INDIANA
NON-NATIVE PLANT INVASIVENESS RANKING FORM
ASSESSMENT FOR INVASIVE PLANTS NOT IN TRADE
Form version date: March 3, 2009

Scientific name:	Cirsium arvense (L.) Scop. (C. setosum, C. incanum, Carduus arvensis, Serratula arvensis & all varieties of C. arvense) USDA Plants Code: CIAR4
Common names:	Creeping thistle, Californian thistle, Canada thistle, field thistle
Native distribution:	Eurasia
Date assessed:	July 15, 2012
Assessors:	Ellen Jacquart, Alison Clements
Reviewers:	Ken Collins, Larry Bledsoe
Date Approved:	September 21, 2012

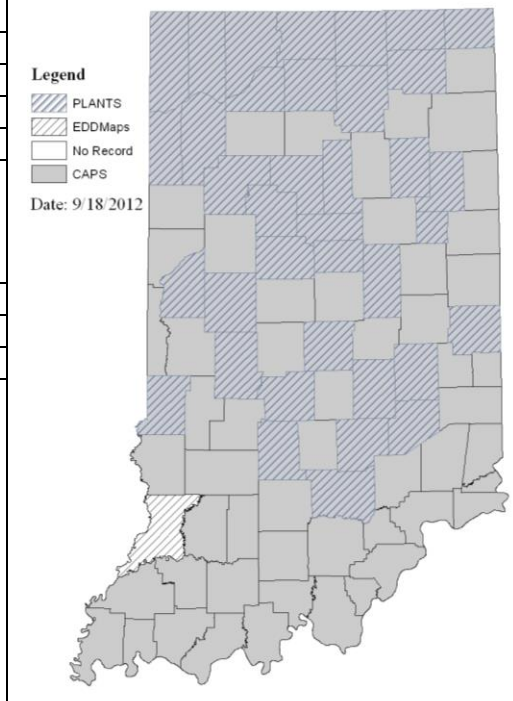
Indiana Invasiveness Rank: High (Relative Maximum Score 70.00-80.00)

Invasiveness Ranking Summary (see details under appropriate sub-section)		Total (Total Answered*) Possible	Total
1	Ecological impact	40 (40)	20
2	Biological characteristic and dispersal ability	25 (25)	21
3	Ecological amplitude and distribution	25 (25)	21
4	Difficulty of control	10 (10)	9
	Outcome score	100 (100)[b]	71[a]
	Relative maximum score †		71.00
	Indiana Invasiveness Rank §	High (Relative Maximum Score 70.00-80.00)	

* For questions answered "unknown" do not include point value in "Total Answered Points Possible." If "Total Answered Points Possible" is less than 70.00 points, then the overall invasive rank should be listed as "Unknown."
†Calculated as 100(a/b) to two decimal places.
§Very High >80.00; High 70.00−80.00; Moderate 50.00−69.99; Low 40.00−49.99; Insignificant <40.00

A. DISTRIBUTION (KNOWN/POTENTIAL):

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



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Indiana CAPS database, http://extension.entm.purdue.edu/CAPS/index.html; Indiana IPSAWG reports (unpublished); and EDDMapS reports, http://eddmaps.org/

If the species does not occur and is not likely to occur in Indiana, then stop here as there is no need to assess the species.

A2.2. Describe the potential or known suitable habitats within Indiana (underlined). Natural habitats include all habitats not under active human management. Managed habitats are indicated with an asterisk.

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

Other potential or known suitable habitats within Indiana:
Wastelands, unmanaged urban landscapes.

Documentation:
Sources of information:
Jacquart and Bledsoe, personal observation

B. INVASIVENESS RANKING

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

1. ECOLOGICAL IMPACT

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

A.	No perceivable impact on ecosystem processes based on research studies, or the absence of impact information if a species is widespread (>10 occurrences in minimally managed areas), has been well-studied (>10 reports/publications), and has been present in the northeast for >100 years.	0
B.	Influences ecosystem processes to a minor degree (e.g., has a perceivable but mild influence on soil nutrient availability)	3
C.	Significant alteration of ecosystem processes (e.g., increases sedimentation rates along streams or coastlines, reduces open water that are important to waterfowl)	7
D.	Major, possibly irreversible, alteration or disruption of ecosystem processes (e.g., the species alters geomorphology and/or hydrology, affects fire frequency, alters soil pH, or fixes substantial levels of nitrogen in the soil making soil unlikely to support certain native plants or more likely to favor non-native species)	10
U.	Unknown	

Score 7

Documentation:
Identify ecosystem processes impacted (or if applicable, justify choosing answer A in the

absence of impact information)
Despite the high number of studies performed on this species, no targeted studies on the impact on natural ecosystem processes or system-wide parameters located. Nonetheless, the species can grow in dense stands much taller than the rest of the herb layer and significantly limit light availability to the lower herb layer. Allelopathy has also been suggested (Nuzzo, 1997; Thunhorst and Swearingen, 2001) and a study from Tazmania showed that extracts from the plant inhibited germination and growth of its own as well as other plant species (Bend All, 2006). No evidence of irreversible impacts to ecosystem processes.
Sources of information:
Nuzzo, 1997; Fellows, 2004; Thunhorst & Swearingen, 2001; Jacquart personal observations.

1.2. Impact on Natural Community Structure

A.	No perceived impact; establishes in an existing layer without influencing its structure	0
B.	Influences structure in one layer (e.g., changes the density of one layer)	3
C.	Significant impact in at least one layer (e.g., creation of a new layer or elimination of an existing layer)	7
D.	Major alteration of structure (e.g., covers canopy, eradicating most or all layers below)	10
U.	Unknown	

Score 3

Documentation:
Identify type of impact or alteration:
Increases the density, and oftentimes the height, of the herb layer. No evidence of signifcant or major alteration of structure.
Sources of information:
Fellows, 2004; Jacquart personal observations.

1.3. Impact on Natural Community Composition

A.	No perceived impact; causes no apparent change in native populations	0
B.	Influences community composition (e.g., reduces the number of individuals in one or more native species in the community)	3
C.	Significantly alters community composition (e.g., produces a significant reduction in the population size of one or more native species in the community)	7
D.	Causes major alteration in community composition (e.g., results in the extirpation of one or several native species, reducing biodiversity or change the community composition towards species exotic to the natural community)	10
U.	Unknown	

Score 7

Documentation:
Identify type of impact or alteration:
Species can grow in dense stands, significantly altering the community composition. No evidence of major alteration of structure.
Sources of information:
Thunhorst and Swearingen, 2001; Fellows, 2004.

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

A.	Negligible perceived impact	0

B.	Minor impact	3
C.	Moderate impact	7
D.	Severe impact on other species or species groups	10
U.	Unknown	

Score 3

Documentation:
Identify type of impact or alteration:
Species known to hybridize with C. hookerianum in the West. Not known to hybridize with any native Cirsium species in the Northeast. Species is exceptionally prickly. Other studies on other species or species groups are not known. Soil microflora could be impacted by compounds produced by the plant, especially those involved with allelopathy.
Sources of information:
Fellows, 2004.

Total Possible 40
Section One Total 20

2. BIOLOGICAL CHARACTERISTICS AND DISPERSAL ABILITY

2.1. Mode and rate of reproduction (provisional thresholds, more investigation needed)

A.	No reproduction by seeds or vegetative propagules (i.e. plant sterile with no sexual or asexual reproduction).	0
B.	Limited reproduction (fewer than 10 viable seeds per plant AND no vegetative reproduction; if viability is not known, then maximum seed production is less than 100 seeds per plant and no vegetative reproduction)	1
C.	Moderate reproduction (fewer than 100 viable seeds per plant - if viability is not known, then maximum seed production is less than 1000 seeds per plant - OR limited successful vegetative spread documented)	2
D.	Abundant reproduction with vegetative asexual spread documented as one of the plants prime reproductive means OR more than 100 viable seeds per plant (if viability is not known, then maximum seed production reported to be greater than 1000 seeds per plant.)	4
U.	Unknown	

Score 4

Documentation:
Describe key reproductive characteristics (including seeds per plant):
One individual plant can produce over 5200 seeds; also abundant asexual spread. Species is dioecious, and seed set in some populations can be quite low when the colony is comprised of only one sex.
Sources of information:
Hay, 1937.

2.2. Innate potential for long-distance dispersal (e.g. bird dispersal, sticks to animal hair, buoyant fruits, pappus for wind-dispersal)

A.	Does not occur (no long-distance dispersal mechanisms)	0
B.	Infrequent or inefficient long-distance dispersal (occurs occasionally despite lack of adaptations)	1
C.	Moderate opportunities for long-distance dispersal (adaptations exist for long-distance dispersal, but studies report that 95% of seeds land within 100 meters of the parent plant)	2
D.	Numerous opportunities for long-distance dispersal (adaptations exist for long-distance dispersal and evidence that many seeds disperse greater than 100 meters from the parent plant)	4
U.	Unknown	

Score 4

Documentation:
Identify dispersal mechanisms:
Seeds are readily dispersed long distances by wind and water.
Sources of information:
Thunhorst & Swearingen, 2001; Beck, 2004; Fellows, 2004; author's pers. obs.

2.3. Potential to be spread by human activities (both directly and indirectly – possible mechanisms include: commercial sales, use as forage/revegetation, spread along highways, transport on boats, contaminated compost, land and vegetation management equipment such as mowers and excavators, etc.)

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

Score 3

Documentation:
Identify dispersal mechanisms:
Seeds readily attach to and are spread by humans and farm and mowing equipment.
Sources of information:
Thunhorst & Swearingen, 2001; Beck, 2004; Fellows, 2004; Jacquart pers. obs.

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

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

Score 6

Documentation:
Evidence of competitive ability:
Perennial, able to grow on infertile soils, allelopathic.
Sources of information:
Thunhorst & Swearingen, 2001; Beck, 2004; Fellows, 2004; Bend All, 2006.

2.5. Growth vigor

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

Score 2

Documentation:
Describe growth form:
Can form a dense layer above shorter vegetation.
Sources of information:
Jacquart pers. obs.

2.6. Germination/Regeneration

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

Score 2

Documentation:
Describe germination requirements:
Seedlings have trouble establishing in existing vegetation with mature individuals of C. arvense due to allelopathy.
Sources of information:
Thunhorst & Swearingen, 2001; Beck, 2004; Fellows, 2004; Bend All, 2006.

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

A.	No	0
B.	Yes	3
U.	Unknown	

Score 0

Documentation:
Species:
Other non-native species but none listed as invasive.

Total Possible 25
Section Two Total 21

3. ECOLOGICAL AMPLITUDE AND DISTRIBUTION

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

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

Score 2

Documentation:
Identify reason for selection, or evidence of weedy history:
Large stands known, but in disturbed areas with other invasives present.
Sources of information:
Fellows, 2004; author's pers. obs.

3.2. Number of habitats the species may invade

A.	Not known to invade any natural habitats given at A2.2	0
B.	Known to occur in two or more of the habitats given at A2.2, with at least one a natural habitat.	1

C. Known to occur in three or more of the habitats given at A2.2, with at least two a natural habitat. 2
D. Known to occur in four or more of the habitats given at A2.2, with at least three a natural habitat. 4
E. Known to occur in more than four of the habitats given at A2.2, with at least four a natural habitat. 6
U. Unknown

Score 6

Documentation:
Identify type of habitats where it occurs and degree/type of impacts:
See A2.2.
Sources of information:
Brooklyn Botanic Garden, 2009.

3.3. Role of disturbance in establishment

A. Requires anthropogenic disturbances to establish. 0
B. May occasionally establish in undisturbed areas but can readily establish in areas with natural or anthropogenic disturbances. 2
C. Can establish independent of any known natural or anthropogenic disturbances. 4
U. Unknown

Score 2

Documentation:
Identify type of disturbance:
Readily establishes in disturbed areas; not known to require anthropogenic disturbance or occur in undisturbed areas.
Sources of information:
Thunhorst & Swearingen, 2001; Fellows, 2004.

3.4. Climate in native range

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

Score 3

Documentation:
Describe what part of the native range is similar in climate to Indiana:
Europe, temperate Asia.
Sources of information:
Fellows, 2004; Brooklyn Botanic Garden, 2009.

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

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

Score 4

Documentation:
Identify states and provinces invaded:
All northeastern states and provinces.
Sources of information: See known introduced range in plants.usda.gov, and update with information from states and Canadian provinces.
U.S.D.A., 2009.

3.6. Current distribution of the species outside of cultivation in Indiana

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

Score 4

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

Total Possible 25
Section Three Total 21

4. DIFFICULTY OF CONTROL

4.1. Seed banks

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

Score 3

Documentation:
Identify longevity of seed bank:
Seeds can remain viable for up to at least 20 years.
Sources of information:
Thunhorst and Swearingen 2001; Beck 2004; Fellows, 2004.

4.2. Vegetative regeneration

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

Score 2

Documentation:

Describe vegetative response:
Regrowth from extensive underground root system.
Sources of information:
Thunhorst and Swearingen 2001; Beck 2004; Fellows, 2004.

4.3. Level of effort required

A.	Management is not required: e.g., species does not persist without repeated anthropogenic disturbance.	0
B.	Management is relatively easy and inexpensive: e.g. 10 or fewer person-hours of manual effort (pulling, cutting and/or digging) can eradicate a 1 acre infestation in 1 year (infestation averages 50% cover or 1 plant/100 ft^2).	2
C.	Management requires a major short-term investment: e.g. 100 or fewer person-hours/year of manual effort, or up to 10 person-hours/year using mechanical equipment (chain saws, mowers, etc.) for 2-5 years to suppress a 1 acre infestation. Eradication is difficult, but possible (infestation as above).	3
D.	Management requires a major investment: e.g. more than 100 person-hours/year of manual effort, or more than 10 person hours/year using mechanical equipment, or the use of herbicide, grazing animals, fire, etc. for more than 5 years to suppress a 1 acre infestation. Eradication may be impossible (infestation as above).	4
U.	Unknown	

Score	4

Documentation:
Identify types of control methods and time-term required:
Potential occurrence in wetlands, prickly leaves and stem, long-lived seed bank, extensive dense stands pose major control problems.
Sources of information:
Fellows, 2004.

Total Possible	10
Section Four Total	9

Total for 4 sections Possible	100
Total for 4 sections	70

References for species assessment:

Alley, H. P., and N. E. Humburg. 1979. Perennial weed control. Wyoming Agricultural Experiment Station, Research Journal 137: 2-12.

Amor, R. L., and R. V. Harris. 1974. Distribution and seed production of Cirsium arvense (L.) Scop. in Vitoria, Australia. Weed Res. 14: 317-323.

Ankle, D. D. 1963. Vegetation and soil comparisons among three areas: mowed, relict, and moderately grazed. M.S. thesis, Fort Hays Kansas State College, Fort Hays, Kansas. 45 pp.

Arny, A. C. 1932. Variations in the organic reserves in underground parts of five perennial weeds from late April to November. Minnesota Agr. Exp. Sta. Tech. Bull. 84.

Bakker, D. 1960. A comparative life-history study of Cirsium arvense (L.) Scop. and Tussilago farfara (L.) the most troublesome weeds in the newly reclaimed polders of the former Zuiderzee. Pp. 205-222 in J. L. Harper, ed. The Biology of Weeds, Symp. British Ecology Socl., No. 1.

Baradari, M. R., L. C. Haderlie, and R. G. Wilson. 1980. Chlorflurenol effects on absorption and translocation of dicamba in Canada thistle (Cirsium arvense). Weed Science 28: 197-200.

Beaudoin, X., K. Norwel, and G. Quere. 1981. Use of 3,6-dichloropicolinic acid to control perennial composite in flax and linseed. Compte Rendu de la 11 Conference du COLUMA 2: 425-433.

Beck, K. G. 2004. Canada Thistle. No.3.108. Colorado State University Cooperative Extension. <ext.colostate.edu/pubs/natres/03108.html>. [Accessed May 5, 2009].

Belles, W. S., D. W. Wattenbarger, and G. A. Lee. 1980. Herbicidal control of Canada thistle [Cirsium arvense (L.) Scop.] Proc. Western Weed. Science Society 33: 134.

Bend All, G. M. The allelopathic activity of Californian thistle (Cirsium arvense) in Tasmania. Weed Research 15(2): 77-81.

Beuerman, D. S. N., D. L. Hensley, and R. L. Carpenter. 1984. Translocation of glyphosate in Cirsium arvense. Horculture Science 19: 296-298.

Boldt, P. F. 1981. Mechanical, cultural and chemical control of Canada thistle in horticultural crops. In Canada thistle Symposium, Proc. North Carolina Weed Control Conference 36: 179-180.

Brattain, R. L., and P. K. Fay. 1980. Glyphosate for chemical fallow. Proceedings Western Weed Science Society 33: 76-77.

Brooklyn Botanic Garden. 2009. AILANTHUS database. [Accessed on 28 April 2009].

Carlson, S. J., and W. W. Donald. 1984. The effect of glyphosate on shoots, roots, and root buds of Canada thistle. Proc. North Carolina Weed Control Conference 39: 84.

Carson, A. G., and J. D. Bandeen. 1975. Influence of ethephon on absorption and translocation of herbicides in Canada thistle. Canadian Journal Plant Science 55: 795-800.

Cox, H. R. 1913. Controlling Canada thistle. U. S. Dept. of Agriculture, Farmer's Bulletin 545.

Derschied, L. A., and R. E. Schultz. 1960. Achene development of Canada thistle and perennial sow thistle. Weeds 8: 55-62.

Detmers, F. 1927. Canada thistle (Cirsium arvense Tourn), field thistle, creeping thistle. Ohio Experiment Stattion Bulletin 414: 1-45.

Donald, W. W. 1984. Chlorsulfuron effects on shoot growth and root buds of Canada thistle (Cirsium arvense). Weed Science 32: 42-50.

Evans, J. E. 1984. Canada thistle (Cirsium arvense): A literature review of management practices. Natural Areas Journal. 4(2):11-21.

Fellows, M. 2004. Cirsium arvense. U.S. Invasice Species Impact rank (I-Rank). NatureServe Explorer. An Online Encyclopedia of Life.

Forsyth, S. F., and A. K. Watson. 1985. Predispersal seed predation of Canada thistle. Canadian Entomologist 117: 1075-1081.

Friesen, H. A. 1968. Trends in Canadian research to control Canada thistle. Proceedings Northeast Weed Control Society 22: 27-36.

Haderlie, L. C., and R. S. McAllister. 1981. Photosynthesis, assimilate translocation, and root carbohydrates in Canada thistle, in Canada thistle symposium. Proc. North Carolina Weed Control Conference 36: 160-162.

Haggar, R. J., A. K. Oswald, and W. G. Richardson. 1986. A review of the impact and control of creeping thistle (Cirsium arvense L.) in grassland. Crop. Prot. 5: 73-76.

Hamdoun, A. M. 1972. Regenerative capacity of root fragments of Cirsium arvense (L.) Scop. Weed Research 12: 128-136.

Hansen, A. A. 1918. Canada thistle and methods of eradication. U.S.D.A. Farmers Bulletin 1002.

Hay, W. D. 1937. Canada thistle seed production and its occurrence in Montana seeds. Seed World. March 26, 1937.

Hayden, A. 1934. Distribution and reproduction of Canada thistle in Iowa. American Journal of Botany 21: 355-373.

Helgeson, F. A., and R. Konzak. 1950. Phytotoxic effects of aqueous extracts of field bindweed and Canada thistle, preliminary report. North Dakota Agricultural Experimental Station Bulletin 12: 71-76.

Hetzer, W. A., and R. L. McGregor. 1951. An ecological study of the prairie and pasture lands in Douglas and Franklin counties, Kansas. Kansas Academy Science Transactions 54: 356-369.

Hodgson, J. M. 1964. Variations in ecotypes of Canada thistle. Weeds 12: 167-171.

Hodgson, J. M. 1968. The nature, ecology, and control of Canada thistle. U.S.D.A. Technical Bulletin 1386. 32 pp.

Hoefer, R. H. 1981. Growth and development of Canada thistle. In Canada thistle symposium, Proceedings North Carolina Weed Control Conference 36: 153-156.

Holowid, J. R. 1984. Acifluorfen sodium treatments for Canada thistle control in soybeans. Proceedings N. C. Weed Control Conference 39: 26.

Hope, A. 1927. The dissemination of weed seeds by irrigation water in Alberta. Science Agriculture 7: 268-270.

Hunter, J. H., and L. W. Smith. 1972. Environmental and herbicide effects on Canada thistle ecotypes (Cirsium arvense). Weed Science 20: 163-167.

Kay, W. O. N. 1985. Hermaphrodites and subhermaphrodites in a reputedly dioecious plant, Cirsium arvense (L.) Scop. New Phytologist 100: 457-472.

Laing, J. E. 1978. Establishment of Urophora cardui L. (Diptera: Tephritidae) on Canada thistle in southern Ontario. Proceedings Entomological Society Ontario 108:2.

Lake, C. T., and H. A. Bennett. 1980. Dichloropicolinic acid for control of creeping thistle (Cirsium arvense) in strawberries. Proc. 1980 British Crop. Prot. Conf. 315-320.

Linck, A. J., and T. Kommendahl. 1958. Canada thistle- spotlight on a troublesome weed. Minnesota Farm and Home Science 15: 21-22.

Lisk, J. M., and C. G. Messersmith. 1979. Factors affecting Canada thistle control. Proceedings North Central Weed Control Conference 34:4.

Marriage, P. B. 1981. Response of Canada thistle to herbicides. In Canada thistle symposium, Proceedings N.C. Weed Control Confernece 36: 162-167.

Maw, M. G. 1976. An annotated list of insects associated with Canada thistle (Cirsium arvense) in Canada. Canadian Entomolologist 108: 235-244.

McAllister, R. S., and L. C. Haderlie. 1981. Canada thistle root anatomy and root but dormancy. In Canada thistle Symposium. Proceedings N. C. Weed Control Conference 136: 157-159.

McAllister, R. S., and L. C. Haderlie. 1985. Effects of photoperiod and temperature on root bud development and assimilate translocation in Canada thistle (Cirsium arvense). Weed Science 33: 148-152.

McIntyre, G. I., and J. H. Hunter. 1975. Some effects of nitrogen supply on growth and development of Cirsium arvense. Canandian Journal of Botany 53: 3012-3021.

Messersmith, C. G. 1978. Canada thistle control with spring and fall applied glyphosate. Proceedings N.C. Weed Control Conference 33: 107.

Miller, G., and R. Behrens. 1966. Controlling Canada thistle. University of Minnesota, Agricultural Ext. Serv., Extension Bulletin 329.

Moore, R. J. 1975. The biology of Canadian Weeds 13: Cirsium arvense (L.) Scop. Canadian Journal Plant Sciences 55: 1033-1048.

Moore, R. J., and C. Frankton. 1974. The thistles of Canada. Res. Bv. Canada Department of Agriculture Monograph No. 10, Ottawa, Canada.

Nuzzo, V. 1997. Element Stewardship Abstract for Cirsium arvense. The Nature Conservancy, Arlington. <tncweeds.ucdavis.edu/esadocs/cirsarve.html> [Accessed May, 5, 2009.]

O'Sullivan, P. A. 1982. Response of various broad-leaved weeds, and tolerance of cereals, to soil and foliar application of DPX-4189. Canadian Journal Plant Science 62: 715-724.

O'Sullivan, P. A., V. C. Kossatz, and G. M. Weiss. 1985. Influence of chlopyralid on several yield and quality characteristics of Altex, Candle, and Regent rapeseed. Canadian Journal Plant Science 65: 638-639.

O'Sullivan, P. A., and V. C. Kossatz. 1982a. Selective control of Canada thistle in rapeseed with 3,6 dichlorpicolinic acid. Canadian Journal Plant Sciences 62: 715-724.

O'Sullivan, P. A., and V. C. Kossatz. 1982b. Influence of picloram or Cirsium arvense (L.) Scop. control with glyphosate. Weed Research 22: 251-256.

O'Sullivan, P. A., and V. C. Kossatz. 1984. Absorption and translocation of 3.6 dichloropicolinic acid in Cirsium arvense (L.) Scop. Weed Research 24: 17-22.

Olson, W. W. 1975. Effects of controlled burning on grassland within the Tewaukon National Wildlife Refuge. M.S. Thesis. North Dakota State University, Fargo, North Dakota. 137 pp.

Osoki, K. L., P. K. Fay, B. K. Salley, E. L. Sharp, and D. C. Sands. 1979. Use of Canada thistle rust as a biological control agent. Proc. West. Weed Science Society 32: 61.

Oswald, A. K. 1985. The height-directed application of dicamba for controlling Rumex obtusifolius and Cirsium arvense in grassland in Southcombe, E.S.E. (ed.), Application and Biology. Croydon, United Kingdom. BCPC Publications.

Peschken, D. P. 1979. Biological control of Canada thistle (Cirsium arvense): analysis of releases of Altica carduorum (Col.: Chrysomelidae) in Canada. Entomophaga 22: 425-428.

Peschken, D. P., H. A. Friesen, N. V. Tonks, and F. L. Barnham. 1970. Releases of Altica carduorum (Chrysomelidae, Coleoptera) against the weed Canada thistle (Cirsium arvense) in Canada. Canadian Entomologist 102: 264-271.

Peschken, D. P., and A. T. S. Wilkinson. 1981. Biocontrol of Canada thistle (Cirsium arvense); releases and effectiveness of Ceutorhynchus litura (Coleoptera: Cuculionidae) in Canada. Canadian Entomologist 113: 777-785.

Peschken, D. P., and G. R. Johnson. 1978. Host specificity and suitability of Lema cyanella (Coleoptera. Chrysomelidae), a candidate for the biological control of Canada thistle (Cirsium arvense). Canadian Entomologist 111: 1059-1068.

Peschken, D. P., and P. Harris. 1975. Host specificity and biology of Urophora cardui (Diptera: Tephritidae), a biological control agent for Canada thistle. Canadian Entomologist 107: 1101-1110.

Peschken, D. P., and R. W. Beecher. 1973. Ceutorhynchus litura (Coleoptera:Cuculionidae): biology and first releases for biological control of the weed Canada thistle (Cirsium arvense) in Ontario, Canada. Can. Ent. 105: 1489-1494.

Poisson, J. C. 1981. Results obtained with the isopropylamine salt of glyphosate using a new application procedure for wetting weeds. Compte Rendu de la 11e Conference du COLUMA 1: 13-20.

Roberts, H. A., and R. J. Chancellor. 1979. Periodicity of seedling emergence and achene survival in some species of Carduus, Cirsium, and Onopordum. Journal of Applied Ecology 16: 641-647.

Rogers, C. F. 1928. Canada thistle and Russian knapweed and their control. Colorado Agriculture Experiment Station Bulletin 434. 44 pp.

Rotheray, G. E. 1986. Effect of moisture on the emergence of Urophora cardui (L) (Diptera: Tephritidae) from its gall on Cirsium arvense (L). Entomological Gazette 37(1): 41-44.

Sagar, G. R., and H. M. Rawson. 1964. The biology of Cirsium arvense (L.) Scop. Proceedings British Weed Control Conference 7: 553-562.

Saidak, W. J. 1966. Differential reaction of Canada thistle varieties to certain herbicides. Res. Rpt. Nat'l. Weed Comm. (Eastern Canada section). p. 212.

Schaber, B. D., E. V. Balsbaugh, and B. H. Kantack. 1975. Biology of the flea beetle, Altica carduorum (Coleoptera: Chrysomelidae) on Canada thistle (Cirsium arvense) in South Dakota. Entomophaga 20: 325-335.

Schumacher, W. J., G. A. Lee, and W. S. Bell. 1980. Effect of glyphosate on seeds of Canada thistle (Cirsium arvense (L.) Scop.). Proceedings Western Weed Science Soc. 33: 112-113.

Seely, C. I. 1952. Controlling perennial weeds with tillage. Idaho Agricultural Experiment Station Bulletin 288. 43 pp.

Smith, K. A. 1985. Canada thistle response to prescribed burning. Restoration and Management Notes. 3(2): Note 94.

Sprankle, O., W. F. Meggitt, and D. Penner. 1975. Absorption, action, and translocation of radioactive glyphosate. Weed Science 23: 235-240.

Stachion, W. J., and R. L. Zimdahl. 1980. Allelopathic activity of Canada thistle (Cirsium arvense) in Colorado. Weed Science 28: 83-96.

Stojanic, D. 1980. [Effect of Puccinia suaveolans (Pers.) Rostr. on the population of Canada thistle (Cirsium arvense (L) Scop.] Uticaj Puccinia suaveolans (Pers.) Rostr. na razvoj populacije palamide (Cirsium arvense (L.) Scop.). Fragmenta Herbologica Jugoslavia 9: 3-10. (English abstract).

Story, J. M., H. DeSmet-Moens, and W. L. Morrill. 1985. Phytophagous insects associated with Canada thistle Cirsium arvense (L) Scop. in southern Montana. Journal of the Kansas Entomological Society. 58:472-478.

Sylvester, E. P. 1974. Thistle control (Cirsium) Proc. North Carolina Weed Control Conference 29: 101-103.

Thunhorst, G. and J.M. Swearingen. 2001. Canada Thistle. Cirsium arvense (L.) Scop. PCA Alien Plant Working Group. <nps.gov/plants/alien/fact> [Accessed May 5, 2009.]

Tomarek, G. W., and F. W. Albertson. 1953. Some effects of different intensities of grazing on mixed prairies near Hays, Kansas. Journal Range Managment 6: 299-306.

Toole, E. H. 1946. Final results of the Duval buried seed experiment. Journal of Agricultural Research 72:201-210.

Trumble, J. T., and L. T. Kok. 1982. Integrated pest management techniques for the thistle suppression in pastures of North America. Weed Research 22:345-359.

Tworkoski, J. J., and J. P. Sterrett. 1985. Canada thistle control with combinations of growth regulators and glyphosate or triclopyr. Proceedings Northeastern Weed Science Society 39: 98.

United States Department of Agriculture, National Resources Conservation Service. 2009. The PLANTS Database. National Plant Data Center, Baton Rouge, Louisiana [Accessed on 28 April 2009].

Warner, D. D. 1974. Integrated systems for control of Canada thistle due to Puccinia punctiformis. Proceedings North Central Weed Control Conference 29: 95-97.

Watson, A. K., and W. J. Keogh. 1981. Mortality of Canada thistle due to Puccinia punctiformis. Proceedings International Symposium, Biological Control of Weeds. 5: 325-332.

Weldy, T. & D. Werier. 2009. New York Flora Atlas. [S. M. Landry and K. N. Campbell (original application development), Florida Center for Community Design and Research. University of South Florida]. New York Flora Association, Albany, New York. [Accessed on 28 April 2009].

Welton, F. A., V. H. Morris, and A. J. Hartzler. 1929. Organic food reserves in relation to the eradication of Canada thistle. Ohio Agricultural Experimental Station Bulletin 441.

Wilson, R. G. 1980. Wilson, R. G. 1980. Survey of pesticide use in the irrigated regions of the Nebraska panhandle. Nebraska Agriculture Experimental Station Special Bulletin 554. 19 pp.

Wilson, R. G. 1981. Effect of Canada thistle (Cirsium arvense) residue on the growth of some crops. Weed Science 29: 159-164.

Wilson, R.G. 1979. Germination and seedling development of Canada thistle (Cirsium arvense). Weed Science 27: 146-151.

Zuris, N. K. and R. G. Wilson. 1984. Effect of plant growth stage and rate of chlor-sulfuron on Canada thistle control. Proc. North Carolina Weed Control Conference 39: 79.

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

Acknowledgments: The IN form incorporates components and approaches used in several other systems, cited in the references below. The Invasive Plant Advisory Committee was created by the Indiana Invasive Species Council in October 2010, and is made up of the original members of the Indiana Invasive Plant Assessment Working Group (IPSAWG). Original members of IPSAWG included representatives of the The Nature Conservancy; Indiana Native Plant and Wildflower Society; Indiana Nursery and Landscape Association; Indiana Chapter of the American Society of Landscape Architects; Indiana Forage Council; Indiana Wildlife Federation; Indiana State Beekeepers

Association; Indiana Beekeeper's Association; Department of Natural Resources; Hoosier National Forest; Indiana Academy of Science; Natural Resources Conservation Service; Indiana Department of Environmental Management; Indiana Department of Transportation; Purdue Cooperative Extension Service; Seed Administrator, Office of the Indiana State Chemist.

References for ranking form:

Carlson, Matthew L., Irina V. Lapina, Michael Shephard, Jeffery S. Conn, Roseann Densmore, Page Spencer, Jeff Heys, Julie Riley, Jamie Nielsen. 2008. Invasiveness ranking system for non-native plants of Alaska. Technical Paper R10-TPXX, USDA Forest Service, Alaska Region, Anchorage, AK XX9. Alaska Weed Ranking Project may be viewed at: http://akweeds.uaa.alaska.edu/akweeds_ranking_page.htm.

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

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

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

Warner, Peter J., Carla C. Bossard, Matthew L. Brooks, Joseph M. DiTomaso, John A. Hall, Ann M.Howald, Douglas W. Johnson, John M. Randall, Cynthia L. Roye, Maria M. Ryan, and Alison E. Stanton. 2003. Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands. Available online at www.caleppc.org and www.swvma.org. California Exotic Pest Plant Council and Southwest Vegetation Management Association. 24 pp.

Williams, P. A., and M. Newfield. 2002. A weed risk assessment system for new conservation weeds in New Zealand. Science for Conservation 209. New Zealand Department of Conservation. 1-23 pp.