraded (Elmore, 1998). Cost estimates for eradication (by herbicide application and droughting) of 19 infestations (gross area 1.4 ha, net area 0.1 ha, over distance 40 km) of *Rorippa sylvestris* at three main sites in south Australia and Tasmania were between USD$739 (South Australia) and USD$3177 (Tasmania) (Woldendorp and Bomford, 2004).

18. MINIMUM TIME COMMITMENT

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Czarapata (2005) sites successful control of related *Rorippa* species by hand removal, several times a year.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

U - UNKNOWN

COMMENTS: Impact on native species is not known.

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: It appears most to all areas are easily accessible, as for most aquatic plants outside unusual habitats such as caves or high elevation streams or ponds.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Rubus discolor

ELEMENT NATIONAL ID: 210167
SCIENTIFIC NAME: *Rubus discolor*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-18
EVALUATOR: Fellows, M., rev. Maybury (2006)

I-RANK: Medium/Insignificant

I-RANK REASONS SUMMARY:
Widspread but primarily a problem in the West (probably most common from western Washington south to southern California) and mostly establishing in low quality disturbed habitats. Often found in wet areas and riparian infestations my be of conservation concern. Care should be taken to prevent infestion, as it can take several years to eradicate it.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High/Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Low

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Western Europe (Bossard et al. 2000).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: (Bossard et al. 2000).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: A large quantity of litter develops in older thickets (Bossard et al. 2000) but otherwise no significant abiotic alterations noted.

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2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Forms impenetrable thickets (Bossard et al. 2000), presumably in areas where such dense vegetation would not otherwise exist.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C - LOW SIGNIFICANCE

COMMENTS: Strong competitor in old fields and pasture lands, displacing native vegetation (Bossard et al. 2000, Hoshovski 2001). The impenetrable thickets presumably shade out other vegetation.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Dense thickets may impede access to water for medium-and large-sized animals (Hoshovski 2001).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C - LOW SIGNIFICANCE

COMMENTS: Established in wastelands, pastures and forest plantations, roadsides, creak gullies, river flats, fence lines, right-of-way corridors (Bossard et al. 2000). Established on at least two TNC preserves (Hoshovsky 2001). Some riparian areas (where scour/innundation provide the disturbance needed for establishment) may be of conservation concern.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Western U.S. (including HI) from ID to NM; disjunct in eastern U.S. (approximately 1/2 of the states) (Kartesz 1999).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Some negative impacts assumed at least in the California-to-western Oregon and Washington area, where this species is quite common (Hitchcock and Cronquist 1973; Hickman 1993; J. Kartesz, unpublished 2005 draft distribution data).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Potentially in c. 39 ecoreigions - inferred from Kartesz (1999) and TNC (2001).

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9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Colonizes disturbed areas, especially wet places: wastelands, pastures and forest plantations, roadsides, creak gullies, river flats, fence lines, right-of-way corridors (Bossard et al. 2000).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Unknown but presumed not rapidly expanding nor declining.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

U - UNKNOWN

COMMENTS:

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Seeds are dispersed by mammals and birds (Bossard et al. 2000). Originially introduced in cultivation in CA (c. 1885), then introduced to OH in 1945 (Bossard et al. 2000). Seeds can be distributed by streams and rivers (Bossard et al. 2000).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Unknown but assumed not rapidly increasing (doubling in area in 10 years) nor stable (given increases in disturbance in general).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: Common in riparian areas where periodic inundation maintains an early seral community (Bossard et al. 2000). Seedlings require sunlight, and are not expected to establish in mature communities (Bossard et al. 2000). *R. discolor* establishment depends on the availability of open habitats such as degraded pastures, eroded soils along streams, lands formerly cultivated; in Australia seedlings receiving less than 44 percent of full sunlight did not survive (Amor 1974, as cited in Hoshovski 2001).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: ON and BC, Canada (Kartesz 1999). Australia (Hoshovski 2001).

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16. REPRODUCTIVE CHARACTERISTICS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Seeds heavily, 7,000 - 13,000 seeds/square meter (Bossard et al. 2000). Will root at cane tips (Bossard et al. 2000). Several modes of fruit-producing asexual reproduction increases seed set and contributes to agressive spread (Bossard et al. 2000). Inferential evidence for long-lived seed bank (Bossard et al. 2000). "In less than 2 years a cane cutting can produce a thicket sixteen feet (5 m) in diameter" (Bossard et al. 2000).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B - MODERATE SIGNIFICANCE

COMMENTS: Mechanical removal or burning (Bossard et al. 2000). Remove whole rootstock (Bossard et al. 2000). Herbicides available (Bossard et al. 2000).

18. MINIMUM TIME COMMITMENT

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Requires several cutting treatments to exhaust carbohydrate stores (Bossard et al. 2000).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Species tends to form monoculture, low impacts on natives suspected.

20. ACCESSIBILITY OF INVADED AREAS

U - UNKNOWN

COMMENTS: Biological control will not occur because of risk to economically importatnt *Rubus* spp. crops (Bossard et al. 2000).

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Hitchcock, C.L., and A. Cronquist. 1973. Flora of the Pacific Northwest: An Illustrated Manual. University of Washington Press: Seattle, Washington. 730 pp.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Rubus fruticosus

ELEMENT NATIONAL ID: 197826
SCIENTIFIC NAME: *Rubus fruticosus*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-17
EVALUATOR: K. Maybury

I-RANK: Not Applicable

I-RANK REASONS SUMMARY:
This name does not seem to properly apply to any material that has escaped from cultivation anywhere in the U.S. Hitchcock et al. (1961) listed *Rubus fruticosus* sensu G. N. Jones (not in the sense of Linneaus) in synonymy with *R. vestius*, a European species. (G. N. Jones collected the material in question from western Washington State.) Hitchcock and Cronquist later (1973) put the name in synonymy with the very similar Himalayan blackberry, *R. discolor*. Kartesz (1999) excludes the name *R. fruticosus*, i.e., he indicates there is no documentation of this species occurring, even as a waif, in the areas his checklist covers (which includes all of the United States). He similarly excluded this name from more recent data (J. Kartesz, unpublished draft 2005 data). Weber (1998) noted that customary usage of the name *Rubus fruticosus* was for an aggregate of apomicts. *Rubus discolor* (= *R. armeniacus*) is a part of this aggregate (Hoshovski 1989) but the type material for *R. fruticosus* was a distinct apomict.

SUBRANK I - ECOLOGICAL IMPACT:
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:
SUBRANK IV - MANAGEMENT DIFFICULTY:

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Eurasian.

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? NO - I-RANK NOT APPLICABLE
COMMENTS:

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS?
COMMENTS:

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

COMMENTS:

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

COMMENTS:

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

COMMENTS:

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

COMMENTS:

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

COMMENTS:

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

COMMENTS:

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

COMMENTS:

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

COMMENTS:

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

COMMENTS:

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SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

COMMENTS:

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

COMMENTS:

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

COMMENTS:

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

COMMENTS:

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

COMMENTS:

15. SIMILAR HABITATS INVADED ELSEWHERE

COMMENTS:

16. REPRODUCTIVE CHARACTERISTICS

COMMENTS:

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

COMMENTS:

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18. MINIMUM TIME COMMITMENT

COMMENTS:

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

COMMENTS:

20. ACCESSIBILITY OF INVADED AREAS

COMMENTS:

REFERENCES:

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Invasive Species Assessment Protocol:
U.S. National Assessments

Rubus phoenicolasius

ELEMENT NATIONAL ID: 212200
SCIENTIFIC NAME: *Rubus phoenicolasius*
COMMON NAME:
I-RANK REVIEW DATE: 2005-10-10
EVALUATOR: Gravuer, K.

I-RANK: Medium

I-RANK REASONS SUMMARY:

Rubus phoenicolasius (wineberry) invades a large variety of habitats, including floodplain forests, shrub wetlands and thickets, herbaceous wetlands and wet meadows, early- to mid-successional forests, forest edges, upland grasslands, and shale bluffs. It had a tendency to form very large, dense thickets, which can reduce light availability for ground-level vegetation, cause structural changes (especially in open habitats), and cause noticeable decreases in populations of ground-level native species. The species is currently established in the central portion of the eastern US, extending from southwestern VT to northern GA and AL and as far west as IL and AR. Although further increases in local populations are likely, the range appears near the species' abiotic limits. Management can be achieved relatively easily by cutting and stump application of herbicide or intensive hand-pulling to remove all root material, although the dense, prickly thickets may pose accessibility problems.

SUBRANK I - ECOLOGICAL IMPACT:	Medium
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Low

NON-NATIVE THROUGHOUT NATION

NATIVE RANGE: Native to temperate Asia, including parts of China (Gansu, Henan, Hubei, Qinghai, Shaanxi, Shandong, Shanxi, Sichuan), Japan (Hokkaido, Honshu, Kyushu, Shikoku), and Korea (GRIN 2001).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: This species has invaded floodplain forests, shrub wetlands and thickets, herbaceous wetlands and wet meadows, early- to mid-successional forests, forest edges, upland grasslands, and shale bluffs (Plants for a Future 2001, Swearingen et al. 2002, Mehrhoff et al. 2003, Snyder and Kaufman 2004, Bugwood Network et al. 2005, Innis 2005, Spencer 2005, Wisconsin DNR 2005).

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Wineberry tends to form large, very dense thickets (Mehrhoff et al. 2003). These thickets can significantly reduce light availability for ground-level vegetation (Bugwood Network et al. 2005). When it invades open habitats, such light reduction can make the area unsuitable for formerly dominant native species (Snyder and Kaufman 2004).

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B - MODERATE SIGNIFICANCE

COMMENTS: Wineberry tends to form large, very dense thickets (Mehrhoff et al. 2003). When it invades open habitats, these thickets can dramatically alter community structure (Snyder and Kaufman 2004). In forest understories, the density of the understory may also be altered (Spencer 2005). However, wineberry also invades existing thickets, where it has minimal impact on structure.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B - MODERATE SIGNIFICANCE

COMMENTS: Thickets may reduce the population size of native, ground-level species (Bugwood Network et al. 2005, Spencer 2005). When wineberry establishes in forest understories, changes in light availability resulting from thicket formation may also alter successional patterns.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: According to Snyder and Kaufman (2004), in the early 1930s, North American *Rubus* expert L. H. Bailey determined that wineberry, in association with Japanese honeysuckle and tree-of-heaven, had completely altered the habitat at the type locality of a rare indigenous species of blackberry (*Rubus ostryifolius*) in Monmouth County, NJ. Bailey reported that wineberry was directly contributing to the species' decline at the time, and in fact this species is now listed as historical (SH.1) in New Jersey. In addition, in forests on the Maryland coastal plain, *Rubus phoenicolasius* had greater negative effects on a common herbaceous plant (*Duchesnea indica*) than a native congener (*R. argutus*). *R. phoenicolasius* therefore appears more likely to competitively exclude understory herbs which can coexist with the native *R. argutus* (Innis 2005).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B - MODERATE SIGNIFICANCE

COMMENTS: In New Jersey, wineberry forms a thick understory layer in mesic forests over dolomite, marble, shale, diabase, and traprock substrates. These forests are known to support several rare plant communities and unique plant assemblages (Snyder and Kaufman 2004). In addition, the New Jersey species thought to have been extirpated as a partial result of wineberry invasion is of conservation concern (*Rubus ostryifolius*, G3?Q).

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SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Wineberry is established in a large portion of the central-eastern US. The range extends as far north as southwestern VT, as far south as northern GA and AL, and as far west as IL and AR, although it does not appear to have established in MO (Kartesz 1999). There are some sporadic reports of establishment in western states (e.g CO, Swearingen 2005), but, as these were not mentioned by the vast majority of sources consulted, they were assumed not to be part of the generalized range.

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B - MODERATE SIGNIFICANCE

COMMENTS: Wineberry is considered an invasive plant of natural areas in Maryland, Pennsylvania, Tennessee, Virginia, North Carolina, West Virginia, and the District of Columbia (Spencer 2005, Swearingen 2005). There are also reports of natural area invasion from Connecticut, Delaware, Massachusetts, New Jersey, and New York (Swearingen 2005). It appears on invasive plant lists for many of these states, often in the second most problematic category (e.g. moderately invasive). Compiling these reports, it appears that wineberry has negative impacts in approximately 40% of its exotic range.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: Approximately 21 ecoregions are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Wineberry prefers moist soil and sun or partial shade conditions (Plants for a Future 2001, Spencer 2005, Wisconsin DNR 2005), but it can also grow in forests and make some recovery from drought (Snyder and Kaufman 2004, Innis 2005). It occurs in approximately seven broad habitat types: floodplain forests, shrub wetlands and thickets, herbaceous wetlands and wet meadows, early- to mid-successional forests, forest edges, upland grasslands, and shale bluffs (Plants for a Future 2001, Swearingen et al. 2002, Mehrhoff et al. 2003, Snyder and Kaufman 2004, Bugwood Network et al. 2005, Innis 2005, Spencer 2005, Wisconsin DNR 2005).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

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COMMENTS: Sporadic reports of establishment in western states (e.g CO, Swearingen 2005) suggest that the range is not decreasing. However, the species has also been cited as an invader of the eastern US, predominantly the mid-Atlantic and adjacent areas, fairly consistently despite being present in the US for over 100 years (Swearingen et al. 2002, Mehrhoff et al. 2003, Spencer 2005), suggesting that the range is not expanding in most or all directions. Some states on the border of the current range have placed the plant on watch or early-detection lists (e.g. Wisconsin, Wisconsin DNR 2005).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Wineberry was introduced into the United States in 1890 (Swearingen et al. 2002, Mehrhoff et al. 2003, Spencer 2005), allowing over 100 years for spread into suitable areas. Because it is only hardy to zone 5 (Griffiths 1994), it appears to have nearly reached the northern limits of its potential distribution. A preference for moist soils may limit its spread into much of the western US, though some wetland areas may be suitable.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: This species was originally introduced as breeding stock for new *Rubus* (raspberry genus) cultivars, and it is still used in the same way today in this limited market (Swearingen et al. 2002, Spencer 2005). Although this species is not frequently planted as a cultivar in its own right, the fruits have been described as enjoyable and sought after, and are dispersed by birds and mammals (including humans) (Mehrhoff et al. 2003, Spencer 2005). However, even where the species is most densely established, the appearance of new isolated plants in previously invaded habitats has been described as infrequent (Imlay 2004).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B - MODERATE SIGNIFICANCE

COMMENTS: Local patches seem to be expanding (Imlay 2004), and the species seems to be slowly moving into suitable adjacent regions (e.g. northern AL).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: Although wineberry is frequently found in open, disturbed habitats, evidence also suggests that it has little trouble establishing in mid-successional forests (e.g. coastal plain forests in MD (Innis 2005), calcareous, diabase, and traprock forests in NJ (Snyder and Kaufman 2004)).

15. SIMILAR HABITATS INVADED ELSEWHERE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: A weed in at least Australia (noxious), New Zealand (noxious), and South Africa (Randall 2002). No information could be located as to whether additional habitats are invaded in these countries. However, given that the species was introduced in 1890 and appears to have invaded many of the US habitats that are in accord with its abiotic preferences, it was assumed that invasion of a substantial number of additional habitats is unlikely.

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16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: Reproduces both vegetatively and by seed (Swearingen et al. 2002). One source noted that plants can resprout from the crown after control measures (Snyder and Kaufman 2004), and several sources mentioned copious fruit production (Mehrhoff et al. 2003, Innis 2005, Wisconsin DNR 2005).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Re-sprouting from root crowns can be an obstacle to managing this species (Snyder and Kaufman 2004). A common management prescription is mowing or cutting followed by an application of an herbicide such as triclopyr or glyphosate (e.g. Wisconsin DNR 2005). On smaller areas, hand-pulling can be very effective (Imlay 2004). However, removal of all root material is essential to this approach, which makes it time- and labor-intensive (Imlay 2004).

18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS: Because of the potential for re-sprouting, some follow-up is necessary. However, no source indicated that a prolonged effort would be necessary, so control can presumably be accomplished within 5 years.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: If herbicides are applied carefully to cut stumps, significant impacts on native species are not likely. However, if only manual control is used, the necessity to dig out all roots (Imlay 2004) may cause substantial soil disturbance.

20. ACCESSIBILITY OF INVADED AREAS

B - MODERATE SIGNIFICANCE

COMMENTS: The species itself creates some accessibility issues if management is undertaken on the ground, as it forms very dense, spiny thickets (Spencer 2005). However, the majority of the habitats invaded are reasonably accessible, with the possible exception of shale bluffs.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Rumex acetosella

ELEMENT NATIONAL ID: 219622
SCIENTIFIC NAME: *Rumex acetosella*
COMMON NAME: Sheep Sorrel
I-RANK REVIEW DATE: 2006-06-26
EVALUATOR: J. Cordeiro

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:
Although negative impacts of this species are not great (sometimes forms dense colonies by adventitious shoots from widely spreading roots and rhizomes, poisons livestock and sometimes native ungulates), it is widespread across the country and is spreading at a moderate rate, particularly in disturbed areas. The plant can be prolific and become a nuisance if left untended, but control is costly and difficult with control measures impacting native grassland species.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	High

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: This species is native to Eurasia (Agricultural Research Service USDA, 1970).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This is one of the earliest non-indigenous plants introduced into the United States that likely arrived from Europe as a seed contaminant (Mack and Erneberg, 2002).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: It has become naturalized throughout the U.S. (Agricultural Research Service USDA, 1970; Esser, 1995; USDA, 2006).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

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COMMENTS: Little is known about the effect of this species on ecosystem processes, but considering it does have some significant effects on community structure and individual natives, it is likely the species may have limited negative effects on ecosystem processes.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Sheep sorrel is an introduced rhizomatous perennial herb that sometimes forms dense colonies by adventitious shoots from widely spreading roots and rhizomes (Hitchcock and Cronquist, 1973; Great Plains Flora Association, 1986). This assumed to negatively impact community structure.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Sheep sorrel is an introduced rhizomatous perennial herb that sometimes forms dense colonies by adventitious shoots from widely spreading roots and rhizomes (Hitchcock and Cronquist, 1973; Great Plains Flora Association, 1986). On Fire Island, New York, this species has come to form the dominant herbaceous layer under low thicket vegetation (Dowhan and Rozsa, 1989).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C - LOW SIGNIFICANCE

COMMENTS: This species is known to poison livestock, and possibly native ungulates, if sufficient quantities are consumed (Czarapata, 2005; Uva et al., 1997; Esser, 1995). Mule deer are known to graze on sheep sorrel in California and Ohio (Krueger and Donart, 1974; Nixon et al., 1970), but effects have not been studied.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No direct evidence is available on the impact of this species on native species of conservation concern.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: This species is distributed throughout the United States and southern Canada (Uva et al., 1997) occurring in every U.S. state as a non-native (USDA, 2006).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B - MODERATE SIGNIFICANCE

COMMENTS: Sheep sorrel is classified as a noxious weed in 23 states in Mitich and Kyser (1992) but only listed as a noxious weed in two states in USDA (2006). This indicates that although the species is introduced widely, the proportion of its range negatively impacting biodiversity is a much smaller fraction of that total range.

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8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: It is conservatively estimated that over half of the 81 ecoregions in the U.S. have been invaded by *Rumex acetoxella* with the species occupying every U.S. state (Cordeiro, pers. obs. June 2006 based on TNC, 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Typical habitat includes disturbed areas, pastures, meadows, roadsides; but the species does not tolerate shade. It persists in areas of poor drainage and low soil fertility; in gravelly sterile fields (Agricultural Research Service USDA, 1970). It also is tolerant of forested communities (often as a common understory species) throughout temperate North America (Esser, 1995). This species can spread extensively, especially on acidic and nutrient-deficient soils (Czarapata, 2005).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Although already widespread, this species is likely only continuing to spread into new portions of its existing range, as it already occupies much of the U.S.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: At least 23 states in the U.S. have officially declared sheep sorrel as a noxious or prohibited weed (Mitich and Kyser, 1992). In addition, it is listed as in Uva et al. (1997) as an invasive weed in the northeast and in Whitson et al. (1996) weeds of the west. Local expansion continues, however.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: The plant is wind pollinated and seed is dispersed by wind and insects (Houssard and Escarre, 1991).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B - MODERATE SIGNIFICANCE

COMMENTS: Although the species is widespread, it is still expanding rapidly within its non-native range in the U.S. so local range expansion is ranked moderate significance.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

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COMMENTS: This species is listed as an "invasive plant of lesser concern" in Czarapata (2005). Typically, however, the species is a weed of turfgrass, landscapes, and nursery crops. It is often found on, but not limited to, acid soils and areas with poor drainage, low nitrogen, and little competition from other species (Uva et al., 1997; Agricultural Research Service USDA, 1970). Sheep sorrel is generally found in open, unshaded areas on disturbed sites, but may move into undisturbed sites when growing conditions are ideal (Escarre et al., 1994; Esser, 1995; Schramm, 1966). It is commonly found in old fields, annual grassland, and montane meadow communities (Esser, 1995). In Massachusetts, however, sheep sorrel was not present in the ground cover of most eastern white pine and red pine (*Pinus resinosa*) stands, but seeds were contained in soil samples from 1-to 80-year-old stands. In the laboratory soil-stored seeds from all stands germinated (Livingston and Allesio, 1968).

15. SIMILAR HABITATS INVADED ELSEWHERE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: In Alberta, Canada, sheep sorrel is a member of an 80-year-old white spruce (*Picea glauca*)-jack pine (*Pinus banksiana*)-feathermoss (*Pleurozium* spp.) community (Fyles, 1989), but typically it inhabits similar habitats in the U.S. elesewhere in its range.

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: Rhizomes spread rapidly in tangles masses (Esser, 1995). Seeds germinate often in two periods- one in spring and one in early fall; and seeds remain viable in soil for ten to twenty years. Reproduction is by seeds and creeping horizontal roots that produce new shoots (Czarapata, 2005; Uva et al., 1997; Agricultural Research Service USDA, 1970; Esser, 1995). In Massachusetts sheep sorrel was not present in the ground cover of most eastern white pine and red pine (*Pinus resinosa*) stands, but seeds were contained in soil samples from 1-to 80-year-old stands. In the laboratory soil-stored seeds from all stands germinated (Livingston and Allesio, 1968). It colonizes rapidly by seed and may persist for 15 to 20 years through vegetative growth and propagation (Escarre et al., 1994).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A - HIGH SIGNIFICANCE

COMMENTS: This species is very difficult to eradicate (Agricultural Research Service USDA, 1970). Dicamba is generally an effective control on this species (Czarapata, 2005). It probably survives fire by sprouting from rhizomes and roots and regenerates from on-site buried seed (Esser, 1995). Repeat cultivation during dry weather gradually weakens rootstalks of sheep sorrel and several herbicides can selectively control sheep sorrel (Fitzsimmons and Burrill, 1993).

18. MINIMUM TIME COMMITMENT

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This species likely requires repeated treatment. Fitzsimmons and Burrill (1993) cited repeated cultivation over 4 years during dry weather weakens rootstalks and helps reduce infestations, but this is not applicable where native species impacts are a concern.

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19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Fitzsimmons and Burrill (1993) cited repeated cultivation over 4 years during dry weather weakens rootstalks and helps reduce infestations, but this is not applicable where native species impacts are a concern.

20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: As this species frequently occurs on private land, particularly grasslands, some access issues will arise and cooperation with landownders for management will be necessary.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Sagittaria sagittifolia

ELEMENT NATIONAL ID: 232980
SCIENTIFIC NAME: *Sagittaria sagittifolia*
COMMON NAME: Hawaii Arrowhead
I-RANK REVIEW DATE: 2006-06-26
EVALUATOR: J. Cordeiro

I-RANK: Not Applicable

I-RANK REASONS SUMMARY:
Kartesz (1999) does not list *Sagittaria sagittifolia* as occurring in the United States. The USDA (2006) online Plants Database lists the species as a noxious weed (with status "excluded") but cite its nativity as "cultivated, or not in the U.S." with no state occurrences mapped. PIER (2005) lists the *Sagittaria latifolia* as occurring in French Polynesia and Hawaii (noting it has been, at times, mistakenly cited as *Sagittaria sagittifolia*) only. Staples and Cowie (2001) do not list it in their invasive species of Hawaii book. Dorken and Barrett (2003) cite this species as an aquatic perennial found in wetland habitats throughout Europe, noting it superficially resembles the globally widespread *S. latifolia* and *Sagittaria trifolia*. Champion and Clayton (2001) similarly list it as a European native with invasive populations in New Zealand but further note it very much resembles the American native *Sagittifaria montevidensis*. The only reference citing the species in the U.S. is Scher (2004) and ISSG (2005) (basing their information solely on Scher) listing Hawaii with no source; this is believed to be in error.

SUBRANK I - ECOLOGICAL IMPACT:
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:
SUBRANK IV - MANAGEMENT DIFFICULTY:

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE:

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? NO - I-RANK NOT APPLICABLE

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COMMENTS: Kartesz (1999) does not list Sagittaria sagittifolia as occurring in the United States. The USDA (2006) online Plants Database lists the species as a noxious weed (with status "excluded") but cite its nativity as "cultivated, or not in the U.S." with no state occurrences mapped. PIER (2005) lists the Sagittaria latifolia as occurring in French Polynesia and Hawaii (noting it has been, at times, mistakenly cited as Sagittaria sagittifolia) only. Staples and Cowie (2001) do not list it in their invasive species of Hawaii book. Dorken and Barrett (2003) cite this species as an aquatic perennial found in wetland habitats throughout Europe, noting it superficially resembles the globally widespread S. latifolia and Sagittaria trifolia. Champion and Clayton (2001) similarly list it as a European native with invasive populations in New Zealand but further note it very much resembles the American native Sagittifaria montevidensis. The only reference citing the species in the U.S. is Scher (2004) and ISSG (2005) (basing their information solely on Scher) listing Hawaii with no source; this is believed to be in error.

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Not Applicable

COMMENTS:

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

COMMENTS:

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

COMMENTS:

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

COMMENTS:

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

COMMENTS:

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

COMMENTS:

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SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

COMMENTS:

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

COMMENTS:

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

COMMENTS:

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

COMMENTS:

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

COMMENTS:

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

COMMENTS:

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

COMMENTS:

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

COMMENTS:

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

COMMENTS:

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15. SIMILAR HABITATS INVADED ELSEWHERE

COMMENTS:

16. REPRODUCTIVE CHARACTERISTICS

COMMENTS:

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

COMMENTS:

18. MINIMUM TIME COMMITMENT

COMMENTS:

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

COMMENTS:

20. ACCESSIBILITY OF INVADED AREAS

COMMENTS:

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Invasive Species Assessment Protocol:
U.S. National Assessments

Sedum telephium

ELEMENT NATIONAL ID: 208417
SCIENTIFIC NAME: *Sedum telephium*
COMMON NAME:
I-RANK REVIEW DATE: 2005-11-18
EVALUATOR: Gravuer, K.

I-RANK: Low

I-RANK REASONS SUMMARY:

Sedum telephium is a widely available horticultural species that frequently escapes from cultivation. It predominantly establishes in disturbed habitats, but has also been found in woodlands and riparian areas and, rarely, in prairies, rock outcrops, and swamps. This species has been assessed for invasiveness by a number of agencies and field personnel, and concern about its impact on native communities appears low. However, better information is needed where it is most abundant and/or established in less disturbed areas, as greater impacts than those documented thus far could potentially be occurring. This species is well-established in the Northeast and Lake states and appears to be spreading into the southeast, Midwest, and northwest. Control by hand-pulling appears relatively straightforward.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low/Insignificant

OTHER CONSIDERATIONS:

Resembles the native *Sedum telephioides*, though the native occupies a more restricted habitat (Cliffs and knobs, w. N.Y. to s. Ill., s., especially on the mts. (Fernald 1950)). This may have lead to some inaccuracies in the distribution information.

NON-NATIVE THROUGHOUT NATION

NATIVE RANGE: Native to Europe and temperate Asia.
Asia: Armenia, Azerbaijan, Georgia, Russian Federation [Ciscaucasia, Dagestan, Eastern Siberia, Western Siberia, Far East], Mongolia, China [Heilongjiang, Jilin, Liaoning, Xinjiang], Japan [Hokkaido, Honshu, Shikoku], Korea.
Europe: Denmark, Ireland, Norway, Sweden, United Kingdom, Austria, Belgium, Czechoslovakia, Hungary, Netherlands, Poland, Switzerland, Belarus, Estonia, Latvia, Lithuania, Russian Federation [European part], Ukraine [incl. Krym], Albania, Bulgaria, Greece, Italy [incl. Sardinia], Romania, Yugoslavia, France [incl. Corsica], Portugal, Spain. (GRIN 2001)

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SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: This species predominantly occurs in grass/forb-dominated open habitats (including disturbed areas and roadsides as well as natural prairie communities), various woodland communities, and riparian areas (including stream banks, lakeshores, and their anthropogenic analogue, ditches). Habitats invaded to a minor extent include outcrop/ledge/bluff areas and swamps (Fernald 1950, Voss 1985, Wisconsin State Herbarium 2005).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: This is a succulent species that invades habitats where few or no other succulents are found. Therefore, minor changes in water or nutrient cycling may occur where it forms substantial stands.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

COMMENTS: May cause moderate changes in the density or cover of the herbaceous layer in the open habitats or woodland understories that it invades. However, as it is similar in stature to many native species and no mention was found of formation of dense stands, major changes were assumed to be unlikely.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C - LOW SIGNIFICANCE

COMMENTS: Little information is available on the impact of this species once it has invaded a native community (MIPAG 2005). However, a number of agencies have considered the species' invasiveness, and the majority have classified it at the lowest invasiveness level (Petrella et al. 1999, USGS 2003, USFS-ER 2005, MIPAG 2005; although the US Army Corps of Engineers has prohibited its use in wetland mitigation plantings in New England (USACE 2002)). Fernald (1950) notes it to be abundantly (often aggressively) naturalized in the northeast. Therefore, the impact of this species on community composition was inferred to be detectable in some areas, but not substantial. This evaluation may need to be modified as more information becomes available.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: Although the species has been naturalized since at least the early 1930s (Rydberg 1932), no mention was found of disproportionate impacts on particular native species. However, note that a similar native species exists with a partially overlapping range (*S. telephioides*: G4, but S2 in KY and IN, S3 in PA, SH in NY, and SX.1 in NJ). As horticulturalists have managed to hybridize *S. telephium* with at least one other *Sedum* species (Whitinger 2005), the potential for hybridization between the native and the exotic should be investigated.

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5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C - LOW SIGNIFICANCE

COMMENTS: The majority of sources indicated that this species is found in habitats of low conservation significance, such as disturbed open areas, roadsides and railroad rights-of-way. However, some invasion does appear to occur into relatively intact woodlands, lakeshores, outcrop/ledge/bluff areas and swamps (Voss 1985, Wisconsin State Herbarium 2005).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Appears to be most abundantly established in the Northeast and Lake states. Scattered occurrences have also been reported from some southeastern states (VA, KY, NC, SC, TN, MS), some Midwestern states (KS, IA, MO), and WA and ID in the Pacific northwest (Gleason and Cronquist 1991, Kartesz 1999, NRCS 2005). Generalized range estimated to cover about 20% of the contiguous U.S.

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Most abundantly established and noted to be troublesome as a weed in the northeastern states (Muenscher 1955, Gleason and Cronquist 1991). Mentioned from the most natural habitats in Wisconsin and Michigan (e.g. prairies, rock outcrops, swamps) (Voss 1985, Wisconsin State Herbarium 2005). In the southeast, Midwest, and northwest, it appears to exhibit only scattered establishment in disturbed habitats and is therefore unlikely to be having negative impacts on biodiversity.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: Approximately 25 ecoregions are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: This species can grow under diverse light conditions (full sun to shade), and although it flourishes with regular watering, it is also reasonably drought-tolerant (Plants for a Future 2001, Faucon 2005, MIPAG 2005, Whitinger 2005). The majority of sources indicated that it is found in disturbed open areas, including roadsides and railroad rights-of-way (e.g. Fernald 1950, Voss 1985). Because it has escaped from cultivation as an ornamental, its immediate habitat was often noted as the old home sites or cemeteries where it had presumably been planted in the past (Steyermark 1963, Voss 1985). This species also invades analogous grass/forb-dominated natural habitats, such as prairie communities (Wisconsin State Herbarium 2005). In addition, a number of sources noted invasion into woodland habitats and riparian areas (including stream banks, lakeshores, and their anthropogenic analogue, ditches) (Voss 1985, Wisconsin State Herbarium 2005). Habitats invaded to a minor extent by this species include outcrop/ledge/bluff areas (Wisconsin State Herbarium 2005) and swamps (Voss 1985).

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SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: The establishment (or at least detection) of this species in the Pacific northwest is quite recent - Kartesz (1999) cites a source from 1975 and there are few (possibly no) herbarium specimens from before 2000 (Rice 2005). The species also appears to be spreading southward, as Fernald (1950) does not list it anywhere in the southeast, but it has now been reported from several southeastern states (VA, KY, NC, SC, TN, MS) (Kartesz 1999).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: This species is believed to be hardy south to zone 9a, and north to at least zone 4, possibly zone 2b (Plants for a Future 2001, Faucon 2005, Whitinger 2005). Therefore, nearly all of the U.S. appears to be suitable in terms of temperature. Precipitation is also unlikely to present a major constraint, as several sources (e.g. Plants for a Future 2001) noted the species to be drought-tolerant.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: This species is widely sold as an ornamental throughout the United States (GRIN 2001). Many cultivars are available (e.g. Whitinger 2005).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B - MODERATE SIGNIFICANCE

COMMENTS: Appears to be increasing at the Moosehorn National Wildlife Refuge in southeastern Maine (USGS 2003). Planting of the species as an ornamental does not appear to be decreasing, as new cultivars are still being developed and it has not been flagged as invasive by conservation groups (e.g. USGS 2003, MIPAG 2005).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: Although the majority of sources indicated that it is found in disturbed open areas (e.g. Fernald 1950, Voss 1985), it is clear that at least some genotypes possess substantial shade tolerance (Plants for a Future 2001, Faucon 2005, MIPAG 2005, Whitinger 2005). Woodlands that are somewhat open but not majorly disturbed appear to be invaded with some frequency (Wisconsin State Herbarium 2005).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Also naturalized in Canada (Kartesz 1999), where it appears to invade similar habitats (Scoggan 1978).

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16. REPRODUCTIVE CHARACTERISTICS

C - LOW SIGNIFICANCE

COMMENTS: Weakly exhibits the following characteristics: reproduces readily both vegetatively and by seed, has quickly spreading rhizomes or stolons that may root at nodes, and fragments easily, with fragments capable of dispersing and subsequently becoming established (Muenscher 1955, Plants for a Future 2001).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

C - LOW SIGNIFICANCE

COMMENTS: Can be controlled relatively easily by hand-pulling, cultivation, or close grazing (Muenscher 1955). It is known to be resistant to at least one herbicide (Dacthal or DCPA) (Norcini 1992).

18. MINIMUM TIME COMMITMENT

D - INSIGNIFICANT

COMMENTS: A collector of the species in Washington state noted that the plant does not re-appear where it has been pulled out (Rice 2005).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: A single round of hand-pulling would presumably have minor effects on native species. However, for larger infestations where this approach is not feasible, cultivation or grazing control could have more substantial impacts.

20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: Because this is an escaped ornamental species, some invasion foci will likely be located on private property. In addition, the rock outcrop habitats where it has been found in Wisconsin (Wisconsin State Herbarium 2005) may present accessibility problems. However, accessibility overall should be fairly good, given that most populations appear to be on roadsides or in disturbed open areas.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Setaria pumila

ELEMENT NATIONAL ID: 230382
SCIENTIFIC NAME: *Setaria pumila*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-18
EVALUATOR: Tomaino, A.

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:
Established in Louisiana where it occurs on moist disturbed sites. It may occur sporadically in Oregon, Texas, and Arkansas. This taxon is a weed of tropical and subtropical areas that apparently has a limited range in the U.S. Very little information was found about its impacts on native species habitats in the U.S.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Unknown

OTHER CONSIDERATIONS:
There may be some confusion with a closely related taxon, Setaria glauca (sometimes treated as Setaria pumila ssp. pumila), that is a widespread weed of lawns and cultivated fields.

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Native to tropical Africa (FNA 2003).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Established outside cultivation in the U.S. (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Established as a weed in southeastern Louisiana (FNA 2003).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

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COMMENTS: No mention of changes in abiotic ecosystem processes or system-wide parameters found in the literature; assumption is that any alterations are not high or moderate.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: An annual grass 30-130 cm tall (FNA 2003). No mention of impacts on ecological community structure found in the literature; assumption is that any impacts are not high or moderate.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No mention of impacts on ecological community composition found in the literature; assumption is that any impacts are not high or moderate.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not high or moderate.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No mention of threats to elements of conservation significance found in the literature; assumption is that it is not often or occasionally threatening elements of conservation significance.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Established in southeastern Louisiana; collected in the past from Portland Oregon on ballast dumps (FNA 2003). Also, reported from Texas and Arkansas (J. Kartesz, unpublished data).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: No mention of negative impacts on biodiversity found in the literature; assumption is that impacts occur in <50% of the species' current generalized range.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

C - LOW SIGNIFICANCE

COMMENTS: Inferred from distribution as currently understood (J. Kartesz, unpublished data; TNC 2001).

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9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: In Louisiana, it occurs on moist with disturbance including river/lake shore, fill, levee, sand bar, shell dump, headlands, pasture, roadsides, railroads, and cleared areas (LSU 2004).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Occurs in disturbed areas; assumption is that disturbed areas are not declining or remaining stable and therefore this species' total range is not declining or remaining stable.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

A - HIGH SIGNIFICANCE

COMMENTS: Inferred from USDA (1990) and FNA (2003).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Found in ballast dumps so presumeably carried in ship ballast (FNA 2003). Barbed seeds attach to fur, feathers, or clothing (FAO 2005).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Occurs in disturbed areas; assumption is that disturbed areas are not decreasing or remaining stable and therefore this species' local range is not decreasing or remaining stable.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: In Louisiana, it occurs on moist with disturbance including river/lake shore, fill, levee, sand bar, shell dump, headlands, pasture, roadsides, railroads, and cleared areas (LSU 2004). No mention of invasion of undisturbed habitats found in the literature; assumption is that it rarely or seldom invades undisturbed habitats.

15. SIMILAR HABITATS INVADED ELSEWHERE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: A worldwide weed, especially in the tropics and subtropics (USDA 2005).

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16. REPRODUCTIVE CHARACTERISTICS

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: An annual grass (FNA 2003). It germinates late in the season (FAO 2005). Described as moderately to slow-growing (FAO 2005). Apparently not extremely aggressive.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: The species persists without repeated human disturbance and/or reintroduction.

18. MINIMUM TIME COMMITMENT

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: No mention of control requiring more than 10 years found in the literature; assumption is that control requires less than 10 years.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

U - UNKNOWN

COMMENTS:

20. ACCESSIBILITY OF INVADED AREAS

U - UNKNOWN

COMMENTS:

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Invasive Species Assessment Protocol:
U.S. National Assessments

Sinapis arvensis

ELEMENT NATIONAL ID: 225466
SCIENTIFIC NAME: *Sinapis arvensis*
COMMON NAME:
I-RANK REVIEW DATE: 2006-06-07
EVALUATOR: Gravuer, K.

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:

Sinapis arvensis is a Eurasian annual currently established in every US state. It is relatively common in most states (especially the Northeast and Great Lakes states), with the exception of the Southeast, where it establishes only rarely. It is virtually absent from land that has not been recently disturbed and is thought to be very infrequent in natural habitats. It predominantly invades cultivated fields, open disturbed areas, roadsides, and railroads, and is sometimes also found in riparian habitats (e.g. riverbanks and lakeshores), old fields, and grasslands (pastures, Midwestern prairies, and California grasslands). In Michigan, it is invading dry and moist woods, but its distribution is likely limited in those habitats because it is not shade-tolerant. Impacts are essentially limited to competition with native species that also prefer disturbed environments. However, this species can be difficult to eradicate from an area once established because it forms an extremely long-lived seed bank.

SUBRANK I - ECOLOGICAL IMPACT:	Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Low

NON-NATIVE THROUGHOUT NATION

NATIVE RANGE: Apparently native to a significant portion of Eurasia, including Europe, the Russian Federation (European part, Ciscaucasia, s. Eastern Siberia, s. Western Siberia), Afghanistan, Iran, Iraq, Israel, Jordan, Lebanon, Syria, Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, Pakistan, n. Algeria, Egypt, Libya, Morocco, and Tunisia. However, it is widely naturalized and is probably only truly native to the Mediterranean region (USDA-ARS 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

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S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Predominantly invades cultivated fields and field edges (particularly spring-sown grains and cereals), open disturbed areas (e.g. waste places and gardens), and roadsides and railroad areas. Sometimes also found in riparian habitats (e.g. riverbanks and lakeshores), old fields and forest edges, or grassland habitats (pastures, Midwestern prairies, and California grasslands). Additionally, according to Voss (1985), in Michigan it is "invading woods, both dry and moist". (Spencer 1940, Drew 1941, Fernald 1950, Kearney and Peebles 1951, Muenscher 1955, Buchholtz et al. 1960, Peck 1961, Steyermark 1963, Hitchcock et al. 1964, Seymour 1969, Agricultural Research Service 1970, Correll and Johnson 1970, Mulligan and Bailey 1975, Strausbaugh and Core 1978, Martin and Hutchins 1980, Hough 1983, Voss 1985, Great Plains Flora Association 1986, Kartesz 1988, Gleason and Cronquist 1991, Hickman 1993, Haines and Vining 1998, Diggs et al. 1999, Rhoads and Block 2000, Plants for a Future 2001, Welsh et al. 2003, Wunderlin and Hansen 2003, Brusati and DiTomaso 2005, Holmgren et al. 2005, Jones 2005, Cal-IPC 2006, Weakley 2006, Wisconsin State Herbarium 2006)

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

D - INSIGNIFICANT

COMMENTS: This species has been established in North America since at least 1748 (Mulligan and Bailey 1975). Despite being present for over 250 years and being reasonably well-studied because of its significance as an agricultural weed, no reports of impacts on ecosystem processes or system-wide parameters were found. Therefore, assume impacts insignificant.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

D - INSIGNIFICANT

COMMENTS: Noted to be "common" in many invaded areas (Mulligan and Bailey 1975). This abundance may slightly increase the density of the herbaceous layer in the habitats it invades. No other impacts on community structure reported.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: This species exhibits rapid early growth, which allows it to be an effective competitor under certain conditions (Mulligan and Bailey 1975), most notably in agricultural fields. However, it is not shade-tolerant (Plants for a Future 2001), so its impacts are limited to relatively open environments. Some limited impacts on community composition may occur when this species establishes abundantly in sites where natives might otherwise establish.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: This species is one of many non-natives that invades grasslands that are habitat for the federally threatened San Joaquin adobe sunburst (*Pseudobahia peirsonii*) (US Fish and Wildlife Service 2002, cited in Brusati and DiTomaso 2005). It is not known to produce any interspecific hybrids in nature (Mulligan and Bailey 1975).

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5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: This species is "virtually absent from land that has not been recently disturbed" (Mulligan and Bailey 1975) and was noted to be "very infrequent in wildlands" in California (Brusati and DiTomaso 2005). In Michigan, it is "invading woods, both dry and moist" (Voss 1985), but it is not shade-tolerant (Plants for a Future 2001), so presumably much of this woodland invasion is occurring in areas with local disturbance. However, in California, it is found in grassland communities (Cal-IPC 2006), some of which appear to be of conservation significance as habitat for threatened animal species (US Fish and Wildlife Service 2002, cited in Brusati and DiTomaso 2005).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Established in every US state, including Alaska and Hawaii (Kartesz 1999). Appears relatively common in most states (especially the Northeast and Great Lakes states), with the exception of the Southeast, where it establishes only rarely (Wunderlin and Hansen 2003, Jones 2005, Weakley 2006).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Noted as a "weed" in a number of US regions (NRCS 2006), but appears to invade disturbed habitats almost exclusively. In Michigan, it is "invading woods, both dry and moist" (Voss 1985), suggesting the possibility of some biodiversity impact there.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: Greater than 35 ecoregions are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

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COMMENTS: Grows in high light, unshaded areas in a variety of soils, though it appears to have a preference for heavy, alkaline soils (Mulligan and Bailey 1975, Diggs et al. 1999, Plants for a Future 2001). Apparently, it is highly associated with disturbance and is very infrequently found in natural or wildland areas (Brusati and DiTomaso 2005). Predominantly invades cultivated fields and field edges (particularly spring-sown grains and cereals), open disturbed areas (e.g. waste places and gardens), and roadsides and railroad areas. Sometimes also found in riparian habitats (e.g. riverbanks and lakeshores), old fields and forest edges, or grassland habitats (pastures, Midwestern prairies, and California grasslands). Additionally, according to Voss (1985), in Michigan it is "invading woods, both dry and moist". (Spencer 1940, Drew 1941, Fernald 1950, Kearney and Peebles 1951, Muenscher 1955, Buchholtz et al. 1960, Peck 1961, Steyermark 1963, Hitchcock et al. 1964, Seymour 1969, Agricultural Research Service 1970, Correll and Johnson 1970, Mulligan and Bailey 1975, Strausbaugh and Core 1978, Martin and Hutchins 1980, Hough 1983, Voss 1985, Great Plains Flora Association 1986, Kartesz 1988, Gleason and Cronquist 1991, Hickman 1993, Haines and Vining 1998, Diggs et al. 1999, Rhoads and Block 2000, Plants for a Future 2001, Welsh et al. 2003, Wunderlin and Hansen 2003, Brusati and DiTomaso 2005, Holmgren et al. 2005, Jones 2005, Cal-IPC 2006, Weakley 2006, Wisconsin State Herbarium 2006)

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: This species was introduced to the United States quite early; it was common in fields around Albany, NY by 1748 (Mulligan and Bailey 1975) and may even have been present in the US since prehistoric times (Holmgren et al. 2005). In 1940, it was apparently still spreading to new areas (Spencer 1940). At this time, however, it occurs in all 50 US states, so its range is no longer increasing.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Because this species is already widespread, it cannot expand further at a broad scale. However, it is still infrequent in the Southeast (Wunderlin and Hansen 2003, Jones 2005, Weakley 2006) and may expand to occupy more habitat there as disturbance produces additional potential colonization sites.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Through natural means, this species is not particularly well-adapted for long-distance dispersal; most seeds fall near the parent plant or may rarely be carried by wind or water (Brusati and DiTomaso 2005). It has achieved much long-distance spread as an impurity of crop and forage seed (Mulligan and Bailey 1975), but many states have now attempted to curtail this by designating the species as a noxious weed seed (NRCS 2006).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: This species is highly adapted to disturbance, so assumption is that its local range is not decreasing overall. It was, however, noted to be decreasing in New Jersey (Hough 1983).

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14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: This species is "virtually absent from land that has not been recently disturbed" (Mulligan and Bailey 1975) and was noted to be "very infrequent in wildlands" in California (Brusati and DiTomaso 2005). The presence of established plants significantly inhibits this species' germination and reduces the probability of recruitment of those seeds that germinate (Rees and Brown 1991). In Michigan, it is "invading woods, both dry and moist" (Voss 1985), but it is not shade-tolerant (Plants for a Future 2001), so presumably much of this woodland invasion is occurring in areas with local disturbance.

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Established worldwide (Brusati and DiTomaso 2005), including at least Canada, South America, South Africa, Australia, New Zealand, and Japan (Mulligan and Bailey 1975, Randall 2002). Appears to be established in habitats largely similar to those it infests in the U.S. (e.g. Scoggan 1978, Webb et al. 1988).

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: An annual plant that reproduces only one per year by seed only. In Canada, plants grown in cultivated fields were found to produce 2000-3500 seeds per plant, with plants growing without competition producing much more seed (Mulligan and Bailey 1975). This species has a very long-lived seed bank; seeds may remain viable in the soil for up to 60 years (Mulligan and Bailey 1975). Consequently, it exhibits high persistence in many habitats (Hails et al. 1997).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

C - LOW SIGNIFICANCE

COMMENTS: For small infestations, hand-pulling, cutting, or grazing as soon as the plants begin to flower can provide effective control (Muenscher 1955). It is important to remove plants prior to seed set because the seed bank is very long-lived. In areas where plants have already set seed in prior years, cultivation, disking, or harrowing will induce germination so that control measures can be applied (Muenscher 1955). For larger infestations, where feasible, mechanical methods such as mowing or harrowing will control this species (Muenscher 1955). Herbicides can also be used (Mulligan and Bailey 1975), although biotypes resistant to a number of commonly used herbicides (e.g. 2,4-D, dicamba, imazethapyr) are known (Zheng and Hall 2001, Warwick et al. 2005, Jugulam et al. 2005). There is also some concern that genes for herbicide resistance inserted into the related species *Brassica napus* may escape to this species through hybridization (U.S. Congress Office of Technology Assessment 1993). However, the probability that these two species will hybridize to produce viable seeds under natural conditions is virtually zero.

18. MINIMUM TIME COMMITMENT

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This species has a very long-lived seed bank; seeds may remain viable in the soil for up to 60 years (Mulligan and Bailey 1975). Consequently, it exhibits high persistence in many habitats (Hails et al. 1997).

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19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: The opportunity for control by hand-pulling means that, in many cases, management could result in only very minor impacts on native species. If herbicide application is necessary, however, there is the potential for some impact to occur.

20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: Because this species is strongly associated with disturbance, infestations that are targets for control should be relatively accessible. However, because so many infestations are located on farmland, some targets for control will likely be on private land.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Solanum dulcamara

ELEMENT NATIONAL ID: 243275
SCIENTIFIC NAME: *Solanum dulcamara*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-21
EVALUATOR: Gravuer, K.

I-RANK: Low

I-RANK REASONS SUMMARY:

Solanum dulcamara has naturalized throughout most of the US with the exception of a few southern states. It appears to be most problematic in Michigan and Wisconsin, where it has established substantially in relatively natural habitats (e.g. forests, swamps, bogs). In New England, the mid-Atlantic, and the northwest, the species' local abundance is also high and there appears to be some limited establishment in natural areas. Although a majority of populations are found in disturbed areas, the full range of invaded habitats is quite large and includes open riparian areas, forested riparian areas, woodlands and forests, grasslands and open disturbed areas, partially open upland habitats, marshes and wet meadows, wet thickets, swamp forests, bogs, cliffs, and dunes. This species is a vine, and its most important impact on natural communities appears to be an occasional tendency to climb up and over adjacent vegetation, causing changes in community structure and, to a lesser extent, composition. It reproduces by both seeds and by rooting at prostrate nodes. Seeds are dispersed by birds and through the limited continuing horticultural use of this species. Management by cultivation, repeated cutting, and/or herbicide requires little effort.

SUBRANK I - ECOLOGICAL IMPACT:	Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low/Insignificant

NON-NATIVE THROUGHOUT NATION

NATIVE RANGE: Native to a large area of Eurasia and northern Africa. European countries where considered native include Denmark, Finland, Ireland, Norway, Sweden, United Kingdom, Austria, Belgium, Czechoslovakia, Germany, Hungary, Netherlands, Poland, Switzerland, Belarus, Estonia, Latvia, Lithuania, Moldova, Russian Federation (European part), Ukraine (incl. Krym), Albania, Bulgaria, Greece, Italy, Romania, Yugoslavia, France, Portugal, and Spain. Asian countries where native include Iran, Iraq, Lebanon, Syria, Turkey, Armenia, Azerbaijan, Georgia, Russian Federation (Ciscaucasia, Dagestan, Western Siberia), Turkmenistan, China (sw Sichuan, nw Yunnan), northern India, Nepal, and Pakistan. Northern African countries where native include Algeria, Morocco, and Tunisia (USDA ARS 2005).

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SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Invaded habitats include open riparian areas (including river banks, pond shores, and lake shores), forested riparian areas, woodlands and forests, grasslands and open disturbed areas (including meadows, fields, pastures, waste areas, parks, and gardens), partially open upland habitats (including forest edges, old fields, fencerows, roadsides, and railroad right-of-ways), marshes and wet meadows, wet thickets (e.g. alder thickets), swamp forests (both conifers and hardwoods), bogs, cliffs, and dunes (Abrams 1951, Muenscher 1955, Hitchcock et al. 1959, Peck 1961, Strausbaugh and Core 1978, Cronquist et al. 1984, Pegtel 1985, Great Plains Flora Association 1986, Kartesz 1988, Gleason and Cronquist 1991, Hickman 1993, Cooperrider 1995, Voss 1996, Rhoads and Block 2000, Mehrhoff et al. 2003, Welsh et al. 2003, Hilty 2006, Tenaglia 2006, Wisconsin State Herbarium 2006).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: This species was naturalized in the US by at least 1860 (Wisconsin State Herbarium 2006). Despite being present for over 140 years, no reports of impacts on ecosystem processes or system-wide parameters were found. However, it can become very abundant where established (Samodien et al. 1999) and has been found growing in streams (Wisconsin State Herbarium 2006), so there is the potential for colonies to impede water flow in some areas.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: A vine which can climb up and over adjacent herbs and shrubs, sometimes reducing their abundance (Samodien et al. 1999, Mehrhoff et al. 2003). In some areas, this may replace the existing layer with a layer of *S. dulcamara* vines. However, it also often grows prostrate along the ground, in which case its impacts on community structure are less significant (Buchholtz et al. 1960, Hilty 2006).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C - LOW SIGNIFICANCE

COMMENTS: A vine which can climb up and over adjacent herbs and shrubs, sometimes reducing their abundance (Samodien et al. 1999, Mehrhoff et al. 2003).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not significant.

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5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B - MODERATE SIGNIFICANCE

COMMENTS: In at least Michigan and Wisconsin, appears to occasionally invade relatively intact upland and wetland forests (Voss 1996, Wisconsin State Herbarium 2006). However, in general, the plant prefers disturbed areas, and most populations are found there (Hilty 2006).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Established throughout most of the United States, with the exception of only South Carolina, Mississippi, Arkansas, Louisiana, Texas, and Arizona (Kartesz 1999). Most densely established in the northeast (both New England and mid-Atlantic), Great Lakes, and northwestern states; establishment is sparse and scattered in the southeast, Great Plains, and southwest states (NRCS 2006).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C - LOW SIGNIFICANCE

COMMENTS: Appears to be most problematic in Michigan and Wisconsin, where it has established substantially in relatively natural habitats (forests, swamps, bogs, etc.) (Voss 1996, Wisconsin State Herbarium 2006, Swearingen 2006). In New England, the mid-Atlantic, and the northwest, the species' local abundance is also high and there appears to be some limited establishment in relatively natural areas (Hitchcock et al. 1959, Peck 1961, Hickman 1993, Mehrhoff et al. 2003, Rhoads and Block 2000, Swearingen 2006). In the southeast, Great Plains, and southwest, establishment is more scattered and impacts appear minimal.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: Approximately 35-40 ecoregions are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Grows in a wide range of light environments, from full sun to shade, as well as in a range of soil moisture conditions, from relatively dry to waterlogged soils (although moist to mesic soil is preferred) (Plants for a Future 2001, Mehrhoff et al. 2003, Hilty 2006, Cardina et al. no date). Although a majority of populations are found in disturbed areas, the full range of invaded habitats is quite large (especially in the Great Lakes states and mid-Atlantic). Invaded habitats include open riparian areas (including river banks, pond shores, and lake shores), forested riparian areas, woodlands and forests, grasslands and open disturbed areas (including meadows, fields, pastures, waste areas, parks, and gardens), partially open upland habitats (including forest edges, old fields, fencerows, roadsides, and railroad right-of-ways), marshes and wet meadows, wet thickets (e.g. alder thickets), swamp forests (both conifers and hardwoods), bogs, cliffs, and dunes (Abrams 1951, Muenscher 1955, Hitchcock et al. 1959, Peck 1961, Strausbaugh and Core 1978, Cronquist et al. 1984, Pegtel 1985, Great Plains Flora Association 1986, Kartesz 1988, Gleason and Cronquist 1991, Hickman 1993, Cooperrider 1995, Voss 1996, Rhoads and Block 2000, Mehrhoff et al. 2003, Welsh et al. 2003, Hilty 2006, Tenaglia 2006, Wisconsin State Herbarium 2006).

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SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Naturalized in the US since at least 1860 (Wisconsin State Herbarium 2006) and was becoming widespread in both New England and the Great Lakes states by the late 1800s (Voss 1996, Mehrhoff et al. 2003). Appears to be spreading somewhat in the northwest (Abrams 1951, King County Noxious Weed Control Board 2005).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Whitinger (2006) lists its USDA hardiness zones as 4a - 8b, so there is presumably still some potential for southward spread (e.g. into Arkansas).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Berries are frequently transported long distances by birds (Samodien et al. 1999, Mehrhoff et al. 2003, Hilty 2006). In addition, it is still grown as an ornamental (King County Noxious Weed Control Board 2005) and has limited availability over the internet (Whitinger 2006).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

C - LOW SIGNIFICANCE

COMMENTS: Appears to be increasing in abundance in the northwest (Abrams 1951, King County Noxious Weed Control Board 2005).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: Shade-tolerant, which allows it to invade relatively undisturbed forest habitats (Mehrhoff et al. 2003, Wisconsin State Herbarium 2006). Does not appear to have much success invading established grassland vegetation, however (Egler 1983). In general, the plant prefers disturbed areas, and most populations are found there (Hilty 2006).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Also naturalized in at least Canada, Australia, and New Zealand (Kartesz 1999, Randall 2002); appears to have invaded largely similar habitats in those areas (Scoggan 1978, Webb et al. 1988, Munro 2006).

16. REPRODUCTIVE CHARACTERISTICS

A/B - HIGH/MODERATE SIGNIFICANCE

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COMMENTS: Reproduces primarily by seed, but also be rooting of prostrate stems (Buchholtz et al. 1960, Mehrhoff et al. 2003). Small pieces of rhizome in the soil can regenerate new plants, which can make eradication difficult (King County Noxious Weed Control Board 2005, Hilty 2006).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

C - LOW SIGNIFICANCE

COMMENTS: If the land can be plowed, this generally allows relatively easy and cost-effective control (Drew and Helm 1941, Muenscher 1955, Cardina et al. no date). If land the land cannot be plowed, either frequent close cutting or herbicide application can be employed (Drew and Helm 1941, Muenscher 1955, King County Noxious Weed Control Board 2005). Cutting needs to be repeated a number of times to overcome the plant's re-sprouting ability (King County Noxious Weed Control Board 2005).

18. MINIMUM TIME COMMITMENT

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Cultivation should achieve effective control in less than 2 years, but if this is not possible, a longer time investment may be required. The species does not appear to form a long-term persistent seed bank (Peat and Fitter 2006).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Cultivation may have relatively significant impacts on native species. However, if plants are significantly interspersed with native species, choosing the frequent close cutting method may reduce impact.

20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: This species still has some horticultural use, so it is likely that some populations will be on privately-owned lands.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Solanum torvum

ELEMENT NATIONAL ID: 239514
SCIENTIFIC NAME: *Solanum torvum*
COMMON NAME:
I-RANK REVIEW DATE: 2005-12-30
EVALUATOR: Gravuer, K.

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:

Solanum torvum is a subtropical/tropical shrub with a limited U.S. range. It is most abundantly established in southern Florida, where it occurs in at least 6 counties, as well as having scattered establishment in central and northern Florida (at least 3 counties total), Mobile County, Alabama, Washington County, Mississippi, O'ahu and Maui, Hawai'i, and perhaps one site in Maryland. This species predominantly invades human-disturbed open sites, is more rarely found on naturally disturbed sites such as landslides, riverbanks, and forest clearings, and also invades swamps. Despite placement on the federal noxious weed list and on several state noxious lists, some cultivation, especially in Florida, continues, as a yard plant and for its sharp-tasting immature fruits. Most significant impacts on native biodiversity probably occur as a result of the species' ability to form large, impenetrable thickets, which can displace native species and alter vegetation structure in formerly open areas. This species is widely known as a pantropical weed. Because it appears to have greater impacts on biodiversity in other regions (e.g. Australia), it may have more significant impacts in the U.S. in the future, as it increases its range and local abundance. However, it has been cultivated in Florida since 1900, so it is also possible that its impact will not increase in the future.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Low

NON-NATIVE THROUGHOUT NATION

NATIVE RANGE: Native to Central and South America and the Caribbean, including southern Mexico, Belize, Costa Rica, Guatemala, Honduras, Nicaragua, Panama, French Guiana, Guyana, Venezuela, Brazil (Rio de Janeiro), Colombia, Ecuador, Antigua, Barbados, Cuba, Dominica, Dominican Republic, Grenada, Haiti, Jamaica, Martinique, Montserrat, Puerto Rico, St. Kitts and Nevis, St. Lucia, St. Vincent and Grenadines (GRIN 2001).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999)

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S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Predominantly invades human-disturbed, open sites, such as roadsides, waste places, pastures, and old fields (Small 1933, Wunderlin 1982, Langeland and Burks 1998, Wunderlin and Hansen 2003, FLEPPC 2005); more rarely found on naturally disturbed sites such as landslides, riverbanks, open native vegetation, and forest clearings and edges (Cuda et al. 2002, Francis 2003, Scher 2004, PIER 2005). Forest habitats within which it has been found include hardwood forest (e.g. hammocks or tree islands) and maritime forest (FLEPPC 2005). Also invades swamps (Small 1933, Langeland and Burks 1998, Scher 2004, FLEPPC 2005).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

D - INSIGNIFICANT

COMMENTS: Although this species has been naturalized since at least the 1930s (Small 1933), no reports of impacts on ecosystem processes or system-wide parameters were found. Also, although it is naturalized throughout the tropical regions of the world, no mention was found of impacts in these areas. Therefore, assume impacts insignificant.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: This species is a shrub that has been noted to form large, impenetrable thickets (Langeland and Burks 1998, Cuda et al. 2002, Scher 2004, Bugwood Network et al. 2005, PIER 2005). Because it predominantly invades open sites, these thickets may often add a new layer to the vegetation. However, in other invaded habitats, such as forest edges and swamps, the thickets probably form within an existing shrub layer and therefore cause less significant changes.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Given an equal start after disturbance, this species has been recorded to overtop other herbs, grasses, and shrubs (Francis 2003). Thickets created by this species may displace native vegetation (Medal et al. 2002, Bugwood Network et al. 2005), and the often impenetrable nature of these thickets may impede the natural passage of wildlife (Scher 2004).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not significant.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

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COMMENTS: Because this species predominantly invades disturbed habitats, assumption is that it does not often threaten species or communities of conservation significance. Some of the Florida swamp habitats it invades may have some conservation significance, but there was no evidence that these areas represent high-quality swamp communities.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

C - LOW SIGNIFICANCE

COMMENTS: A subtropical/tropical species with a limited U.S. range. Most abundantly established in southern Florida, where it occurs in at least 6 counties (Langeland and Burks 1998). Also more scattered establishment in central and northern Florida (at least 3 counties total, Cuda et al. 2002), as well as in Mobile County, AL and Washington County, MS (Kartesz 1999). Apparently recorded in MD in the early 1960s (Kartesz 1999). In Hawai'i, it is established on O'ahu and Maui (Wagner et al. 1999). Altogether, range occupies <5% of U.S. land area.

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Reported from 3 natural areas in Broward and Collier counties, FL (Langeland and Burks 1998); also reported from less-disturbed habitats (hardwood forest, swamp, and dune/maritime forest) in Broward County, FL (FLEPPC 2005). Noted as invasive in FL, but not in the other states it has invaded (Swearingen 2005).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

C - LOW SIGNIFICANCE

COMMENTS: Approximately 5 continental ecoregions + Hawai'i are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Can apparently tolerate either wet or relatively dry soil, though it prefers soils that are moist and fertile (Scher 2004, Bugwood Network et al. 2005, PIER 2005). Prefers full sunlight and can tolerate partial shade, but cannot tolerate full shade, such as that under a closed forest canopy (Francis 2003). Predominantly invades human-disturbed, open sites, such as roadsides, waste places, pastures, and old fields (Small 1933, Wunderlin 1982, Langeland and Burks 1998, Wunderlin and Hansen 2003, FLEPPC 2005); more rarely found on naturally disturbed sites such as landslides, riverbanks, open native vegetation, and forest clearings and edges (Cuda et al. 2002, Francis 2003, Scher 2004, PIER 2005). Forest habitats within which it has been found include hardwood forest (e.g. hammocks or tree islands) and maritime forest (FLEPPC 2005). Also invades swamps (Small 1933, Langeland and Burks 1998, Scher 2004, FLEPPC 2005).

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SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Appears to be spreading slowly both within and outside Florida. Although it had been collected only a few times in south Florida by 1974 (Langeland and Burks 1998), it has now been reported in at least nine Florida counties (Cuda et al. 2002). Also, a new state record for Alabama has apparently been reported within the past 5 years (Kartesz 1999). In Hawai'i, it established on Maui in 1954 and has since spread to O'ahu (Wagner et al. 1999); biologists predict further spread within O'ahu (USGS 2003). However, some new reports may be due to increasing awareness of the species' invasive potential rather than to actual geographic spread. This increased awareness probably resulted from the recent dramatic spread and impact of its congener, tropical soda apple (*S. viarum*), in the southeastern U.S. (Cuda et al. 2002).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Given establishment in Alabama and Mississippi, parts of Georgia and South Carolina appear suitable. The remaining Hawaiian islands are probably suitable as well. Given that the species is native to relatively moist, subtropical and tropical areas, much of the remainder of the U.S. is likely unsuitable.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This species has been listed as a federal noxious weed and is also on the state noxious weed lists of Florida, Alabama, and Hawaii, as well as a number of other states in which it has not yet established (GRIN 2001). Despite these listings, some people, especially in Florida, continue to cultivate it, as a yard plant and for its sharp-tasting immature fruits (Langeland and Burks 1998, Cuda et al. 2002, Scher 2004). It has been found cultivated in Florida within the last 10 years (Scher 2004). Seeds are also dispersed by birds throughout the invaded range (Langeland and Burks 1998, Cuda et al. 2002, Francis 2003, Scher 2004, PIER 2005).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Increases in disturbance generally allow this species to increase in local abundance (Francis 2003). Appears to be spreading slowly within Florida. Although it had been collected only a few times in south Florida by 1974 (Langeland and Burks 1998), it has now been reported in at least nine Florida counties (Cuda et al. 2002). In Hawai'i, biologists predict further spread within O'ahu (USGS 2003).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Frequently associated with disturbance, especially human disturbance (Small 1933, Wunderlin 1982, Langeland and Burks 1998, Wunderlin and Hansen 2003, FLEPPC 2005). However, also apparently capable of invading relatively undisturbed swamp areas (Small 1933, Langeland and Burks 1998, Scher 2004, FLEPPC 2005).

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15. SIMILAR HABITATS INVADED ELSEWHERE

B - MODERATE SIGNIFICANCE

COMMENTS: Naturalized throughout the tropical regions of the world, including West and Central Africa, South Africa, Indian subcontinent, Southeast Asia, China, Japan, Pacific Islands, Australia, New Zealand, New Guinea (Langeland and Burks 1998, Randall 2002, Scher 2004, Bugwood Network et al. 2005). Considered a weed in 32 countries, and a serious or principal weed in 7 of these (Langeland and Burks 1998). Appears to be somewhat more aggressively spreading into natural areas in at least some of these places; for example, it has been noted as an environmental weed in Queensland, Australia (Randall 2002) and has been reported to be impacting the native vegetation in Fiji (Tuiwawa 2005).

16. REPRODUCTIVE CHARACTERISTICS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Sprouts from lateral rhizomes to form thickets (Cuda et al. 2002) and also reproduces by seed.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Mechanical control is possible, but must be done by grubbing out entire plants; lopping is not effective (Francis 2003, PIER 2005). Effective control can also be achieved by applying herbicide (e.g. glyphosate, 2,4-D, picloram or triclopyr) to cut stumps (Francis 2003, PIER 2005); this method was estimated to cost approximately $185 per hectare when used on the congeneric tropical soda apple (*S. viarum*) (Cuda et al. 2002). Several leaf-eating chrysomelid beetles (*Leptinotarsa texana*, *Leptinotarsa undecimlineata*, and *Metriona elatior*) have shown promise as potential biological control agents for *Solanum torvum*, but further testing of non-target impacts remains to be completed before these can be cleared for release into the wild (Cuda et al. 2002, Medal et al. 2002, PIER 2005).

18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS: If mechanical control only (grubbing) is employed, resprouting can occur and delay the completion of the effort. No evidence was found that the seed bank is particularly long-lived.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: If mechanical control only (grubbing) is employed (i.e. if herbicide is not an option), the control operation may result in significant soil disturbance, with consequent impacts on natives.

20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: Predominantly invades human-disturbed areas, which should not present access problems. However, swamp areas are also invaded; these will likely be more difficult to access.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Sonchus arvensis

ELEMENT NATIONAL ID: 197514
SCIENTIFIC NAME: *Sonchus arvensis*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-18
EVALUATOR: K. Maybury

I-RANK: Medium/Low

I-RANK REASONS SUMMARY:
This is primarily known as a problematic weed species of annual croplands, especially in the northern U.S. It is typcially found in cultivated fields, roadside ditches, and other very ruderal habitats, and in most parts of the U.S. it is not a major problem in natural areas. However, it has extremely wide environmental tolerances and in a few situations at least it has invaded natural communities of high conservation concern. Additional research on this species' impact in natural areas, particularly in natually disturbed wet and/or saline habitats in parts of the West, is warranted. It can be an aggressive invader of disturbed areas and, once established, can persist for long periods and is difficult to control or eradicate. It may have the potential to become more abundant in the southern continental U.S. and to establish in Hawaii.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Low

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Europe

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species has been listed among the most frequently listed in a recently compiled database of noxious weeds in the United States and Canada (Skinner et al., 2000).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS:

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SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No significant impacts reported.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: This coarse perennial herb can reach 2 m in height (Butterfield et al. 1996) and can form vigorous stands; it could potentially alter the density and height of the herbaceous layer.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: McWilliams (2004), who conducted an extensive literature review, notes that information about the impacts of this species on natural communities is absent from the literature; however, Butterfield et al. (1996) state that, once established, this species has the potential to modify existing native plant communities and it may modify or delay succession through the suppression or reduction of plant species that might otherwise establish over time.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No indications of disproportionate impacts.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

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COMMENTS: This is primarily known as a problem weed in cultivated fields and is also found in other highly disturbed areas and waste places such as roadside ditches (Butterfield et al. 1996, Rutledge and McLendon 1996, McWilliams 2004). However, it can also invade riparian systems (e.g., Rice and Harden 2002), saline meadows and prairies (McWilliams 2004), and other habitats that may be of much greater conservation concern. It has been found (but was not frequent or abundant) in the habitat of the Federally Listed Threatened desert tortoise in the Mojave and Colorado deserts (Brooks and Esque 2002). McWilliams (2004) notes that it can invade open wet sites even with little soil disturbance and further notes that information about the impacts of this species on natural communities is absent from the literature. Per a 2006 email discussion among botanists and ecologists in the Network of Natural Heritage programs and Conservation Data Centres in the U.S. and Canada, this species is strictly ruderal and *not* thought to be a problem in any high quality natural areas in much of the U.S.: Maine, New York, West Virginia, Kentucky, Ohio, Michigan Wisconsin, Missouri, and Nevada and other adjacent Great Basin areas (pers. comms. from D. Cameron, S. Young, J. Vanderhorst, D. White, R. Gardner, M. Penskar, K. Kearns, T. Smith, and J. Morefield); it is probably not a serious problem in Colorado (J. Rocchio and K. Schultz, pers. comms.) although it has established in some native riparian communities there (J. Rocchio, pers. comm.). However, there appear to be special circumstances where the species does (or could) impact high quality habitats and native species of conservation concern. Most notable are high-salinity streamside habitats in Wyoming and Idaho where it occurs with great abundance with *Spiranthes diluvialis*, a Listed Threatened species (G. Jones, pers. comm; B. Colket, pers. comm.; Jones 2000; Jones 2001). The disturbance that allows *Sonchus arvensis* to establish in these areas is natural flooding, rather than livestock or human activities (G. Jones, pers. comm.). Other areas where there may be reason for concern are native habitats in the ecotone between wetland and upland in South Dakota, where it can be a pernicious invader (although not as abundant as *Cirsium arvense*) (D. Ode, pers. comm.) and some coastal salt marshes (it has been noted in eastern Canada in very remote and otherwise pristine salt marsh areas per W. Bakowsky and S. Blaney, pers. comms.). More research on this question is clearly warranted.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Documented in most of the U.S. though less frequent in the South (J. Kartesz, unpublished draft distribution data).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B - MODERATE SIGNIFICANCE

COMMENTS: This species has been listed among the most frequently listed in a recently compiled database of noxious weeds in the United States and Canada (Skinner et al., 2000). Negative impacts assumed only in portions of the generalized range. This species is very rare to infrequent in the southern states and is not impacting natural areas in many areas.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS:

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9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Found in a wide range of habitats including very wet soils, dry soils, and saline situations (McWilliams 2004) ranging from Maine and Alaska to the Mojave Desert.

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Unknown but assumed not expanding in all directions nor decreasing.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: Already widespread but there is no obvious reason why this species could not spread farther into the Southeast and into Hawaii (where it has not yet been reported). It is clearly tolerant of subtropical and tropical conditions as it occurs in Fiji, Samoa, Tonga, and New Caledonia (PIER 2003) as well as Louisiana and possibly Mississippi (J. Kartesz, unpublished draft distribution data).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Seeds are primarily wind dispersed (Butterfield et al. 1996, Harris and Peschken 2005) but maximum wind dispersal distance may be only about 33 feet (Sheldon and Burrows 1973 as cited in McWilliams 2004). The seeds are also spread through contaminated hay and via animal fur (Harris and Peschkin 2005) and presumably through contaminated agricultural seed since the first introduction to the U.S. was thought to be via contaminated seed (Long 1922 as cited in McWilliams 2004).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

U - UNKNOWN

COMMENTS: Unknown.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: This is an early successional species (McWilliams 2004) that is somewhat shade tolerant but grows best in full sun (Butterfield et al. 1996). It is essentially a pioneer species but it can *persist* at mid-successional sites (those disturbed in the last 11-50 years) and may even delay succession (Butterfield et al. 1996). The degree to which it can persist once established is of concern (B. Bennett, pers. comm., W. Rapp, pers. comm.); it has persisted around an old homestead on an infrequently visited island in southeastern Alaska for approximately 70 years with minimal human disturbance (W. Rapp, pers. comm.).

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15. SIMILAR HABITATS INVADED ELSEWHERE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Escaped and naturalized in similar habitats in the Pacific Islands (PIER 2003) and yet not currently documented for the U.S. tropics (Hawaii and South Florida). Also escaped in Canada.

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: Characterized as a "rapid and opportunistic invader" by Harris and Peschken (2005). This species is a prolific seed producer (McWilliams 2004) with seeds that remain viable for at least 3 years (McWilliams 2004) or as long as 6 (Rutledge and McLendon 1996). It reproduces both vegetatively and by seed and even tiny fragments of the easily-broken roots can establish new plants (Harris 1996 as cited in McWilliams 2005). The spreading rootstocks can reach a depth of 2 m (Butterfield et al. 1996), which enables the plants to survive even deep cultivation and fire.

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: McWilliams (2004) notes that there is no information on control of this species in natural areas but sources (focused on control in annual croplands) indicate that the species is resistant to most broadleaf herbicides. The deep roots make tilling and fire poor alternatives, so control is assumed to be difficult.

18. MINIMUM TIME COMMITMENT

C - LOW SIGNIFICANCE

COMMENTS: Rutledge and McLendon (1996) state that *continuous* removal of of above ground parts over a period of 80 days will exhaust underground food reserves.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Uncertain. Continuous removal (cutting or mowing), assuming it is possible at all, would would presumably be extremely difficult to do in a selective way.

20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: Many infestations are on agricultural and other private lands but this is considered a noxious weed and presumably there would be no objections to control efforts that would benefit nearby natural areas by eliminating the seed source for reinvasion following disturbance.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Sorghum halepense

ELEMENT NATIONAL ID: 239438
SCIENTIFIC NAME: *Sorghum halepense*
COMMON NAME: Johnson Grass
I-RANK REVIEW DATE: 2006-06-27
EVALUATOR: J. Cordeiro, rev. K. Gravuer

I-RANK: High/Medium

I-RANK REASONS SUMMARY:
Johnson grass has been shown to severely inhibit pioneer grass species which normally appear in abandoned fields and can persist in almost pure stands for many years. The massive size (up to 3 m tall) of this plant creates difficulties for the establishment of other plants and rapid growth of rhizomes also provides the plant with a competitive edge over other species. It is one of the most frequently listed noxious weeds in the U.S. and occurs throughout the entire southern half of the country. The plant is self-pollinated, aggressive, and wind dispersed though humans often disperse it during field cultivation. Although it can colonize undisturbed sites as a pioneer species, it is often found in old fields or previously cultivated areas. Control is difficult and costly and, although some selective herbicides have been developed, such treatment usually impacts natives.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	High/Medium

OTHER CONSIDERATIONS:
There are numerous ecotypes of this species and the weed Johnson grass originated either from the Mediterranean ecotype or the tropical ecotype. Johnson grass, the introduced weed that has inundated disturbed lands throughout the world, is a slender plant with relatively small inflorescences and narrow leaf blades that is more characteristic of the plants from the Mediterranean region than the robust plants of tropical ecotypes (Monaghan, 1979; Warwick and Black, 1983; De Wet, 1978). Additionally, the tetraploid chromosome number of the introduced New World plant is the same as the Mediterranean ecotype, whereas the tropical ecotype is diploid (Warwick and Black, 1983). *Sorghum halepense* and *Sorghum bicolor* are not easily distinguished from one another as monophyletic taxa when restriction site variation was analyzed in chloroplast DNA of the two species (Duvall and Doebley, 1990). These two species are known to form fertile hybrids when an unreduced pollen grain of *S. bicolor* fertilizes *S. halepense* (Celarier, 1958). Introgression could also be achieved through partially fertile triploid intermediates.

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: This species is cosmopolitan and believed to be native to the Mediterranean region (Agricultural Research Service USDA, 1971; Newman, 1993; Howard, 2004).

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SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Sorghum halepense is considered to be one of the ten worst weeds in the world (Holm et al., 1977). Fifty-three countries, ranging in latitude from 55 N to 45 S report Johnson grass as a major problem; the problem is most serious in the region from the Mediterranean to the Middle East and India, Australia, central South America and the Gulf Coast of the United States (Holm et al., 1977; Newman, 1993; Howard, 2004). This species has been listed among the most frequently listed in a recently compiled database of noxious weeds in the United States and Canada (Skinner et al., 2000). It was originally introduced as a forage crop but has become naturalized throughout the southern United States and west coast and is spreading northward into New York, Massachusetts, Michigan, and other regions (Newman, 1993; Uva et al., 1997).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: By the end of the 19th century Johnson grass was growing throughout most of the United States (McWhorter, 1981). New ecotypes have evolved allowing the species to expand its range (Newman, 1993).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C - LOW SIGNIFICANCE

COMMENTS: Little is known about the effect of this species on ecosystem processes, but considering the magnitude of its effects on community structure and individual natives, it is likely the species has some negative effects.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Johnson grass has been shown to severely inhibit pioneer grass species which normally appear in abandoned fields and can persist in almost pure stands for many years (Abdul-Wahab and Rice, 1967). The massive size (up to 3 m tall) of this plant creates difficulties for the establishment of other plants. The rapid growth of rhizomes also provides the plant with a competitive edge over other species; the plant directly shades other plants, decreases nutrient and moisture availability to other plants, and possibly inhibits the growth of other plants via the production of allelopathic chemicals (Holm et al., 1977; Warwick and Black, 1983).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B - MODERATE SIGNIFICANCE

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COMMENTS: Little is documented on Johnson grass' impact in wildlands, and further research is needed on how Johnson grass affects wildland habitats. Generalizations about Johnson grass must always be qualified because of numerous ecotypes. Typically, Johnson grass is a good competitor for nutrients, space, and water resources. It can outcompete associated species for water by extracting water from lower soil profiles (12 inches (30 cm) or more below ground). Johnson grass may also negatively impact plant community composition through its reputed allelopathy. Cyanogenetic glycosides and other toxins in Johnson grass may inhibit germination and growth of associated plant species (see Howard, 2004). Crowding of Johnson grass results in intraspecific competition. A delay in rhizome and panicle formation, and a reduction in total final dry weight results as the density increases from one to twenty plants per 20 cm pot (Williams and Ingber, 1977). Shoot growth is affected more than rhizome growth when the plants are stressed. The initial rhizome growth rate, but not the final size of the rhizomes, is affected by crowding. This quality, which accounts for the exceptional competitive ability, could result from an accelerated transfer of photosynthates from the shoot to the rhizomes. Although delayed, flower and seed development occurs even in the most crowded conditions, indicating a significant partitioning of photosynthates to insure reproductive success (Williams and Ingber, 1977). Along forest edges it can slow the natural succession of fields to woodlands (Akerson and Gounaris, 2000).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Dead stems and leaves of this perennial herb cover the ground all winter. It aggressively crowds out native species, most often along riverbanks, but also along forest edges (Akerson and Gounaris, 2000). Friedman and Horowitz (1970) showed a retardation effect in barley, mustard and wheat as well as in other Johnson grass plants by both an exudate from Johnson grass and decaying plant matter. An allelopath from Johnson grass, dhurrin, inhibited seed germination and seedling development in several plant species (Warwick and Black, 1983).

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: No direct evidence is available on the impact of this species on native species of conservation concern but it can be inferred, based on its widespread distribution and magnitude of effects on individual natives and community composition, that some deleterious effect on conservation concern species would result.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: This species occurs approximately throughout the entire southern half of the United States and nearly every northern state extending as far north as central New York, New Hampshire and Vermont in the east and southern Oregon and disjunct parts of Washington in the west with a distinct area in central Washington and Oregon (Agricultural Research Service USDA, 1971; USDA, 2006). It was originally introduced as a forage crop but has become naturalized throughout the southern United States and west coast and is spreading northward into New York, Massachusetts, and other regions (Uva et al., 1997).

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7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B - MODERATE SIGNIFICANCE

COMMENTS: This species has been listed among the most frequently listed in a recently compiled database of noxious weeds in the United States and Canada (Skinner et al., 2000). It is listed as a noxious weed in 18 U.S. states (USDA, 2006). Johnson grass is now widely escaped from cultivation in much of the United States. It is most invasive in the Southeast, although it is widespread in central California and New Mexico (Wunderlin, 1998; McWhorter, 1989). Johnson grass is not persistent in the Pacific Northwest, upper northern Great Plains, extreme northern portions of the Great Lake states, the Northeast; or in Arizona, Colorado, and Utah (Howard, 2004).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: It is conservatively estimated that over half of the 81 ecoregions in the U.S. have been invaded by the invasive *Sorghum halepense* or its various ecotypes with almost all ecoregions having some ecotype present (Cordeiro, pers. obs. June 2006 based on TNC, 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Johnson grass occurs in cultivated and abandoned fields, forest edges, stream banks, roadsides, vacant lots or any disturbed ground (Akerson and Gounaris, 2000). The USDA Agricultural Research Service (1971) lists habitat in the United States as open ground, fields, and waste places; cultivated for forage. Johnson grass is adapted to a wide variety of soil types, however fertile porous soils support larger plants than poorly drained clay soils (Warwick and Black, 1983). It is most common in ecosystems with moist to mesic moisture regimes, including riparian, southern old-field, subtropical, and tropical habitats (Howard, 2004).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: This species occurs approximately throughout the entire southern half of the United States and nearly every northern state extending as far north as central New York, New Hampshire and Vermont in the east and southern Oregon and disjunct parts of Washington in the west with a distinct area in central Washington and Oregon (Agricultural Research Service USDA, 1971; USDA, 2006). It was originally introduced as a forage crop but has become naturalized throughout the southern United States and west coast and is spreading northward into New York, Massachusetts, and other regions (Uva et al., 1997). Because it is so ubiquitous, continued expansion can only occur into new portions of the existing range which seems to be the case for the more northern states.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

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COMMENTS: At least 18 states in the U.S. and the province of Ontario in Canada have officially declared Johnson grass as a noxious or prohibited weed (USDA, 2006). In addition, it is listed as in Uva et al. (1997) as an invasive weed in the northeast and in Whitson et al. (1996) weeds of the west. Local expansion has been tremendous, especially with the development of more highly tolerant ecotypes (several) that are, for the most part, highly invasive (Newman, 1993; Alex et al., 1979). It is most invasive in the Southeast, although it is widespread in central California and New Mexico (Wunderlin, 1998; McWhorter, 1989). Johnson grass is not persistent in the Pacific Northwest, upper northern Great Plains, extreme northern portions of the Great Lake states, the Northeast; or in Arizona, Colorado, and Utah (Howard, 2004).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Johnson grass is primarily self-pollinated. Some pollination is effected by wind, especially when plants are <</u> 425 feet (130 m) apart (Warwick and Black, 1983; Howard, 2004). When rhizomes are severed by cultivation, equipment can transport small pieces to other areas, including natural areas, to form new colonies (Uva et al., 1997). Shattering of the seeds from the spikelets enhances seed dispersal (Holm et al., 1977). Seeds that land in a water source may be carried, possibly quite far, to new sites. Other modes of dispersal include wind, livestock and contaminated machinery, grain or hay (Newman, 1993). Seeds pass unharmed through birds and cattle (Holm et al., 1977; Warwick and Black, 1983).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Local expansion has been tremendous, especially with the development of more highly tolerant ecotypes (several) that are, for the most part, highly invasive (Newman, 1993; Alex et al., 1979). It is most invasive in the Southeast, although it is widespread in central California and New Mexico (Wunderlin, 1998; McWhorter, 1989). Johnson grass is not persistent in the Pacific Northwest, upper northern Great Plains, extreme northern portions of the Great Lake states, the Northeast; or in Arizona, Colorado, and Utah (Howard, 2004). Although the species is widespread, it is still expanding rapidly within its non-native range in the U.S.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

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COMMENTS: Johnson grass is a pioneer species, and is often found on old fields, frequently inundated, or otherwise disturbed sites. Johnson grass is not restricted to disturbed sites, however, as it invades undisturbed tallgrass and coastal prairies, savannas, and riparian zones (Howard, 2004). Self-compatibility, immense seed production, effective dispersal techniques, seed dormancy and seed longevity are features which make *Sorghum halepense* a prolific weed (Newman, 1993). Although aboveground portions are killed by frost, the stout stems and seedheads persist well into winter (Holm et al., 1977; Uva et al., 1997). Cold tolerant ecotypes have been found growing in northern United States and southern Canada (Warwick and Black, 1983). Johnson grass is adapted to a wide variety of soil types, however fertile porous soils support larger plants than poorly drained clay soils (Warwick and Black, 1983). Most land-types, especially disturbed and flooded bottom lands, are susceptible to this tenacious and invasive weed (McWhorter, 1981). The massive creeping rhizome system and the abundance of dormant seeds protect this plant from severe conditions. Seed dormancy and longevity provide a source of seed in the soil which is ready to germinate when unfavorable conditions subside. The seed dormancy properties are dependent on the ecotype (Monaghan, 1979). The longevity of seeds varies depending on the environmental conditions in which the seed was stored. Seeds stored in the laboratory under dry conditions remained viable for over seven years. Studies in California showed a 50% viability in seeds stored for five years, however another study resulted in only 2% viability in seeds which remained in the soil for six years (Warwick and Black, 1983). Seeds buried in the soil for two and a half years displayed a 60% to 75% viability (Warwick and Black, 1983).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Because this species is so adaptable, it is assumed that the wide range of habitats occupied in the U.S. are similarly occupied elsewhere.

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

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COMMENTS: Self-compatibility, immense seed production, effective dispersal techniques, seed dormancy and seed longevity are features which make *Sorghum halepense* a prolific weed (Newman, 1993). This species is a perennial reproducing by large rhizomes and by seeds. Although growth of established populations is primarily through rhizomes, Johnson grass expands its distribution and establishes new populations through seed spread (Holm et al., 1977). The root system is freely branching, fibrous, and the rhizomes stout and creeping, often spreading to form vegetative stands (Agricultural Research Service USDA, 1971; Uva et al., 1997). This grass also easily propagates asexually by stem cuttings (Rea and Karper, 1932) and small or broken rhizomes, especially secondaries, can form new plants (Anderson et al., 1960; Stephens, 1980). Seed production is prolific. Depending on the ecotype, anywhere from 37 to 352 seeds can form on a panicle (Warwick and Black, 1983). A single Johnson grass plant produces 200 to 300 feet of rhizomes in one month and 10 bushels of seed can be produced on one acre in a single growing season (McWhorter, 1981). The life-cycle of *Sorghum halepense* is conducive to its survival in a wide range of environmental conditions (Holm et al., 1977; Monaghan, 1979; Warwick and Black, 1983). Growth from the apical or axillary nodes on the primary rhizomes which have survived the winter begins as temperatures increase in the spring. The secondary structure, the annual above- and below-ground growth, uses the stored carbohydrates from the primary rhizome to get a rapid, early start in growth (Holm et al., 1977). Depending on the climate, flowering begins roughly two months after growth commences and continues throughout the growing season. Most of the year's rhizome growth takes place after flower production (Warwick and Black, 1983), however, no causal relationship exists between the two (Horowitzk, 1972; Monaghan, 1979). The tertiary rhizomes which grow deep into the soil (as deep as 120 cm) survive the winter and become the following season's primary structure (Holm et al., 1977; Warwick and Black, 1983). The remains of the primary rhizomes from the previous year's growth decay as the temperature begins to drop (Holm et al., 1977). Hundreds of seeds are produced on each panicle throughout the summer flowering period (Monaghan, 1979; Warwick and Black, 1983). Seedlings emerge later and grow slower than rhizome sprouts, but the pattern of development is similar between the two structures (Warwick and Black, 1983). Johnson grass builds up a soil seed bank and seeds may remain viable for several years (Howard, 2004).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/B - HIGH/MODERATE SIGNIFICANCE

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COMMENTS: Complete eradication of *Sorghum halepense* is extremely difficult. It was recognized as one of the six most damaging weeds in the United States by the turn of the 20th Century, and was the first weed targeted by the USDA for research on control methods (Holm et al., 1977; McWhorter, 1989). The immense number of seeds which are produced on each panicle and which remain dormant until favorable conditions prevail provide a reservoir of potential plants. Rhizomes which over-winter deep in the soil make the subterranean portion of the plant difficult to control. The majority of the buds on the rhizomes remain dormant and thus herbicide or cultivation techniques will not harm these inactive regions. However, fragmenting the rhizomes will relieve axillary buds from apical dominance, allowing for their growth and thus increasing their susceptibility to control techniques. In addition, seed viability is drastically reduced from 50% to 2% after five years and six years, respectively, in the soil. The seed-supply in the soil can be expunged if seed development is prevented. The most likely mode of preventing the spread of *Sorghum halepense* is by maintaining undisturbed land contiguous to the invaded area (Newman, 1993). When cut, rhizomes underground resprout to form new plants. At all times, including during favorable conditions, the majority of rhizome buds will not be growing (due to physiological dormancy), thus the application of herbicides will have little to no effect on the viability of these inactive regions (Newman, 1993; Monaghan, 1979). The plants are resistant to many herbicides; glyphosates are recommended (applied to leaves or stems late in the season) because they are biodegradable. Small stands may be controlled by pulling plants when soil is moist. Severe infestations can be controlled by repeated winter tilling to expose and kill root material. Spring burning is discouraged as it encourages regrowth (Akerson and Gounaris, 2000). Regardless, the cost of burning is now more than the cost of herbicides so this practice has been largely ceased (McWhorter, 1981). Fire may be a useful tool in controlling Johnson grass as long as it is used in conjunction with follow-up treatments to control rhizome sprouts (see Howard, 2004 for more information on management with fire).

18. MINIMUM TIME COMMITMENT

B - MODERATE SIGNIFICANCE

COMMENTS: Several techniques may be helpful in controlling *Sorghum halepense*: torching and burning, mowing and grazing, tilling and plowing and herbicide applications. These methods primarily focus on starving the plants by reducing growth, thus limiting photosynthesis which results in a reduction of stored carbohydrates and all require a multiple year time commitment (Newman, 1993). Glyphosate herbicide treatment must be repeated over several years to eradicate the seed bank (Akerson and Gounaris, 2000). Extremely high herbicide rates are necessary to control Johnson grass in wheat fields if no other mechanical control is employed (Brown et al., 1987). Fragmenting the rhizomes will relieve axillary buds from apical dominance, allowing for their growth and thus increasing their susceptibility to control techniques. In addition, seed viability is drastically reduced from 50% to 2% after five years and six years, respectively, in the soil. The seed-supply in the soil can be expunged if seed development is prevented (Newman, 1993). Due to persistence of underground rhizomes, all treatments require multiple (5+) years of application (Howard, 2004).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B - MODERATE SIGNIFICANCE

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COMMENTS: Dalapon and glyphosate are not specific for grasses and will kill any plant that is accidentally sprayed (McWhorter, 1981).The herbicide, Poast, is selective for monocots and can be used to kill grasses in mixed fields with broadleaf plants. Poast is expensive and since it kills all monocots, native grasses, etc. would also be destroyed (Heathman pers. comm. in Newman, 1993). Glyphosate is recommended for controlling Johnson grass in natural, non-agricultural sites (Brookbank pers. comm., K. Hamilton pers. comm., Heathman pers. comm., all in Newman, 1993; Lorenzi and Jefferey, 1987). As of 2004, there are no biocontrol agents approved for Johnson grass, but several biological agents are being tested for possible use (Howard, 2004).

20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: As this species frequently occurs on private land, particularly grasslands, some access issues will arise and cooperation with landownders for management will be necessary.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Stellaria media

ELEMENT NATIONAL ID: 240303
SCIENTIFIC NAME: *Stellaria media*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-24
EVALUATOR: Gravuer, K.

CALCULATED I-RANK: Low/Insignificant
I-RANK: Low

I-RANK ADJUSTMENT JUSTIFICATION:
Adjusted from Low/Insignificant to Low because quantitative range centered on Low rank and just barely entered Insignificant rank.

I-RANK REASONS SUMMARY:
Stellaria media is an extremely widespread and common species in the United States and throughout the world. It prefers cooler, more humid climates, tolerating very low temperatures and shade but being notably sensitive to drought. It is found predominantly in open disturbed areas (e.g. lawns, gardens, and agricultural fields, roadsides) and additionally in more grassland-like communities and in (often disturbed) upland forests. This species is a prolific seed producer and can continue reproduction through the winter in many areas of the U.S., allowing it to reach high abundances. However, it is not a strong competitor and does not appear to have significant effects on the composition of natural communities. Additionally, this species appears dependent upon continual or periodic soil disturbance and is replaced by perennial communities when the disturbance ceases. Mechanical management methods are not very effective, but the species can be controlled by some commonly-used herbicides.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Low

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Probable origin Eurasia (USDA ARS 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

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COMMENTS: Found predominantly in open waste places (e.g. sidewalks, lawns, gardens, weedy agricultural fields) including roadsides and railroad ROWs; also in more grassland-like communities such as pastures and meadows. Additionally, invades (often disturbed) upland forest and woodland habitats (both coniferous and deciduous), where it is usually found along trails or streambanks (Drew and Helm 1941, Muenscher 1955, Buchholtz et al. 1960, Agricultural Research Service 1970, Holm et al. 1977, Voss 1985, Gleason and Cronquist 1991, Wagner et al. 1999, Defelice 2004, Wisconsin State Herbarium 2006, Saskatchewan AFRR no date).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: This species was introduced to North America by at least 1672 (Defelice 2004). Despite being present for over 300 years, few reports of impacts on ecosystem processes or system-wide parameters were found. One report of possible allelopathy was found (Defelice 2004). However, given that this species is extremely common, widespread, and of economic importance as an agricultural weed, assumed that more reports would have been found if the species was strongly allelopathic.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

COMMENTS: This species roots at the nodes and forms mats (Holm et al. 1977, Sobey 1981, UC IPM Online 2004, Alaska Natural Heritage Program 2006), even when actual plant density is low (Sobey 1981). These mats may cause changes in the density and/or cover of the herbaceous layer.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C - LOW SIGNIFICANCE

COMMENTS: This species roots at the nodes and forms mats (Holm et al. 1977, Sobey 1981, UC IPM Online 2004, Alaska Natural Heritage Program 2006), even when actual plant density is low (Sobey 1981). These mats may shade young seedlings of other plants (Alaska Natural Heritage Program 2006). Although not widely believed to be a strong competitor (Holm et al. 1977), this species' ability to tolerate extremely low temperatures sometimes enables it to initiate growth well before competing species, sometimes enabling it to reduce the yield of co-occurring species substantially (Holm et al. 1977, Manitoba AFRI 2003).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not significant.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C - LOW SIGNIFICANCE

COMMENTS: Predominantly invades low-quality, disturbed habitats. Although it has been found in upland forest communities in at least Michigan and Wisconsin (Voss 1985, Wisconsin State Herbarium 2006), it is often found in disturbed areas within these communities (e.g. along trails or streambanks) (Voss 1985).

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SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Established in every state (Kartesz 1999) and common throughout the U.S. (Muenscher 1955, Crockett 1977). In North America, as one progresses from coastal to continental regions, this species appears to decline in importance as a weed (Sobey 1981); it attains its highest economic importance as a weed in the eastern U.S. (Agricultural Research Service 1970).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C - LOW SIGNIFICANCE

COMMENTS: Appears to be most problematic in the mid-Atlantic and northern southeast (reported as invasive by PA, NJ, MD, VA, WV, KY, TN, NC) as well as in Hawaii (reported as invasive in HI) (Swearingen 2006).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: Greater than 35 ecoregions are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Most successful in cooler, more humid regions; in North America, as one progresses from coastal to continental regions, this species appears to decline in abundance. It can tolerate very low temperatures but is notably sensitive to drought. It will grow on a very wide range of soils, but prefers well-aerated, moist but not waterlogged, weakly acidic to alkaline, nitrogen-rich soils. This species has a wide light tolerance (full sun to complete shade) as well (Holm et al. 1977, Sobey 1981). Found predominantly in open waste places (e.g. sidewalks, lawns, gardens, weedy agricultural fields) including roadsides and railroad ROWs; also in more grassland-like communities such as pastures and meadows. Additionally, invades (often disturbed) upland forest and woodland habitats (both coniferous and deciduous), where it is usually found along trails or streambanks (Drew and Helm 1941, Muenscher 1955, Buchholtz et al. 1960, Agricultural Research Service 1970, Holm et al. 1977, Voss 1985, Gleason and Cronquist 1991, Wagner et al. 1999, Defelice 2004, Wisconsin State Herbarium 2006, Saskatchewan AFRR no date).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: Recorded in New England in 1672 (Defelice 2004) and had reached the Great Lakes states by at least 1869 (Voss 1985). Currently occurs throughout the U.S. with a distribution highly congruent with its abiotic preferences (NRCS 2006), so assumed generalized range to be relatively stable.

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11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Currently occurs throughout the U.S. with a distribution highly congruent with its abiotic preferences (NRCS 2006). Perhaps some potential for further expansion as human modifications create additional suitable areas (e.g. additional irrigation of arid lands in the West).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: No major economic use (Spencer 1940) and no morphological adaptation for long-distance dispersal (Holm et al. 1977). However, it can be dispersed long distance by animals (e.g. pigs, horses, cattle, deer, sparrows, quail, magpies, herring gulls, and ants (Sobey 1981)). In addition, it is still found at low levels as a contaminant in some commercial seed (e.g. wheat, barley, rye, oats, canola, mustard, timothy, swede, sugar beets, and kale (Manitoba AFRI 2003)) and in horticultural crops and topsoil (Sobey 1981, Alaska Natural Heritage Program 2006).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

C - LOW SIGNIFICANCE

COMMENTS: This species has a strong tendency to increase in abundance as habitats are disturbed by humans (Sobey 1981), so assumed some local increase.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: In the habitats it invades, this species appears dependent upon continual or periodic soil disturbance and enrichment (Sobey 1981). When the disturbance ceases, it is relatively quickly replaced by other plant communities that are dominated by perennials (Holm et al. 1977, Sobey 1981). It is shade-tolerant (Manitoba AFRI 2003), allowing it to invade forest and woodland habitats, but even in these habitats it is associated with soil disturbance corridors such as trails and streams (Voss 1985).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Naturalized essentially worldwide (Holm et al. 1977). However, it appears to be strongly associated with disturbed habitats everywhere it has invaded (Defelice 2004).

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: Produces over 1,000 seeds per plant annually; seed production generally ranges from about 750 to 30,400 seeds per plant (Defelice 2004), with an average seed output per plant of about 2,400 (Sobey 1981). Plants can endure extremely cold temperatures and may flower and seed all winter in most of the U.S., allowing several generations per year to be produced (Holm et al. 1977). Although seed is the most important method of reproduction, plants also often root at the nodes of their creeping stems, allowing vegetative reproduction to occur when stems are fragmented (Muenscher 1955, Crockett 1977, Sobey 1981, Alaska Natural Heritage Program 2006). Seeds appear to remain viable in the soil for more than three years (Sobey 1981).

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SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Mechanical control alone is not very effective because residual plant fragments can re-root to form new individuals. Also, this species cannot be effectively controlled by mowing because of its prostrate habit. Control by herbicide is probably the most efficient method, although the species is resistant to some (though not all) commonly used compounds (Crockett 1977, Sobey 1981, Alaska Natural Heritage Program 2006).

18. MINIMUM TIME COMMITMENT

B - MODERATE SIGNIFICANCE

COMMENTS: This species forms a relatively long-term seed bank (Sobey 1981). Various studies have estimated that it takes approximately 8-10 years to eliminate the seedbank completely (Holm et al. 1977, Sobey 1981, Defelice 2004).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: The necessity of using herbicide to manage this species suggests that there will likely be some impact on co-occurring natives.

20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: Most populations are located in disturbed habitats, suggesting that they would be easily accessible. However, the species is so widespread that some infestations are likely located on privately-owned land (e.g. lawn and garden populations).

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Invasive Species Assessment Protocol:
U.S. National Assessments

Thlaspi arvense

ELEMENT NATIONAL ID: 211423
SCIENTIFIC NAME: *Thlaspi arvense*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-28
EVALUATOR: Gravuer, K.

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:

Thlaspi arvense is established in every US state except Hawaii, being abundant in the northern states, especially in the northwest, and more sparsely established in the southeast. Predominantly, it is found in waste places and open disturbed areas, roadsides and railroads, and cultivated fields (e.g. cereals, grains, legumes) and field edges; it is also sometimes present in grasslands (e.g. pastures, grazed rangelands, meadows, and young prairies), old fields, riparian areas, and forest edges. It is widely described as a species found predominantly in (or sometimes even restricted to) disturbed habitats and is a significant weed of agriculture. Impacts on native communities appear low and restricted to early successional stages. However, this species is a prolific seeder (~ 7,000 seeds per plant) and forms a long-lived (up to 20-30 yr) seedbank, making it difficult to eradicate from an area once it becomes common.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Low

NON-NATIVE THROUGHOUT NATION

NATIVE RANGE: Native to much of Eurasia. European countries where native include Denmark, Finland, Ireland, Norway, Sweden, United Kingdom, Austria, Belgium, Czechoslovakia, Germany, Hungary, Netherlands, Poland, Switzerland, Belarus, Estonia, Latvia, Lithuania, Russian Federation (European part), Ukraine (incl. Krym.), Albania, Bulgaria, Greece, Italy, Romania, Yugoslavia, France, and Spain (incl. Baleares). Asian countries where native include Afghanistan, Iran, Turkey, Armenia, Azerbaijan, Georgia, Russian Federation (Eastern Siberia, Western Siberia, southern Far East), Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, northern Mongolia, and northern Pakistan. Also native to the Madeira Islands (USDA ARS 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

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S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Major habitats occupied include waste places and open disturbed areas, roadsides and railroad yards/ROWs, and cultivated fields (e.g. cereals, grains, legumes) and field edges. Also found in grasslands (e.g. pastures, grazed rangelands, meadows, and young prairies), old fields, riparian areas, and forest edges (Drew and Helm 1941, Fernald 1950, Muenscher 1955, Buchholtz et al. 1960, Hitchcock et al. 1964, Agricultural Research Service 1970, Best and McIntyre 1975, Great Plains Flora Association 1986, Gleason and Cronquist 1991, Plants for a Future 2001, IPAW 2003, NAPPO 2003, Welsh et al. 2003, Holmgren et al. 2005, Weakley 2006, Wisconsin State Herbarium 2006, WSSA no date).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: This species was introduced to North America probably by 1701 (WSSA no date). Despite being present for over 300 years, few reports of impacts on ecosystem processes or system-wide parameters were found. One report of possible allelopathy was found (Stefureac and Fratilescu-Sesan 1979, as cited in NAPPO 2003). However, given that this species is extremely common, widespread, and of economic importance as an agricultural weed, assumed that more reports would have been found if the species was strongly allelopathic.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: This species may grow as isolated plants, in small patches or in pure stands (Best and McIntyre 1975). It has been rated as having low competitive ability within ecological communities (IPAW 2003) and is recorded as a poor competitor with grass species such as *Agropyron cristatum*, *A. trachycaulum*, and *Bromus inermis* during the first season of establishment (Best and McIntyre 1975). However, it does compete sufficiently with crop species to cause significant yield reductions (WSSA no date). Potential structural impacts of this species appear to be limited to moderate changes in the density and/or cover of the herbaceous layer.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: It has been rated as having low competitive ability within ecological communities (IPAW 2003) and is recorded as a poor competitor with grass species such as *Agropyron cristatum*, *A. trachycaulum*, and *Bromus inermis* during the first season of establishment (Best and McIntyre 1975). However, it does compete sufficiently with crop species to cause significant yield reductions (WSSA no date). Impacts on community composition are likely limited to competition with other pioneer species. When this species colonizes abandoned land in prairie environments, it does not appear to have significant impacts on the normal pattern of succession (Best and McIntyre 1975, WSSA no date).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not significant.

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5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Major habitats occupied include waste places and open disturbed areas, roadsides and railroad yards/ROWs, and cultivated fields (e.g. cereals, grains, legumes) and field edges. Also found in grasslands (e.g. pastures, grazed rangelands, meadows, and young prairies), old fields, riparian areas, and forest edges (Drew and Helm 1941, Fernald 1950, Muenscher 1955, Buchholtz et al. 1960, Hitchcock et al. 1964, Agricultural Research Service 1970, Best and McIntyre 1975, Great Plains Flora Association 1986, Gleason and Cronquist 1991, Plants for a Future 2001, IPAW 2003, NAPPO 2003, Welsh et al. 2003, Holmgren et al. 2005, Weakley 2006, Wisconsin State Herbarium 2006, WSSA no date). This species is widely described as being found predominantly in (or sometimes even restricted to) disturbed habitats (e.g. IPAW 2003).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Established in every state in the US except Hawaii (Kartesz 1999). Apparently most abundant in the northern states, especially in the northwest (Muenscher 1955). Establishment appears more scattered in the southeast (NC west to TX and south) and in Alaska (Weakley 2006, NRCS 2006).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Noted as invasive in Great Smoky Mountains National Park (TN) and Craters of the Moon National Monument (ID) (Swearingen 2006). Impacts to native biodiversity appear minimal in most areas, although if impacts were to occur, they would be most likely in the northwestern US where the species' abundance is highest. A declared noxious weed seed in IN, KS, MI, MN, NE, NV, OH, SD, and WA (USDA ARS 2005).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: Greater than 35 ecoregions are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

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COMMENTS: Found on a range of soils, from dry to moist, though preferring soils that are moist and fertile; not very shade-tolerant. Major habitats occupied include waste places and open disturbed areas, roadsides and railroad yards/ROWs, and cultivated fields (e.g. cereals, grains, legumes) and field edges. Also found in grasslands (e.g. pastures, grazed rangelands, meadows, and young prairies), old fields, riparian areas, and forest edges. In eastern North America, it is mainly a weed of waste places; in the northwestern states, it becomes a more significant agricultural pest. Present from sea level to the lower mountains, up to about 2750 m (Drew and Helm 1941, Fernald 1950, Muenscher 1955, Buchholtz et al. 1960, Hitchcock et al. 1964, Agricultural Research Service 1970, Best and McIntyre 1975, Great Plains Flora Association 1986, Gleason and Cronquist 1991, Plants for a Future 2001, IPAW 2003, NAPPO 2003, Welsh et al. 2003, Holmgren et al. 2005, Weakley 2006, Wisconsin State Herbarium 2006, WSSA no date).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: It is likely that the species' introduction dates back to 1701 (WSSA no date), and it has been distributed throughout the US since at least 1937 (Best and McIntyre 1975, WSSA no date). No evidence was found that the species has been eradicated from any state. Therefore, the generalized range appears stable.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: In North America, the spread of this species does not appear to be restricted by climatic factors (Best and McIntyre 1975). In some areas of the US (e.g. Wisconsin), there does still appear to be potential for some local range expansion (IPAW 2003).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This species is often dispersed as a contaminant of crop seed; its has been reported as a contaminant of commercial oilseed rape seed stocks in the US (NAPPO 2003, USDA ARS 2005). It has also frequently been moved into the eastern states with western feed (Muenscher 1955). The seeds have wings which allow wind dispersal for moderate distances (e.g. 1 km) (NAPPO 2003). They also float in water, which facilitates dispersal by spring floods (WSSA no date).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

C - LOW SIGNIFICANCE

COMMENTS: This species is highly adapted to disturbance, so assumed local range is not decreasing. In Wisconsin, where it has been reported from most but not all of the counties (Wisconsin State Herbarium 2006), it appears to be spreading slowly (IPAW 2003).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

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COMMENTS: This species has an ancient association with agriculture and humans and has become widely adapted to disturbed lands (NAPPO 2003). It is widely described as a species found predominantly in (or sometimes even restricted to) disturbed habitats (e.g. IPAW 2003). In prairie environments, it has been noted as one of the four primary colonizers of abandoned land (Best and McIntyre 1975, WSSA no date).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: This species is present on every continent, but its distribution is limited in Africa and South America (NAPPO 2003). It has been identified as an agricultural weed in 45 countries (NAPPO 2003). Countries where naturalized include Canada, New Zealand, Australia, Mongolia, South Africa, Argentina, Chile, China, and Japan (Randall 2002). Habitats occupied appear to be largely similar in these places to those occupied in the US (Best and McIntyre 1975, Webb et al. 1988, NAPPO 2003).

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: Reproduces by seed only (Muenscher 1955, Buchholtz et al. 1960, Agricultural Research Service 1970, MAFRI 2003, NAPPO 2003, WSSA no date). A single plant may produce from 1,600 to 20,000 seeds, with an average production per plant estimated at approximately 7,000 seeds (Best and McIntyre 1975, NAPPO 2003, WSSA no date). This species also has a short life cycle and is able to produce a number of generations in a single growing season (NAPPO 2003). The maximum life of the seedbank has been estimated to be 20-30 years (Best and McIntyre 1975, NAPPO 2003, Peat and Fitter 2006, WSSA no date).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: The major issue with controlling this species is preventing formation of a seed bank, since it produces a prolific number of quite long-lived seeds which prolong the time needed for eradication once they get into the soil (Drew and Helm 1941, NAPPO 2003). It can be controlled by repeated tillage where practical (MAFRI 2003, Saskatchewan AFRR no date). If infestations are in natural meadow or grassland habitats, control can be accomplished by clipping the area just before the species comes into flower (Drew and Helm 1941). Although tolerant of some herbicides (NAPPO 2003, Bowran and Gill 2005), it is susceptible to a number of other compounds that are commonly used (Best and McIntyre 1975, NAPPO 2003), providing an additional control option.

18. MINIMUM TIME COMMITMENT

B - MODERATE SIGNIFICANCE

COMMENTS: The maximum life of the seedbank has been estimated to be 20-30 years (Best and McIntyre 1975, NAPPO 2003, Peat and Fitter 2006, WSSA no date). However, few if any seeds survive for more than 6 years in soil under continuous cultivation (Best and McIntyre 1975, WSSA no date).

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19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Broad application of herbicide or application of tillage or clipping to the entire habitat is likely to have some impact on co-occurring species. However, most of the species that co-occur with this species are not native.

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Because this species is a common weed of agriculture, some infestations are likely located on privately owned lands. However, its strong preference for disturbed habitats should enable most populations to be accessed easily.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Trifolium arvense

ELEMENT NATIONAL ID: 229682
SCIENTIFIC NAME: *Trifolium arvense*
COMMON NAME:
I-RANK REVIEW DATE: 2005-08-22
EVALUATOR: Gravuer, K.

I-RANK: Low

I-RANK REASONS SUMMARY:
Trifolium arvense is established in most of the eastern US, as well as in parts of the northwestern US and western California. It is best adapted to open habitats with sandy, nutrient-poor soils. Most established populations are found on roadsides and in other human-disturbed areas, but the species can also invade natural communities that feature these conditions, such as Palouse vegetation and pine barrens. In these more natural locations, the species' ability to fix nitrogen may have some biodiversity impact.

SUBRANK I - ECOLOGICAL IMPACT:	Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low/Insignificant

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Europe, temperate Asia, northern Africa, and northeast tropical Africa.
Africa: Algeria, Egypt, Libya, Morocco, Tunisia, Djibouti, Ethiopia, Sudan; Temperate Asia: Cyprus, Iran, Iraq, Israel, Lebanon, Syria, Turkey, Armenia, Azerbaijan, Georgia, Russian Federation (Ciscaucasia, Dagestan, Western Siberia [s.]), Kazakhstan, Turkmenistan; Europe: Denmark, Finland, Ireland, Norway, Sweden, United Kingdom, Austria, Belgium, Czechoslovakia, Germany, Hungary, Netherlands, Poland, Switzerland, Belarus, Estonia, Latvia, Lithuania, Moldova, Russian Federation (European part), Ukraine [incl. Krym], Albania, Bulgaria, Greece [incl. Crete], Italy [incl. Sardinia, Sicily], Romania, Yugoslavia, France [incl. Corsica], Portugal [incl. Azores, Madeira Islands], Spain [incl. Baleares, Canary Islands] (GRIN 2001).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

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S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Invades grasslands/meadows, riparian areas (riverbeds, lakeshores), coastal dunes, cliffs/coastal bluffs, sagebrush-grass community/Palouse vegetation, and woodland openings/pine barrens/forest edge (Farrell 1998, Weber 2003, Rice 2005, Wisconsin State Herbarium 2005).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: This species fixes nitrogen (Weber 2003). Although it is an herbaceous annual and therefore may not have high biomass per area, it does have a noted preference for nutrient-poor soils (Peat and Fitter 2005), indicating some potential to alter the nutrient balance in these areas.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

COMMENTS: Because this species is adapted to nutrient-poor soils (Muenscher 1955, Weber 2003), some areas where it establishes may have been previously devoid of vegetation. Therefore, there is the potential for moderate changes in the density or cover of the herbaceous layer.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C - LOW SIGNIFICANCE

COMMENTS: This species appears to be a moderately successful competitor (APRS Implementation Team 2001). Although some sources suggest that it can crowd out native species or dominate communities (Weber 2003, City of Portland 2004), others suggest that it is minimally aggressive (Urban Forest Associates 2002). Therefore, it may be able to outcompete a few native species, but should not exert a significant influence on community composition.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: Although the species has been established outside cultivation for at least 150 years (Wisconsin State Herbarium 2005), no mention of impacts on individual native species was found in the literature. Assumption is that any impacts are not significant or perceivable.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C - LOW SIGNIFICANCE

COMMENTS: Although the majority of populations are found in human-disturbed areas, this species has also been reported from a number of native species habitats. In particular, its ability to invade pine barrens and natural Palouse vegetation may have conservation impact.

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SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Throughout the eastern US (except south Florida; Wunderlin and Hansen 2003), with approximate western boundary running through center of MN and IA, following western border of MO, running through center of OK and south from there through TX (Ownbey and Morley 1991, Weber et al. 2005, Hoagland et al. 2004, Diggs et al. 1999). Kartesz (1999) reports the species from ND and KS, but it appears to be very infrequent in those states (Great Plains Flora Association 1977). In the west, the range includes western MT, northern ID, WA, northern and western OR, and CA west of the Sierras (California floristic province) (Rice 2005, Hickman 1993).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: This species has particular potential to negatively impact biodiversity where natural communities are present on sandy, relatively open soils. These areas may include parts of eastern WA and OR, pine barren areas including those of NJ and WI, and coastal areas. It has also been reported as invasive by the National Park Service in HI (Swearingen 2005).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: About 44 ecoregions are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: This species prefers sandy, nutrient-poor soils (Muenscher 1955, Weber 2003). The majority of populations are found in human-disturbed areas such as roadsides, waste places, and cultivated or previously cultivated fields (Rydberg 1932, Muenscher 1955, Steyermark 1963, Voss 1985, Seymour 1989, Isely 1991, Gleason and Cronquist 1991, Hickman 1993, Eilers and Roosa 1994, Diggs et al. 1999, Wunderlin and Hansen 2003, Weakley 2005). However, plants have also been reported from grasslands/meadows, riparian areas (riverbeds, lakeshores), coastal dunes, cliffs/coastal bluffs, sagebrush-grass community/Palouse vegetation, and woodland openings/pine barrens/ forest edge (Farrell 1998, Weber 2003, Rice 2005, Wisconsin State Herbarium 2005).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: This species is adapted to disturbed sites, so it is assumed that the range is not decreasing. Comparison of state, regional, and national floras also does not suggest recent or current spread in multiple directions, but the possibility of limited spread in some directions (e.g. further west from the western front of the eastern distribution) could not be ruled out.

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11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: This species already occurs over a large area of the US. However, its establishment in MN and MT suggests that it should not be restricted from additional northern areas with sufficient moisture, and its establishment in eastern OR and WA suggests that moisture may be sufficient in a number of currently uninvaded states.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Although its economic use in the US is limited, this species is occasionally planted as forage in some areas (Caddel 2004). In addition, seeds are wind-dispersed (Zohary and Heller 1984), so occasional long-distance dispersal events are possible.

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

C - LOW SIGNIFICANCE

COMMENTS: No reports of local expansion were found, and comparison of state, regional, and national floras does not suggest rapid local expansion. However, one source reports the population trend of this species as growing (BayScience Foundation 2005), which is likely since it is adapted to disturbance.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: The habitats invaded by this species are generally open, and most either experience periodic natural or human-caused disturbance or are likely to contain microsites devoid of vegetation.

15. SIMILAR HABITATS INVADED ELSEWHERE

B - MODERATE SIGNIFICANCE

COMMENTS: This species has also established in at least Canada, Australia, New Zealand, Chile, and Japan (Randall 2002). In New Zealand, it has invaded a cushion plant/bare ground habitat (Jamieson 1996) seemingly similar to that present in WY, where it has not yet invaded in the US. In addition, its presence in dry, saline habitats in Australia (Norman et al. 2003) may indicate some potential to invade similar habitats in the southwestern US.

16. REPRODUCTIVE CHARACTERISTICS

C - LOW SIGNIFICANCE

COMMENTS: This species is capable of producing a long-term persistent seed bank (Peat and Fitter 2005). One source also reported some resprouting potential (APRS Implementation Team 2001). It does not exhibit any other aggressive reproductive characteristics.

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SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

C - LOW SIGNIFICANCE

COMMENTS: Recommended methods of control include improvement of soil fertility and herbicides (PBI/Gordon Corporation 2005); in natural communities, herbicides would presumably be the method of choice. Weber (2003) notes that the same control methods used for other *Trifolium* species may apply to this species, and that for *Trifolium repens*, several widely-available herbicides can be effective.

18. MINIMUM TIME COMMITMENT

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: A variety of seedbank longevities have been reported for this species, from transient to long-term persistent (Peat and Fitter 2005). Therefore, typical control is assumed to take more than 2 years, but probably less than 10 years.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: If herbicides are used, these may impact natives. However, some habitats in which this species occurs are sparsely vegetated, so in these locations impacts will probably be minimal.

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Most of the populations, which occur on open, disturbed sites, should not present access problems. However, cliff/coastal bluff populations may prove challenging.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Trifolium pratense

ELEMENT NATIONAL ID: 217738
SCIENTIFIC NAME: *Trifolium pratense*
COMMON NAME:
I-RANK REVIEW DATE: 2005-07-27
EVALUATOR: Killeffer, T.

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:
This species ocurrs in every state in a variety of environments and is planted for forage (livestock and bees) thus many occurrences are probably on private lands. It is a nitrogen fixer but not considered to cause major alterations since it typically occurs in fields, roadsides, disturbed areas, prairies, open forest, forest edges, paths, gardens, and lawns. In crowded areas the species will stand upright competing for sun otherwise it sprawls on the ground, but can tolerate shade and wet soil. Said to be short-lived with slow initial growth unless there is ample moisture. Seed can persist and it has a thick, deep taproot. No mention of long-term problems with this species and it does not appear to be persistant so control and management would appear to be relatively easy.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High/Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Insignificant

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Europe (Weakley, 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: Fields, roadsides, disturbed areas (Weakley, 2005).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Prairies (Robertson, 2004; Palmer, 2001).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Nitrogen fixer (FCPS, No Date) but appears to primarily be doing it in already disturbed places or areas that already have nitrogen fixers.

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2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: In crowded areas the species will stand upright competing for sun otherwise it sprawls on the ground (Schneider, 2005).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Its upright nature when competing for sun and its sprawling nature otherwise would seem to indicate that it would inhibit some native species but there are no indications that it competes heavily or that the typical places it grows has many native species.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No reports found.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: For KY it is noted as typically spreading into and remaining in disturbed areas and not readily invading natural areas (KY List, 2000). Fields, roadsides, disturbed areas (Weakley, 2005). Prairies (Robertson, 2004; Palmer, 2001). Fields, open forest, forest edges, paths, gardens, and lawns (FCPS, No Date). "Found from city lots to farm fields to mountain meadows" (Schneider, 2005).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Occurs in every state (Kartesz, 1999). Reported to be widespread in northern Wisconsin (Falck, et. al., 2002).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

U - UNKNOWN

COMMENTS: New Jersey views it in the category of "strongly invasive and widespread" (Ling, 2003).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: Assumed it occurs in most units since it occurs in every state and a wide range of habitats.

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9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Fields, roadsides, disturbed areas (Weakley, 2005). Prairies (Robertson, 2004; Palmer, 2001). Fields, open forest, forest edges, paths, gardens, and lawns (FCPS, No Date). "Found from city lots to farm fields to mountain meadows" (Schneider, 2005).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: Very common in U.S. as it is cultivated as fodder and planted as a cover crop (Wildflowers of the SE U.S., 2002). Occurs in every state (Kartesz, 1999). Common along roadsides in Vermont; naturalized (Office of the Secretary of State, 1993-1994).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

D - INSIGNIFICANT

COMMENTS: Occupies entire area of interest - U.S.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Numerous species use it for a food source but deer, wild turkeys, red foxes, eastern cottantails, and woodchucks which all may carry it a distance (FCPS, No date). Planted for honey production and as forage. Available for purchase online.

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: According to Kartesz (1999), this species occurs throught the U.S. The county distribution links on the USDA Plants Database (2005), show that some states have counties where it does not occur but would seem likely to occur. These gaps are most likely from under collection. Disturbed areas occur all the time and new plantings for forage most likely occur.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Habitat is tyically a disturbed location but sometimes it does occur in prairies/meadows. Prairies (Robertson, 2004; Palmer, 2001). Fields, open forest, forest edges, paths, gardens, and lawns (FCPS, No Date). "Found from city lots to farm fields to mountain meadows" (Schneider, 2005).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Invades meadows in southern Ontario (Urban Forest Associates, 2002). In a wide variety of environments in the boreal forests of Canada: "fields, meadows, roadsides, riverbanks, vacant lots, open forests, forest margins and field borders" (Runesson, 2005).

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16. REPRODUCTIVE CHARACTERISTICS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Said to be short-lived (Mersereau, et. al., 2003). Initial slow growth; seed can persist; thick deep taproot; tolerates wet soil and shade (Duiker, S. and W. Curran, No Date). In Colorado said to grow quickly given ample moisture (Schneider, 2005).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Species is not a persistant one.

18. MINIMUM TIME COMMITMENT

D - INSIGNIFICANT

COMMENTS: Control, if needed, would seem to be relatively easy since it is not persistant.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

D - INSIGNIFICANT

COMMENTS: Assuming impacts to be minimal given the typical habitats where found, the short life span, and non-aggressive traits.

20. ACCESSIBILITY OF INVADED AREAS

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Many of these populations may be on private lands where it is planted for forage but other sites would be easily accessible.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Tussilago farfara

ELEMENT NATIONAL ID: 193966
SCIENTIFIC NAME: *Tussilago farfara*
COMMON NAME:
I-RANK REVIEW DATE: 2005-12-16
EVALUATOR: Gravuer, K.

I-RANK: Insignificant

I-RANK REASONS SUMMARY:

Tussilago farfara is a rhizomatous perennial plant which is abundantly established in the northeastern U.S., with scattered occurrences in the northern southeast, the Lake states, and the Pacific northwest. It appears to be spreading somewhat rapidly in the northern southeast and Pacific northwest, which has caused some concern among managers in those regions; however, it does not appear to be spreading rapidly in the Lake states. Invaded communities do not appear to be of high conservation significance and include disturbed open areas, riparian areas, partially open upland vegetation, and disturbed or open forested areas. Although colonies, once established, can be competitive with nearby vegetation, this species usually remains patchily distributed in invaded habitats, allowing it to be controlled fairly easily with backpack-applied glyphosate. It does not often take over large areas without human intervention (e.g. soil cultivation which fragments and disperses rhizomes).

SUBRANK I - ECOLOGICAL IMPACT:	Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium/Low

NON-NATIVE THROUGHOUT NATION

NATIVE RANGE: Native to Eurasia, including parts of northern Africa, India, and Nepal.
Northern Africa: Algeria, Morocco. Asia: Iran, Lebanon, Turkey [n. & w.], Azerbaijan, Georgia, Russian Federation [Ciscaucasia, Dagestan, Altay, Eastern Siberia, Western Siberia, Primorye], Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, India [n.], Nepal. Europe: Denmark, Finland, Ireland, Norway, Sweden, United Kingdom, Austria, Czechoslovakia, Germany, Hungary, Netherlands, Poland, Switzerland, Belarus, Estonia, Latvia, Lithuania, Moldova, Russian Federation - European part, Ukraine [incl. Krym], Albania, Bulgaria, Greece, Italy, Romania, Yugoslavia, France, Spain (GRIN 2001).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

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S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: The habitats invaded most frequently by this species are disturbed open areas and riparian areas (Fernald 1950, Strausbaugh and Core 1978, Gleason and Cronquist 1991, Wright 1997). It has also been found in partially open upland vegetation (including forest edges, old fields, and hedgerows) and in forested areas which are either naturally open or have experienced some form of disturbance, such as trail construction or fire (Hendrickson 1999, Remaley 2005).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

D - INSIGNIFICANT

COMMENTS: This species was likely introduced to North America by early settlers (Remaley 2005). Despite being present for a long time in the U.S., no reports of impacts on ecosystem processes or system-wide parameters were found. Therefore, assume impacts insignificant.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: In areas where this species is well-established, clumps of rhizomes can produce quite dense stands of above-ground foliage (Wright 1997). These stands may slightly impact the density or cover of the herbaceous layer.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Once established, this species is a relatively strong competitor. It has been observed to out-compete roadside grasses as well as a wide variety of crop species (e.g. corn, soybeans, winter wheat, spring grain, and alfalfa) (Wright 1997). The rhizomatous habit of this species also allows it to form large colonies under the right conditions; these colonies can crowd out native species (Mehrhoff et al. 2003, Remaley 2005). However, observation indicates that it usually remains as a few discrete patches in the habitats it invades and does not take over large areas on its own (Wright 1997).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not significant.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

D - INSIGNIFICANT

COMMENTS: Some form of disturbance is a feature of virtually all sites invaded by this species, so assumption is that these communities are not of high quality. No mention of impact on rare species or communities was found in the literature.

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SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Has invaded approximately 15% of the area of the United States (Kartesz 1999, NRCS 2005). Well-established in the northeastern states, to eastern OH, VA, and eastern TN. Scattered establishment in NC, IN, IL, MI, WI, MN, WA, OR, and ID (NRCS 2005).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C - LOW SIGNIFICANCE

COMMENTS: The majority of populations are found in waste places and disturbed areas (Gleason and Cronquist 1991, Wright 1997), where they are unlikely to have negative impacts on native biodiversity. Nonetheless, it has been reported as invasive in CT, ME, NJ, NC, and TN, and has been found in Acadia National Park, Great Smoky Mountains National Park, and the Blue Ridge Parkway (Swearingen 2005), so it is probable that at least a few populations in those states occur in situations that cause concern among natural area managers. It has been declared noxious by Alabama and Oregon (NRCS 2005), states on the periphery of the distribution where the intent of the listing appears to be eradication before the species becomes well-established.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: Approximately 17 ecoregions are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Appears to exhibit a preference for moist soils, but can also grow in drier areas (Wright 1997). Preferred soils include clayey soils and gravelly soils with a neutral or alkaline pH (Weakley 2005, Whitinger 2005). Grows best in partial shade and also does well in full sun, but is apparently intolerant of deep shade (Cardina et al., no date). In its native range, it has been found in areas with maritime exposure (e.g. dunes) (Plants for a Future 2001), but no reports of invasion of these areas in the U.S. were found. The habitats invaded most frequently by this species are disturbed open areas (with or without vegetation, including waste places, gravel pits, quarries, roadsides, railroad rights-of-way, road cuts, banks, strip-mining cuts, pastures, disturbed meadows, and cultivated fields) and riparian areas (including streamside or brookside vegetation in sun or partial shade, streamside gravel bars, lake shores, and ditches) (Fernald 1950, Strausbaugh and Core 1978, Gleason and Cronquist 1991, Wright 1997). It has also been found in partially open upland vegetation (including forest edges, old fields, and hedgerows) and in forested areas which are either naturally open or have experienced some form of disturbance, such as trail construction or fire (Hendrickson 1999, Remaley 2005). There is one report of invasion of a tamarack swamp in Michigan (Voss 1996).

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SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: From its stronghold in the northeastern states, appears to be gradually spreading southward (Strausbaugh and Core 1978, Weakley 2005). At the southern edge of its range, in North Carolina, it was first reported in 1971 but is now rather common in most of the mountain counties, and is beginning to appear at scattered sites in the Piedmont (Weakley 2005). It is established in a scattered manner in the Lake states, but does not appear to be increasing rapidly there, as many of the reports from those states are several decades old (Voss 1996, Wisconsin State Herbarium 2005). It has recently made the jump to the Pacific northwest states and does appear to be spreading somewhat in that region (Rice 2005).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: This species prefers a cool, moist climate (Weakley 2005); its hardiness range is zone 4a to zone 6b (Whitinger 2005). Given these constraints, the potential range probably does not extend too much further into the southeast. The preference for a moist climate may also make establishment in much of the Plains and western states unlikely. However, the Pacific northwestern states, where it has recently established, do appear to be within its abiotic preferences; there appears to be potential for much local expansion in these areas.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: This species has been used medicinally, predominantly as a cough suppressant. This use probably accounted for its initial introduction into the U.S. by settlers (Remaley 2005). Medicinal use continues today, though in a much more limited fashion. On a more local scale, dispersal occurs when the species establishes in gravel pits or quarries whose products are then used for roadbed maintenance or trail construction in other areas (Wright 1997, Hendrickson 1999). In agricultural fields, cultivation machinery can spread the plants within and between fields by fragmenting and transporting rhizomes (Wright 1997). Seed dispersal occurs by wind, which may carry seeds up to 8 miles (Mehrhoff et al. 2003).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B - MODERATE SIGNIFICANCE

COMMENTS: Reported to be spreading in North Carolina (Weakley 2005) and appears to be spreading in the Pacific northwest (Rice 2005, NRCS 2005). Does not appear to be spreading rapidly from its scattered establishment sites in the Lake states (e.g. Voss 1996), and has probably already established in most suitable sites in the northeast.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Hendrickson (1999) states that coltsfoot is unable to colonize undisturbed native vegetation. However, it has been observed invading forest vegetation along trails (Hendrickson 1999) and following fire (Remaley 2005). Although some mentions of presence in open forests were found, most sources characterized this plant as a species of disturbed habitats (e.g. Gleason and Cronquist 1991).

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15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Also established in at least Canada, New Zealand, and Japan (Randall 2002, ISSG 2005), but apparently only in similar habitats (Webb et al. 1988, Cowbrough 2003).

16. REPRODUCTIVE CHARACTERISTICS

A - HIGH SIGNIFICANCE

COMMENTS: Reproduces by both seeds and rhizomes (Muenscher 1955). Each plant is reported to produce about 3500 seeds (Wright 1997), though seed production is much lower than many common annual weeds. Although seed viability in the soil is generally 1 year or less (Cardina et al., no date, Peat and Fitter 2005), rhizomes are able to remain dormant underground for many years (Plants for a Future 2001) or long periods of time (Remaley 2005). New plants can regenerate from very small rhizome fragments when the soil is disturbed (Remaley 2005); spread by rhizome fragments is a common dispersal method for this species (Wright 1997).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Control of this species once it is well-established is difficult (ISSG 2005). Because plants can form extensive underground rhizome systems with many rhizomes buried 10 feet or more in the soil, mechanical removal of plants can be challenging (Mehrhoff et al. 2003). Small infestations can be controlled by hand pulling, but it is essential to remove all plant material, as rhizome fragments remaining in the soil can re-sprout (Remaley 2005). Chemical control is recommended for larger infestations, but this species is resistant to many of the more commonly-used and/or selective herbicides (e.g. 2,4-D, dicamba, MCPA, 2-4DB) (Wright 1997). Adequate control can usually be achieved by applying glyphosate with a backpack sprayer (Wright 1997).

18. MINIMUM TIME COMMITMENT

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Although seed viability in the soil is generally 1 year or less (Cardina et al., no date, Peat and Fitter 2005), rhizomes are able to remain dormant underground for many years (Plants for a Future 2001) or long periods of time (Remaley 2005). When the soil is disturbed, new plants sometimes regenerate from these rhizomes (Remaley 2005).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Because this species is resistant to many of the more selective herbicides, it is often necessary to use the non-selective herbicide glyphosate in order to achieve adequate control (Wright 1997). Spraying large infestations with glyphosate may impact native species.

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20. ACCESSIBILITY OF INVADED AREAS

D - INSIGNIFICANT

COMMENTS: The disturbed open areas and riparian areas most frequently invaded by this species should present few accessibility problems.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Typha angustifolia

ELEMENT NATIONAL ID: 241045
SCIENTIFIC NAME: *Typha angustifolia*
COMMON NAME:
I-RANK REVIEW DATE: 2006-03-29
EVALUATOR: Cordeiro, J. and K. Gravuer

I-RANK: High/Medium

I-RANK REASONS SUMMARY:
Typha angustifolia can form dense, nearly single-species communities in shallow, freshwater marshes and ponds and boggy soil. It produces a dense rhizome mat and thick litter layer, which reduces opportunities for other plants to establish. Colony growth spurts can result in the closing of formerly open water. Hybridizes with the native *Typha latifolia* to form *Typha x glauca* over much of its invaded range; hybrids are especially common in the midwest and northeast. Occurs throughout most of the U.S., with the exception of the deep southeast and a few intermountain states. Control by fire and physical removal in conjunction with flooding is most appropriate; chemical control also can have limited success. Time commitment for management is generally high, and the draining, burning, and/or flooding techniques typically employed can have significant impacts on native communities. Note that although some sources consider this species native to at least a portion of the United States, research and rank calculation were performed following Kartesz (1999), who considers the species to be exotic throughout the U.S.

SUBRANK I - ECOLOGICAL IMPACT:	High/Medium
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Medium

OTHER CONSIDERATIONS:
Some sources consider this species native to at least a portion of the United States (e.g. USDA-ARS 2005). However, the species was ranked following Kartesz (1999), who considers it exotic throughout the U.S.

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Eurasia

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS: This species is a non-native established outside cultivation (Kartesz 1999).

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

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COMMENTS: Invades coastal salt marshes and inland in nutrient-rich fresh waters including damp shores, marshes, swamps, marshy river margins, and roadside ditches (Crow and Hellquist, 2000).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

B - MODERATE SIGNIFICANCE

COMMENTS: The effect of a growth spurt is closing open water (Motivans and Apfelbaum, 1987). This species, particularly when hybridized, forms dense, nearly single species communities in shallow, freshwater marshes and ponds and boggy soil (USDA, 2006).

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Cattail plants produce a dense rhizome mat and the clustered leaves produce a thick litter layer. Dense cattail growth and litter may reduce the opportunity for other plants to establish or survive (Motivans and Apfelbaum, 1987). In addition, colony growth spurts can result in the closing of formerly open water (Motivans and Apfelbaum, 1987). This species, particularly when hybridized, forms dense, nearly single species communities in shallow, freshwater marshes and ponds and boggy soil (USDA, 2006). In a study on the St. Lawrence River, this species (as well as a few other aquatic wetland invasive plant species) was found to expand aggressively to a point of almost monospecific dominance during periods of low water levels (be they natural or artificial) as the plants monopolize light and space better than less aggressive species (Hudon, 2004).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: The effect of a growth spurt is closing open water, eliminating habitat and species diversity, and reducing the opportunity for other plants to become established and survive. Shading is a significant effect on other plants (Motivans and Apfelbaum, 1987). This species, particularly when hybridized, forms dense, nearly single species communities in shallow, freshwater marshes and ponds and boggy soil (USDA, 2006).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

B - MODERATE SIGNIFICANCE

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COMMENTS: Hybridizes with the native *Typha latifolia* to form *Typha x glauca* over much of its invaded range (Kartesz, 1999). Hybrids between *Typha angustifolia* and *Typha latifolia* (= *Typha* x *glauca*) are common and might be expected where the parents, especially the invasive *T. angustifolia*, are locally common (Crow and Hellquist, 2000b). Particularly, strands of the hybrid are especially common in the midwest and northeast.
As summarized in Motivans and Apfelbaum (1987):
Typha plants are mined by caterpillars of the moths *Arzama opbliqua* and *Nonagria oblonga* (Klots, 1966). Aphids and *Colandra pertinaux* (the snout beetle) also feed on *Typha* leaves and stems. The stems may have many species of pupa living within them (Klots 1966). The cattail rhizomes provide food to mammals such as the muskrat. The grazing of muskrats may greatly influence cattail communities. A cycling population of muskrats may reach such a density so as to totally set back a cattail stand for the season. These "eat outs" are important to maintain open water in a balanced system. Muskrats utilize leaves and stems for houses and eat the rhizomes (Zimmerman pers. comm.). Cattail fruits provide nesting material for terrestrial birds and dry stems may be used by aquatic birds.
In addition, it is thought to be allelopathic, producing chemicals which discourage growth of other plant species (Ohio Department of Natural Areas and Parks, 2001). Panno et al. (1999) reported an increase in *Typha angustifolia* and a decrease in *Scirpus acutus* coincident with plumes of sodium and chloride.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS:

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: This introduced species ranges from Prince Edward Island and Nova Scotia west to Quebec, Ontario, southern Saskatchewan, southern Montana, Wyoming and southeastern Oregon; and south to Florida, Georgia, Missouri, southern Texas; also in California and parts of Mexico. It was believed to have been introduced in dry ballast in ships from Europe into the Atlantic seaboard (Ohio Department of Natural Areas and Parks, 2001; Stuckey and Salamon, 1987) and was first recorded in the 1820s in Boston, New York, Philadelphia, and other east coast localities (Miklovic, 2000). Hybrids between *Typha angustifolia* and *Typha latifolia* (= *Typha* x *glauca*) are common and might be expected where the parents, especially the invasive *T. angustifolia*, are locally common (Crow and Hellquist, 2000b; Smith, 1967). USDA (2006) includes this species in every U.S. state except Idaho, Utah, Arizona, Texas, Mississippi, Alabama, Georgia, Florida, Alaska, and Hawaii.

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

B - MODERATE SIGNIFICANCE

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COMMENTS: With disruptions to a community, cattail populations may respond by spreading vegetatively at a rapid rate. Although native *Typha latifolia* may outcompete *Typha angustifolia* if allowed to grow broad leaves that shade out the shade-intolerant *Typha angustifolia*, *T. angustifolia* is a more invasive species and persists in the presence of *T. latifolia* by retreating into deeper waters where *T. latifolia* cannot survive and by hybridizing with the native species to produce highly invasive hybrids (Grace and Wetzel, 1982; Miklovic, 2000; Smith, 1967). This species ranges from Prince Edward Island and Nova Scotia west to Quebec, Ontario, southern Saskatchewan, southern Montana, Wyoming and southeastern Oregon; and south to Florida, Georgia, Missouri, southern Texas; also in California and parts of Mexico. Hybrids between *Typha angustifolia* and *Typha latifolia* (= *Typha* x *glauca*) are common and might be expected where the parents, especially the invasive *T. angustifolia*, are locally common (Crow and Hellquist, 2000b). Particularly, strands of the hybrid are especially common in the midwest and northeast.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

A - HIGH SIGNIFICANCE

COMMENTS: TNC (2001)

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Typically, this species inhabits coastal salt marshes and inland in nutrient-rich fresh waters including damp shores, marshes, swamps, marshy river margins, and roadside ditches (Crow and Hellquist, 2000). *Typha angustifolia* is generally restricted to unstable environments, often with basic, calcareous, or somewhat salty soils (Motivans and Apfelbaum, 1987).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Following initial colonization of the Atlantic seaboard in the 1800s, the species began to migrate westward along canals, railroad swales, and roadside ditches, following the development of transportation networks (Miklovic, 2000). Since that time, it has expanded to most states and much of Canada.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

C - LOW SIGNIFICANCE

COMMENTS: *Typha angustifolia* is thought to be introduced from Europe (Stuckey and Salamon, 1987) but occurs in the northeastern range of the native *Typha latifolia* and is considered an invasive species due to its rapidly spreading range and ability to establish monospecific stands that displace native plants.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Following initial colonization of the Atlantic seaboard in the 1800s, the species began to migrate westward along canals, railroad swales, and roadside ditches, following the development of transportation networks (Miklovic, 2000). Since that time, it has expanded to most states and much of Canada.

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13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: The glaciated prairie region of North America, which covers areas of Iowa, Minnesota, the Dakotas, and southern Canada, overlaps part of *T. angustifolia* range and contains numerous marshes well suited for establishment, especially if disturbed thus allowing for the more invasive hybrid to colonize (Miklovic, 2000).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: Farnsworth et al. (2003) demonstrated that this species, when compared to other common native wetland species as well as three other invasive species, shows a high degree of invasiveness in terms of height growth and emergence time, biomass per ramet, standing leaf area, total leaf area per plant, standing crop, and total foliar chlorophyll. *Typha angustifolia* is considered a pioineer in secondary succession of disturbed bogs where it displaces native *Typha latifolia* (Motivans and Apfelbaum, 1987) as vegetative reproduction is extremely effective (Smith, 1967). Salinity tolerance is high and cattails have a wide amplitude compared to other species as they are tolerant to habitat changes, pollutants, and saline or basic substrates (Pianka, 1973 in Motivans and Apfelbaum, 1987). Often, increases in salinity (natural or unnatural) cause in increase in *Typha angustifolia* at the expense of dominant fen flora (Panno et al., 1999). Unlike other emergent species, *T. angustifolia* seeds do not require a dormancy period before germination (Smith, 1967; Baskin and Baskin, 1998), allowing germination to occur at any time during the growing season when favorable light and temperature conditions exist. Ditches along highway corridors have been shown to serve as migration corridors for invasive wetland plants (Wilcox, 1989).

15. SIMILAR HABITATS INVADED ELSEWHERE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Cattail populations can be found in remote locations like Alaska, where temperatures range from 7 to 24 C and -23 to -34 C in winter as well as 58 countries although few African countries report it as an important weed. It is more prevalent as a week in Europe and North America and Australia (Mitich, 2000).

16. REPRODUCTIVE CHARACTERISTICS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Cattail colonies are commonly maintained by vegetative reproduction and a perennial root stock is the major organ responsible for reproduction (Smith, 1967). Germination requirements of *Typha* are few and seed germination can be 100% in slightly flooded conditions (Motivans and Apfelbaum, 1987).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B - MODERATE SIGNIFICANCE

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COMMENTS: Control techniques of fire and physical removal in conjunction with flooding are most appropriate (Motivans and Apfelbaum, 1987). Control is best if plants are cut in late summer or early fall. Temporary flooding does not prevent later seed establishment, unless accompanied by burning (particularly if roots are burned). Chemical control has limited success but works best when cattails are mowed or cut below water level first (Motivans and Apfelbaum, 1987). Control measures include flooding, prescribed burning, drainage, chemical control, biological control through muskrats, and mechanical removal or crushing; often in combination (complete review in Miklovik, 2000).

18. MINIMUM TIME COMMITMENT

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Time commitment generally high with draining because should be followed by burning to prevent seed bank germination and should be repeated. Further, burning alone provides little or no control (Nelson and Dietz, 1966 in Motivans and Apfelbaum, 1987), unless roots are also burned. Flooding also must be repeated for two or more years. Chemical herbicide treatment is necessary for up to three years in some areas (Motivans and Apfelbaum, 1987).

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Draining, burning, and flooding a wetland significantly affects the overall community and can lead to entirely different plant communities (Mallik and Wein, 1986 in Motivans and Apfelbaum, 1987). Reinartz and Warne (1993) reported that artifically created wetlands seeded with a diversity of wetland plants resulted in much higher species diversity and richness than sites left to natural colonization (more *Typha* resulted from natural recolonization- 55%). Control techniques target all *Typha* spp. due to difficulty in identifying individual *Typha* species as well as the ability of all *Typha* spp. to co-exist and form one dense strand within a site (Miklovik, 2000).

20. ACCESSIBILITY OF INVADED AREAS

C - LOW SIGNIFICANCE

COMMENTS: rInvaded areas are typically easily accessible but access to the roots for management and control (necessary for most control types) is difficult, at best.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Urochloa panicoides

ELEMENT NATIONAL ID: 200058
SCIENTIFIC NAME: *Urochloa panicoides*
COMMON NAME:
I-RANK REVIEW DATE: 2006-04-19
EVALUATOR: K. Maybury

I-RANK: Low/Insignificant

I-RANK REASONS SUMMARY:
This is a widespread weed in the eastern hemisphere that now has seveal toeholds in the West (Argentina, Mexico, Texas and Arizona) and can be expected to spread. However, it is primarly a weed of croplands, pastures, roadsides, and other human-disturbed and lower-quality habitats and it is unlikely that it would have great impacts on native biodiversity. It seems more likely that this could become an economic/agricultural problem.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Low
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	High/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Unknown

OTHER CONSIDERATIONS:
Thought to have some toxicity to livestock but a very low-level; used as a forage crop for sheep in Australia (FAO, no date).

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Southern Africa (Randall 2002).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS:

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes
COMMENTS:

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No abiotic alterations noted.

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2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: This is a short-season annual grass species without significant impacts on vegetation structure.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Unknown but asssumed neither high nor insignificant.

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No disproportionate impacts noted.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Not thought to have invaded communities or species of high conservation significance as Wipff and Thompson (no date) only mentioned that it is found in "disturbed sites" in Texas. It is a weed of human-disturbed habitats in Australia: rotation crops, pastures, lawns, and roadsides (Scher, no date.) and was particularly noted by FAO (no date) for being a weed in land bare-fallowed for wheat.

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

C - LOW SIGNIFICANCE

COMMENTS: Naturalized in the Gulf Prairies and Marshes and South Texas Plain areas of extreme south Texas (Texas A&M University 2002) and collected in one county in Arizona (Reeder 2001). Populations formerly known from New Mexico have been distroyed (Wipff and Thompson, no date). There is also a specimen from Maryland (Reed 1964) but this was collected from the port of Baltimore and presumably represents a waif.

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C - LOW SIGNIFICANCE

COMMENTS: Unknown but presumed that this species is still spottily distributed.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

C - LOW SIGNIFICANCE

COMMENTS: Based on current distribution in south Texas and Arizona (presumed extant in Arizona).

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9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Somewhat uncertain. Presumably not in a wide range of habitat types. Said to be in disturbed sites in Texas (Wipff et al. 1993, Wipff and Thompson, no date).

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Expected to spread (Wipff and Thompson, no date).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: This grass is found in a number of other tropical, subtropical, and even temperate areas of the world (Clayton et al. 2005) and there is no obvious reason why it could not spread to similar climates throughout much of the contiguous U.S. and Hawaii.

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

C - LOW SIGNIFICANCE

COMMENTS: Long-distance dispersal assumed infrequent. This is listed as a Federal noxious weed and is not planted or intentionally trasported. Very high winds, of course, especially hurricanes and tornados, will disperse the small seeds long distances.

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Expected to spread (Wipff and Thompson, no date).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

C - LOW SIGNIFICANCE

COMMENTS: Probably requires signficant disturbance to invade. Found in disturbed places in Texas (Wipff and Thompson, no date) and a weed of lawns, roadsides, rotation crops, and pastures in Australia (Scher, no date). FAO (no date) recomended full seed-bed preparation for planting this species for forage as it needs some soil disturbance

15. SIMILAR HABITATS INVADED ELSEWHERE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Also escaped in Mexico, Argentina, parts Europe, Asia, India and Indo-China, Australia, and New Zealand (Clayton et al. 2005; Wipff and Thompson, no date).

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16. REPRODUCTIVE CHARACTERISTICS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: In Australia it is said to seed heavily and spread rapidly by seed especially into bare and overgrazed areas and to dominate the areas it occupies during its life cycle, supressing other annual weeds (FAO, no date).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

A/C - HIGH/LOW SIGNIFICANCE

COMMENTS: Unknown but assumed not insignificant as this species is listed as being resistant to some herbicides by Heap (no date).

18. MINIMUM TIME COMMITMENT

U - UNKNOWN

COMMENTS:

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

B/D - MODERATE SIGNIFICNACE/INSIGNIFICANT

COMMENTS: Unknown but an extremely high level of impact seems unlikely.

20. ACCESSIBILITY OF INVADED AREAS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: Assumed low or insignificant as this is a Federally listed noxious weed.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Valeriana officinalis

ELEMENT NATIONAL ID: 209067
SCIENTIFIC NAME: *Valeriana officinalis*
COMMON NAME:
I-RANK REVIEW DATE: 2006-06-02
EVALUATOR: Gravuer, K.

I-RANK: Low

I-RANK REASONS SUMMARY:

Valeriana officinalis is an herbaceous perennial long planted for ornamental, herbal, and medicinal purposes and still commercially available today. It has repeatedly escaped from cultivation to create a scattered distribution in the northeastern states, the Great Lakes states, and the Pacific northwest. Where established, it can become abundant locally and sometimes even dominates favorable habitats. Where this occurs, native species are displaced. It establishes within a variety of habitat types, including partially open upland habitats, open upland habitats, upland forests and woodlands, riparian areas, wooded swamps and wet woods, and marshes and wet meadows. Although much of the United States appears climatically suitable for this species, past and present spread of established populations do not appear to be particularly rapid, although it does appear to be currently increasing in some regions. Management by hand-pulling or herbicide should be straightforward.

SUBRANK I - ECOLOGICAL IMPACT:	Low/Insignificant
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low/Insignificant

NON-NATIVE THROUGHOUT NATION

NATIVE RANGE: Native to a large part of Europe and temperate Asia, including Denmark, Finland, Iceland, Ireland, Norway, Sweden, United Kingdom, Austria, Belgium, Czechoslovakia, Germany, Hungary, Netherlands, Poland, Switzerland, Belarus, Estonia, Latvia, Lithuania, Moldova, Russian Federation (European part including arctic region, Ciscaucasia, Dagestan, Eastern Siberia, Western Siberia, s. Kurile Islands, Primorye, and Sakhalin), Ukraine (including Krym), Albania, Bulgaria, Greece, Italy, Romania, Yugoslavia, France, Portugal, Spain, Iran, Turkey, Armenia, Azerbaijan, Georgia, n. China, Japan (Hokkaido, Honshu, Kyushu, and Shikoku), Korea, and Taiwan (USDA-ARS 2005).

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES

COMMENTS: This species is a non-native that is established outside of cultivation (Kartesz 1999).

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S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes

COMMENTS: Invaded habitat types include partially open upland habitats (e.g. old fields and forest edges), open upland habitats (e.g. meadows and coastal grasslands), upland forests and woodlands, riparian areas (e.g. streamsides and lakeshores), wooded swamps and wet woods, and marshes and wet meadows (Fernald 1950, Davis 1952, Hitchcock et al. 1959, Hough 1983, Seymour 1989, Gleason and Cronquist 1991, Cooperrider 1995, Voss 1996, Hoffman and Kearns 1997, Haines and Vining 1998, Rhoads and Block 2000, IPAW 2003, Mehrhoff et al. 2003, Czarapata 2005, GLIFWC 2005, Wisconsin State Herbarium 2006).

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

D - INSIGNIFICANT

COMMENTS: This species has been cultivated in North America as a medicinal and ornamental plant for more than 150 years (Mehrhoff et al. 2003) and has been established outside cultivation for at least 90 years (Rice 2006). However, no reports of impacts on ecosystem processes or system-wide parameters were found. Therefore, assume impacts insignificant.

2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

C - LOW SIGNIFICANCE

COMMENTS: Often becomes abundant and sometimes even dominant in favorable habitats (GLIFWC 2005). Its capacity for vegetative reproduction allows it to form dense colonies (GLIFWC 2005). These colonies likely alter the density and/or cover of the herbaceous layer.

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Several sources noted that this species displaces native plant species (Mehrhoff et al. 2003, Czarapata 2005, GLIFWC 2005). Its capacity for vegetative reproduction allows it to form dense colonies (GLIFWC 2005).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No mention of disproportionate impacts on particular native species found in the literature; assumption is that any impacts are not significant. There are two native *Valeriana* species (*V. edulis* var. *ciliata* and *V. uliginosa*) that are locally rare in portions of this species' invaded range (GLIFWC 2005), but no reports of hybridization with these species were found.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Typically inhabits somewhat disturbed habitats, but has often been observed to spread from these disturbed areas into a variety of more natural communities (GLIFWC 2005), such as wet meadows and wooded swamps. This species may establish in high-quality examples of these natural communities, particularly when the communities naturally have fully or partially open canopies.

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SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Established in the northeastern states (ME, NH, VT, MA, CT, NY, PA, NJ, MD, WV), the Great Lakes states (WI, MI, MN, IA, IL, IN, OH), and the Pacific northwest (WA, OR, ID, MT) (Kartesz 1999). Its distribution within these areas is scattered, as it usually becomes established by escaping from cultivation (Hitchcock et al. 1959, Gleason and Cronquist 1991, Voss 1996). Where established, it often becomes abundant locally (GLIFWC 2005); however, it does not yet seem to have established in many apparently suitable sites (IPAW 2003). In New England, it is often abundant near the coast (Mehrhoff et al. 2003).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

C - LOW SIGNIFICANCE

COMMENTS: Appears to be causing some concern in the Great Lakes region (specifically, WI and MI); the Great Lakes Indian Fish and Wildlife Commission lists it as an invasive species and notes that it displaces native plant species in favorable habitats (GLIFWC 2005). The Wisconsin State Herbarium (2006) also lists the species as "potentially invasive". The Invasive Plant Atlas of New England (IPANE) (Mehrhoff et al. 2003) recently found the species to be "extremely abundant" in northeastern Vermont and Down East Maine, and noted it to be an "emerging problem" in northern New England. IPANE also notes that it does not usually appear to be highly invasive in southern New England. Connecticut has the species listed as "Potentially invasive" (NRCS 2006).

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: Approximately 18 ecoregions are invaded, based on visual comparison of the generalized range and ecoregions map (The Nature Conservancy 2001).

9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Predominantly found in sunny to partially shaded habitats and tolerant of a variety of soil moistures (from dry to moist to wet). Invaded habitat types include partially open upland habitats (including old fields, thickets, forest edges, moist forest openings, and roadsides/ditches); fields, meadows, coastal grasslands, pastures, and open disturbed areas; upland forests, woodlands, and orchards; riparian areas (including streamsides and lakeshores); wooded swamps (e.g. alder-willow swamps) and wet woods; and marshes and wet meadows (Fernald 1950, Davis 1952, Hitchcock et al. 1959, Hough 1983, Seymour 1989, Gleason and Cronquist 1991, Cooperrider 1995, Voss 1996, Hoffman and Kearns 1997, Haines and Vining 1998, Rhoads and Block 2000, IPAW 2003, Mehrhoff et al. 2003, Czarapata 2005, GLIFWC 2005, Wisconsin State Herbarium 2006).

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SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B - MODERATE SIGNIFICANCE

COMMENTS: Recently established in Wyoming (Rice 2006). It also appears to be spreading in the Great Lakes region (IPAW 2003).

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Most of the United States appears suitable for this species, given that it has a large native range in Eurasia (USDA-ARS 2005) and is thought to be adapted to USDA hardiness zones 4a - 9b (Whitinger 2006). In Wisconsin, it is thought that a large percentage of vulnerable sites are as yet unoccupied (IPAW 2003).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Planted for ornamental, herbal, and medicinal purposes (Mehrhoff et al. 2003, Czarapata 2005), this species is still widely commercially available (Hoffman and Kearns 1997, GLIFWC 2005, Whitinger 2006). Seeds are wind- and possibly also water-dispersed (Czarapata 2005, GLIFWC 2005).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B - MODERATE SIGNIFICANCE

COMMENTS: Noted as an "emerging problem" in northern New England (Mehrhoff et al. 2003). Also thought to be spreading significantly in the Great Lakes region (IPAW 2003).

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B - MODERATE SIGNIFICANCE

COMMENTS: In Connecticut, it has been observed spreading on its own into mid-successional vegetation (Egler 1983). Disturbance is known to facilitate the establishment and spread of this species (GLIFWC 2005). It typically inhabits somewhat disturbed habitats, but has often been observed to spread from these disturbed areas into a variety of more natural habitats (GLIFWC 2005). It appears to be only moderately shade-tolerant and does not often invade or persist in closed-canopy, late-successional forest vegetation (GLIFWC 2005).

15. SIMILAR HABITATS INVADED ELSEWHERE

C - LOW SIGNIFICANCE

COMMENTS: Also established in Canada (Kartesz 1999, Randall 2002), where it appears to invade similar habitats (Scoggan 1978).

16. REPRODUCTIVE CHARACTERISTICS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Reproduces by seed (Czarapata 2005). In some situations, it also reproduces vegetatively by short aerial stolons (Mehrhoff et al. 2003, GLIFWC 2005).

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SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

C - LOW SIGNIFICANCE

COMMENTS: Small stands and isolated plants can be relatively easily controlled by hand-pulling, since plants are relatively shallow-rooted and are often easy to pull out when the soil is moist. However, because this species is rosette-forming, mowing is not a viable control option. Medium-sized stands can presumably be controlled using commonly available herbicides (e.g. glyphosate, 2,4-D, triclopyr), although little or no published information exists to confirm the efficacy of this approach. For very large stands, late spring burning may be useful in fire-adapted communities (Czarapata 2005, GLIFWC 2005).

18. MINIMUM TIME COMMITMENT

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: This species appears to have a transient seed bank (Peat and Fitter 2006), allowing control to be accomplished quickly. However, its root system does include small rhizomes, so limited re-sprouting may occur after the initial control operation.

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Hand-pulling from moist soil should have minimal impact on native species. Foliar herbicide application will likely have some collateral impacts, but these can be reduced if a dicot-specific herbicide (e.g. 2,4-D or triclopyr) can be used.

20. ACCESSIBILITY OF INVADED AREAS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Because this species predominantly establishes as an escape from horticultural cultivation, many infestations are likely to be located on private land.

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Invasive Species Assessment Protocol:
U.S. National Assessments

Wisteria floribunda

ELEMENT NATIONAL ID: 223265
SCIENTIFIC NAME: *Wisteria floribunda*
COMMON NAME:
I-RANK REVIEW DATE: 2005-12-28
EVALUATOR: Maybury, K.

CALCULATED I-RANK: Medium/Low
I-RANK: Medium

I-RANK ADJUSTMENT JUSTIFICATION:
This species, though perhaps slightly less invasive than W. sinensis, seems solidly "Medium" in its impacts on biodiversity and the score reflects that. The Minimum score was 50 which is the highest score possible in the "Low" category while the maximum score was well into the "Medium" range.

I-RANK REASONS SUMMARY:
An agressive woody vine that commonly invades disturbed areas but can also invade high quality native species habitats. A problem plant in native plant communities throughout the Southeast and Midatlantic.

SUBRANK I - ECOLOGICAL IMPACT:	Medium/Low
SUBRANK II - CURRENT DISTRIBUTION/ABUNDANCE:	High
SUBRANK III - TREND IN DISTRIBUTION/ABUNDANCE:	Medium/Low
SUBRANK IV - MANAGEMENT DIFFICULTY:	Low

NON-NATIVE THROUGHOUT NATION
NATIVE RANGE: Japan

SCREENING QUESTIONS

S-1. ESTABLISHED OUTSIDE CULTIVATION AS A NON-NATIVE? YES
COMMENTS:

S-2. PRESENT IN CONSERVATION AREAS OR OTHER NATIVE SPECIES HABITATS? Yes
COMMENTS:

SECTION I. ECOLOGICAL IMPACT

1. IMPACT ON ECOSYSTEM PROCESSES AND SYSTEM-WIDE PARAMETERS

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS: No significant changes in abioitc processes reported.

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2. IMPACT ON ECOLOGICAL COMMUNITY STRUCTURE

B - MODERATE SIGNIFICANCE

COMMENTS: The woody vines can form thickets so dense that little else grows (Remaley 1998). Overtakes native trees and shrubs through strangling or shading and can kill sizable trees (Remaley 1998, Swearingen et al. 2002).

3. IMPACT ON ECOLOGICAL COMMUNITY COMPOSITION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Can form thickets so dense that little else grows (Remaley 1998).

4. IMPACT ON INDIVIDUAL NATIVE PLANT OR ANIMAL SPECIES

D - INSIGNIFICANT

COMMENTS: No disproportionate impacts noted.

5. CONSERVATION SIGNIFICANCE OF THE COMMUNITIES AND NATIVE SPECIES THREATENED

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Ideal habitat is full sun and wisteria is typically found in disturbed areas such as along forest edges, roadsides and other rights-of-way, and ditches (Remaley 1998). Wisteria has also been reported from riparian areas. In addition to these more open habitats, however, wisteria is known to persist and spread in low light conditions (Remaley 1998) and is said to "rapidly invaded the shady interior of a forest from a sunny forest edge" (Maryland Dept. of Natural Resources 2004).

SECTION II. CURRENT DISTRIBUTION AND ABUNDANCE

6. CURRENT RANGE SIZE IN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Most of the southeastern U.S. and Midatlantic with isolated reports from New England, Ohio, and Illinois (Kartesz 1999).

7. PROPORTION OF CURRENT RANGE WHERE THE SPECIES IS NEGATIVELY IMPACTING BIODIVERSITY

A - HIGH SIGNIFICANCE

COMMENTS: Assumption that this is having at least some negative impacts in at least 50 percent of of the current range.

8. PROPORTION OF NATION'S BIOGEOGRAPHIC UNITS INVADED

B - MODERATE SIGNIFICANCE

COMMENTS: Based on Kartesz's (1999) distribution map.

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9. DIVERSITY OF HABITATS OR ECOLOGICAL SYSTEMS INVADED IN NATION

A/B - HIGH/MODERATE SIGNIFICANCE

COMMENTS: Assumed at least 4 ecological systems given range in the U.S. and ability to invade riparian and forest habitats.

SECTION III. TREND IN DISTRIBUTION AND ABUNDANCE

10. CURRENT TREND IN TOTAL RANGE WITHIN NATION

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Assumed not expanding in all directions nor decreasing in range.

11. PROPORTION OF POTENTIAL RANGE CURRENTLY OCCUPIED

D - INSIGNIFICANT

COMMENTS: Gardening references indicate that wisteria is only hardy to USDA zone 5 and the species is assumed not well adapted to dry areas of zones 5 and up in the West. Expansion into Hawaii is definitely possible, as the closely related*Wisteria sinensis* is a known pest there. Could also expand into east Texas (if not already there).

12. LONG-DISTANCE DISPERSAL POTENTIAL WITHIN NATION

A - HIGH SIGNIFICANCE

COMMENTS: Widely sold and planted as an ornamental. Seeds can be carried great distances in water (Swearingen et al. 2002).

13. LOCAL RANGE EXPANSION OR CHANGE IN ABUNDANCE

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Assumption that expansion is not rapid but that some expansion is ongoing as wisteria is still very commonly planted and "most infestations in natural areas are a result of escapes from landscape plantings" (Swearingen et al. 2002). Ongoing disturbance in most landscapes probably also insures that the species is not becoming less abundant.

14. INHERENT ABILITY TO INVADE CONSERVATION AREAS AND OTHER NATIVE SPECIES HABITATS

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Established vines will persist and reproduce in partial shade (Remaley 1998) and the Maryland Dept. of Natural Resources (2004) indicates that wisteria can rapidly invade shady forest interiors from forest edges by sending out ground-level vines that are supported by the parts of the plants growing in full sun. Presumably, the vines can then take advantage of small-scale canopy openings. The Tennessee Exotic Pest Plant Council (not dated) indicates that both *Wisteria floribunda* and *W. sinensis* are Rank 2 plants----those that are significant threats but do not spread as easily into native plant communites as those in Rank 1 (Rank 3 plants spread only in or near disturbed areas). Franklin (2005) similarly considers *W. floribunda* a Rank 2 in North Carolina.

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15. SIMILAR HABITATS INVADED ELSEWHERE

U - UNKNOWN

COMMENTS:

16. REPRODUCTIVE CHARACTERISTICS

B - MODERATE SIGNIFICANCE

COMMENTS: Seeds may be abundant if conditions are favorable (Remaley 1998) but spreads primarily vegetatively (Martin, not dated). Stolons develop roots and shoots at short intervals (Swearingen et al. 2002). Resprouts after cutting (Remaley 1998). Long-lived and can reach great size and girth (Martin, not dated).

SECTION IV. MANAGEMENT DIFFICULTY

17. GENERAL MANAGEMENT DIFFICULTY

B/C - MODERATE/LOW SIGNIFICANCE

COMMENTS: Cutting and applying herbicides to the stumps can be used; retreatment may be necessary if resprouting occurs (Martin, not dated). In areas where this is impractical, foliar sprays may be used but non-target plants may be affected (Martin, not dated).

18. MINIMUM TIME COMMITMENT

C/D - LOW SIGNIFICANCE/INSIGNIFICANT

COMMENTS:

19. IMPACTS OF MANAGEMENT ON NATIVE SPECIES

C - LOW SIGNIFICANCE

COMMENTS: Large infestations may require herbicide spraying, which will put some non-target plants at risk if great caution is not used (see Martin, not dated).

20. ACCESSIBILITY OF INVADED AREAS

A - HIGH SIGNIFICANCE

COMMENTS: Widely planted and, unfortunately, will reinfest from private gardens. Many garden alternatives exist, including a wisteria native to the U.S. *Wisteria frutescens*.

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