NEW YORK
NON-NATIVE PLANT INVASIVENESS RANKING FORM

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:	April 28, 2009
Assessors:	Gerry Moore
Reviewers:	LIISMA SRC
Date Approved:	May 13, 2009 Form version date: 3 March 2009

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

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

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
	New York Invasiveness Rank §	High (Relative Maximum Score 70.00-80.00)	

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

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

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

Documentation:
Sources of information:
Brooklyn Botanic Garden, 2009; Weldy & Werier, 2009.

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

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

Documentation:
Sources of information (e.g.: distribution models, literature, expert opinions):
Brooklyn Botanic Garden, 2009.

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

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

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

Documentation:
Sources of information:
Brooklyn Botanic Garden, 2009.

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

Aquatic Habitats	Wetland Habitats	Upland Habitats
☐ Salt/brackish waters	☐ Salt/brackish marshes	☒ Cultivated*
☐ Freshwater tidal	☒ Freshwater marshes	☒ Grasslands/old fields
☐ Rivers/streams	☐ Peatlands	☒ Shrublands
☐ Natural lakes and ponds	☐ Shrub swamps	☐ Forests/woodlands
☐ Vernal pools	☐ Forested wetlands/riparian	☐ Alpine
☐ Reservoirs/impoundments*	☒ Ditches*	☒ Roadsides*
	☒ Beaches and/or coastal dunes	

Other potential or known suitable habitats within New York:
Wastelands.

Documentation:
Sources of information:
Brooklyn Botanic Garden, 2009.

B. INVASIVENESS RANKING

Questions apply to areas similar in climate and habitats to New York 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). Author's field observations suggest allelopathy. No evidence of irreversible impacts to ecosystem processes.

Sources of information:

Nuzzo, 1997; Fellows, 2004; Thunhorst & Swearingen, 2001; author's personal observations.

1.2. Impact on Natural Community Structure

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

Score: 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; author's 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; author's pers. observations.

Total Possible: 40
Section One Total: 20

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2. BIOLOGICAL CHARACTERISTICS AND DISPERSAL ABILITY

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

A.	No reproduction by seeds or vegetative propagules (i.e. plant sterile with no sexual or asexual reproduction).	0
B.	Limited reproduction (fewer than 10 viable seeds per plant AND no vegetative reproduction; if viability is not known, then maximum seed production is less than 100 seeds per plant and no vegetative reproduction)	1
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	4

known, then maximum seed production reported to be greater than 1000 seeds per plant.)
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; author's 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:
Author's 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 New York 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 A2.3	0
B.	Known to occur in two or more of the habitats given at A2.3, with at least one a natural habitat.	1
C.	Known to occur in three or more of the habitats given at A2.3, with at least two a natural habitat.	2
D.	Known to occur in four or more of the habitats given at A2.3, with at least three a natural habitat.	4
E.	Known to occur in more than four of the habitats given at A2.3, with at least four a natural habitat.	6
U.	Unknown	

Score: 6

Documentation:
Identify type of habitats where it occurs and degree/type of impacts:
See A2.3.
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 New York	0
B.	Native range possibly includes climates similar to at least part of New York.	1

C. Native range includes climates similar to those in New York — 3
U. Unknown

Score: 3

Documentation:
Describe what part of the native range is similar in climate to New York:
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 introduced distribution of the species in natural areas in the eight New York State PRISMs (Partnerships for Regional Invasive Species Management)

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

Score: 4

Documentation:
Describe distribution:
All PRISMS; see A1.1.
Sources of information:
Brooklyn Botanic Garden, 2009; Weldy & Werier, 2009.

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 desne stands pose major problems. The overview on control below is taken verbatim from Fellows, 2004.

"Methods of thistle control in the literature focus on the management of thistle in agricultural systems. Cultural, mechanical, chemical and biological methods have been developed for thistle eradication.

"MOWING: Early studies recommend mowing at frequent intervals. Hansen (1918) recommends mowing twice a year to prevent seed set. Detmers' (1929) recognized the need not only to prevent seed set, but to starve the root system and therefore recommended weekly mowing. Following studies that demonstrated that root carbohydrates reach an ebb in June (Welton et al. 1929, Arny 1932) efforts were made to time mowing to deplete root reserves. Systematic monthly mowing for a four-year period eliminated practically all the thistles (Welton et al. 1929). The greater the number of mowings the greater the effectiveness of control. Repeated mowing at 21-day intervals weakens roots and prevents seed production (Seely 1952), but is more labor-intensive that most farmers and managers can afford. Hodgson (1968) found that mowing alfalfa fields twice annually, at early-bud to preflowering stage (early to mid-June in Montana) and early fall (September) reduces thistle to 1% of its initial value in four years. A single mowing at early-bud stage accomplishes top removal when root carbohydrate reserves are minimal (Hodgson 1968).

"Observations at Red Rock Prairie, Minnesota, during the 1987 season, suggest that more than a single mowing or handcutting is needed to keep thistles from forming flowers on side branches after cutting. As many as 5 repeated cuts were necessary on individual thistles at this site from June to September to prevent blooming. (Sather pers. obs.)

"It appears that if labor is limited, the strategy of a single mowing at early bud stage would be most effective. The short delay until early flower stage (when natural area managers often cut because plants are most easily seen) will probably not result in significant carbohydrate build-up.

"None of the older literature substantiates the suggestion by Minnesota farmers (Heitlinger pers. comm., 1987; Winter pers. comm., 1987) that cutting thistles during a wet spell will kill them by causing the roots to rot. Hansen (1918) does not mention cutting, but states that plowing, harrowing and cultivation will be less effective in wet weather.

"GRAZING: Early authors suggest grazing as a method of control. Although livestock are not attracted to thistle, sheep will graze and trample plants that have been treated with salt (Detmers 1927, Cox 1913). Rogers (1928) states that very young plants will be eaten by goats or sheep in the spring, but that grazing is the least effective control method for Cirsium arvense. There are no available data on the effect of stocking rates or grazing intensities. It seems likely that animal disturbance from conventional grazing would encourage the spread of C. arvense, as has been demonstrated for C. lanceolatum, C. vulgare, and C. undulatum (Tomarek and Albertson 1953, Ankle 1963, Hetzer and McGregor 1951).

"SMOTHER CROPS: Rogers (1928) discusses the principle of smother crops as the effect of choking out an undesirable species by shading. Smother crops must come up earlier than C. arvense and grow rapidly during the early summer in order to shade out the thistle. They must be able to hold their own against the growing thistle and retain their vigor until frost (Rogers 1928). Although these principles were meant to apply in the selection of smother crops on cultivated fields or haylands, they might be applicable in the selection of native "smother" species of use in restoration of disturbed patches in managed areas.

"Alfalfa and sweet clover are both effective smother crops. Alfalfa is favored over the taller sweet clover because it is cut earlier and more often, producing the side-effect of depleting thistle root carbohydrates. Detmers (1927) recommends sowing at rates of 11.2 to 16.8 kg/ha for thistle control. Other plants that have been used as smother crops include grasses, millet, sugar beets, sorghum, hemp, buckwheat, and small grains (Cox 1913, Rogers 1928). Although the terminology is no longer used, smother crops continue to be used in integrated pest management systems for C. arvense (Hodgson 1968).

"BURNING: No studies have been designed specifically for the purpose of assessing burning as a method of thistle control. However, in studies comparing the response of warm season grassland in eastern Kansas to May and June burns, Alson (1975) found that although thistle abundance was initially increased by May burns, within two growing seasons it declined below the level in control areas. Immediate reductions in thistle abundance were found following June burns. In the same study, May burns in cool season grassland produced immediate reduction of thistles in comparison to a control (Olson 1975).

"Summer burning in North Dakota appears to reduce thistle infestations even on bare soils. Thistle seed production is heavy throughout the summer in areas burned in June. In areas first burned in July or August late summer crops of thistle seedlings are large, but the plants freeze prior to flowering (Smith 1985).

"CHEMICAL CONTROL: The major problem in using herbicides for control of C. arvense is the plant's deep, well-developed root system. Most herbicides that would be used to control broad-leaved perennials do not translocate easily into the root system (Baradari et al. 1980, Marriage 1981). Methods of increasing translocation are therefore at the forefront of research dealing with chemical control of deep-rooted perennials. The literature is enormous and response varies between ecotypes and varieties (Hodgson 1968, Saidak 1966).

"Several environmental factors and methods of application enhance the effectiveness of herbicides. Effectiveness of phenoxy herbicides (MCPA and 2,4-D) is greatest when root carbohydrate reserves are low (Marriage 1981).

"Translocation of glyphosate is significantly greater in plants at the bud to flowering stage than in younger plants (Sprankle et al. 1975). Laboratory studies indicate that total plant absorption of glyphosate and dicamba decreases with increasing water stress, translocation of glyphosate to root buds declines with increasing water stress, but picloram metabolism is unaffected (Lauridson et al. 1980).

"Lisk and Messersmith (1979) have found greater translocation of glyphosate plus 2,4-D below the treated area when herbicide is applied to stems rather than leaves. Translocation to roots was greater when herbicide was applied to the upper leaf surface than to the lower.

"Increased translocation of some herbicides can be caused by growth regulators. Baradari et al. (1980) found that leaf absorption of dicamba was increased from 32% to 64% and basipetal translocation was increased from 6% to 9% by simultaneous application of chlorflurenol. However, similar responses were not observed in studies of ethephon and chlorflurenol with glyphosate (Tworkoski and Sterret 1985). A combination of herbicide with fertilization has also proven effective under some circumstances. Hodgson (1968) found combination treatments with 2,4-D at .24 to 2.24 kg/ha with 33.6 kg/ha nitrogen and 112 kg/ha phosphorus resulted in better thistle control and higher yields of spring wheat than either herbicide or fertilizer alone.

"Jaeger (pers. comm., 1987) states that boom spray application of 2,4-D for thistle control in Kilen Woods State Park, Minnesota, was ineffective because it set back the succession of natural communities, actually opening areas for thistle invasion. Application of Roundup to individual plants with a Walk-a-Wick applicator was difficult because the thistles were often below grass level. In 1985, park personnel converted to the use of a Solo backpack tank of 4 to 5 gallon capacity with the nozzle modified by a brass adjustment to apply a straight stream (not mist) at low pressure. Roundup at 3-4% is mixed with a purple agricultural dye and herbicide is dribbled at the top of the stem, dribbling downward. Both the time involved and amount of herbicide are cut in half by use of the dye, which persists as a marker of treated plants for up to a week. Plants are treated in the pre-bud stage and rounds are made weekly to assure treatment of plants that may have been missed in the initial application.

"BIOLOGICAL CONTROL: Although over 80 native species of insects plus over 50 other native species ranging from fungi to birds are known to frequent Cirsium arvense, only four are presently considered as important enemies of the plant (Maw 1976). These species are the beetles Cassia rubiginosa Muell., Coleoptera, Chrysomelidae and Cleonus piger Scop., Coleoptera, Cuculionidae; a fly, Arellia ruficauda Fab., Diptera, Tephritidae; and the painted lady butterfly, Vanessa Cardui L., Lepidoptera, Nymphaidae (Evans 1984). Only Orellia ruficauda appears to do damage (Maw 1976, Forsyth and Watson 1985), and the level of damage is probably not sufficient to act as a control.

"Rust species of the genus Puccinia offer greater possibilities as biological control agents. Although damage is probably not sufficient for the rust alone to control thistle populations (Ososki et al. 1979, Turner et al. 1980) preliminary results in England suggest that Puccinia punctiformis can be used in conjunction with 2,4-D in integrated programs of thistle control (Haggar et al. 1986).

"Four European insects- Ceutorhynchus litura, Urophora cardui, Altica carduorum, and Lema cyanella- have been released for Canada thistle control in North America with some promise of success.

"Since its initial introduction in North America in 1967, the cuculionid beetle Ceutorhynchus litura has become established in five provinces and in Montana (Peschken and Wilkinson 1981, Story et al. 1985). Weevil populations have increased at nine release sites in Canada (Peschken and Wilkinson 1981). Although C. litura is not effective as a sole means of control, it weakens and damages the plants by mining the stems (Peschken and Wilkinson 1981).

"The gall fly Urophora cardui reduces shoot size and vigor of infested thistles (Peschken and Harris 1975) inhibits seed production (Laing 1978), and results in lower root and above-ground weights than gall-free plants (Peschken and Harris 1975). Since its release in 1974, U. cardui has become established in eastern Canada, but not in western Canada where dry summers may be the limiting factor (Rotheray 1986).

"The Chrysomelid beetle Altica carduorum weakens C. arvense by defoliation and feeding on flower heads. It was first regarded as a promising control agent because of its specificity and continuous feeding habit, but has proven unsatisfactory because of its susceptibility to predation (Peschken et al. 1970, Story et al. 1985, Schaber et al. 1975).

"A second Chrysomelid, Lema cyanella has been released in Canada, but will not be released in the United States because its host preference includes some native California thistles (Turner pers. comm. 1987).

"INTEGRATED CONTROL: In agricultural systems, integrated pest management programs appear to provide more effective thistle control than any individual method. Integrated systems combine the use of herbicides, cultivation and smother crops.

"In Ontario there appeared to be a synergistic relationship between infestation of thistle by C. litura and infection by the rust Puccinia punctiformis. 87% of rust-infected thistles were mined by weevils compared with 32% of uninfected shoots (Peschken and Beecher 1973). Such an effect is not reported for sites in western Canada (Peschken and Wilkinson 1981), but no discussion of possible ecotypic differences is included.

"At the present time, none of the insects being tested as biological control agents has been simultaneously tested for tolerance to herbicides (Trumble and Kok 1982). It appears that 2,4-D at low rates can be used in conjunction with the rust Puccinia punctiformis to achieve better control than either treatment alone (Haggar et al. 1986).
Monitoring Requirements: Monitoring may be required to judge the effect of control measures in natural areas. In cases like C. arvense where natural succession may accomplish long-term control and "treatment" is mostly a matter of public relations,

monitoring can measure changes in thistle populations as the community matures.

"The best time to search for C. arvense is just before the blooming period, which varies from south to north, but corresponds with 14- 18 hours of daylight (Linck and Kommedahl 1958, Hunter and Smith 1972).

"Because of the patchy growth and ability to regenerate from roots and root fragments, measurement of patch size by the line intercept methods may be more meaningful than actual stem counts.

"If comparable methods of control are used from year-to-year throughout the same area, the number of person-hours required from control can provide a rough measure of effectiveness. A certain minimum number of hours will be required to search the tract regardless of the number of thistles encountered."
Sources of information:
Fellows, 2004.

Total Possible	10
Section Four Total	9

Total for 4 sections Possible	100
Total for 4 sections	71

C. STATUS OF CULTIVARS AND HYBRIDS:

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

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

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