

COSEWIC Assessment and Status Report

on the

Pitcher's Thistle *Cirsium pitcheri*

in Canada



SPECIAL CONCERN
2010

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada



COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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Maun, M.A. 1999. Update COSEWIC status report on the Pitcher's Thistle *Cirsium pitcheri* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-14 pp.

Keddy, C.J. 1988. COSEWIC status report on the Pitcher's Thistle *Cirsium pitcheri* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 22 pp.

Production note:

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For additional copies contact:

COSEWIC Secretariat
c/o Canadian Wildlife Service
Environment Canada
Ottawa, ON
K1A 0H3

Tel.: 819-953-3215

Fax: 819-994-3684

E-mail: COSEWIC/COSEPAC@ec.gc.ca

<http://www.cosewic.gc.ca>

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COSEWIC Assessment Summary

Assessment Summary – November 2010

Common name

Pitcher's Thistle

Scientific name

Cirsium pitcheri

Status

Special Concern

Reason for designation

This globally vulnerable endemic thistle of the Great Lakes occupies a small area including a series of sandy shoreline habitats from southeastern Lake Huron to Pukaskwa National Park on the north shore of Lake Superior. The species' core range in Canada occurs along the southern margin of Manitoulin Island and nearby islands. Increases in population size and number have occurred over the past decade due to increased surveys. This species is at continued but reduced risk because of its specialized life history of flowering and reproducing only once at age 3-11 years before dying, its mainly small populations that undergo fluctuation, and ongoing habitat impacts from a variety of causes. Such threats as recreational ATV use in the species' habitat, presence of an exotic grass (Common Reed) and spread of woody plants into its habitat affect various populations.

Occurrence

Ontario

Status history

Designated Threatened in April 1988. Status re-examined and designated Endangered in April 1999. Status re-examined and confirmed in May 2000. Status re-examined and designated Special Concern in November 2010.



COSEWIC Executive Summary

Pitcher's Thistle *Cirsium pitcheri*

Wildlife species description and significance

Pitcher's Thistle is a perennial herb of the aster family that flowers only once in its lifetime. It spends 3-11 years as a ring (rosette) of leaves at ground level, then produces a flowering stem with a thistle head of flowers, sets seed, and dies. Plants have a whitish-green colour from a layer of fine hairs on the surface of the plant. Spines are present only at the tips of the leaves and on the flower head. Pitcher's Thistle has no means of vegetative reproduction

Pitcher's Thistle is a globally rare endemic of the Great Lakes region. It is also an indicator of beach habitat quality. No Aboriginal traditional ecological knowledge has been identified.

Distribution

In Canada, it is found only in Ontario. In the U.S., it is found in Michigan, Indiana, Illinois and Wisconsin. There are 30 extant populations in Canada: two on Lake Superior, 20 on Manitoulin Island, five on islands surrounding Manitoulin Island, and three on Southern Lake Huron. The species has a linear shoreline distribution of about 835 km in extent by about 100 m in width covering about 83.5 km² of shoreline habitat.

Habitat

Pitcher's Thistle is found only on sand dunes and sandy beaches. Optimal Pitcher's Thistle habitat is open, dry, loose sand with sparse or no vegetation immediately surrounding or shading the thistles. The habitat is dynamic due to effects from wind, water, and ice which move sand, causing the build-up of mounds, burial of vegetation, exposure of roots, and blowouts. Natural succession may cause habitat to become unsuitable when vegetation becomes too dense. The amount of habitat has stayed roughly the same since the last status report. Of 30 total, four small populations are in national or provincial parks.

Biology

Pitcher's Thistle flowers mainly from mid-June through July. Flowers are self-fertile, but selfing produces lower seed-set than open pollination. A wide array of insects visit Pitcher's Thistle, so pollination is probably not a limiting factor. Seeds are viable for up to three years and are wind-dispersed. The entire seed head may occasionally break off and disperse as a unit. Long-distance dispersal of up to 99 km has been confirmed in the Manitoulin Region but this is probably uncommon because there is also unoccupied habitat in the region.

Population sizes and trends

Considerable fieldwork undertaken since 2000 has greatly increased the number of Canadian populations from about 10 to 30. Annual monitoring shows a multi-year increase in numbers of plants in most populations. In the total Canadian population, 15 populations show a steady increase in numbers; seven have natural fluctuations from flowering and die-off; three are stable; only five currently show serious declines. The total Canadian population had 50,435 plants (rosettes, flowering plants and seedlings) in 2008. Of these, 11,739 flowered and died. The trigger for flowering in this species is still not understood, consequently there is no way to estimate how many plants will flower and die in subsequent years.

On Lake Superior there are two populations. Population #1 (consisting of 119 rosettes, flowering plants and seedlings) is declining and could become extirpated within 5-8 years. A subpopulation has already become extirpated. Population #2 (total of 331 plants of all stages) is an introduced site and is increasing. Along southeastern Lake Huron, of three populations (total of 233 plants of all stages), one is declining and two are increasing. In the Manitoulin Island Region, of 25 populations, 12 have steadily increased since 2001, and of these, six have increased 200-800%. Seven populations have shown apparently natural fluctuations from flowering and die-off, and 3 populations appear stable. Only three populations have shown declines due to threats. The Manitoulin Region had a total of about 50,000 plants at all stages in 2008.

Most populations in the Manitoulin Region have increased greatly in numbers, and this increase has occurred with little human intervention. It is not known why numbers were so low at previously surveyed sites when monitoring began in 2001.

Threats and limiting factors

For the five populations that are declining, natural succession and filling in of vegetation is the primary threat, compounded by browsing and/or ATV use. Recreational use may be causing a decline at one population.

Protection, status, and ranks

COSEWIC previously assessed Pitcher's Thistle as Endangered in May 2000, and it is currently listed as endangered on Schedule 1 of the federal *Species at Risk Act* (SARA). The Pitcher's Thistle – Dune Grasslands Recovery Strategy has not yet been posted on the SARA Public Registry but will include a critical habitat definition for sites in Pukaskwa National Park. The species is also listed on Schedule 3 of the Ontario *Endangered Species Act, 2007* as a transition species to be listed as Endangered. Most of the Canadian Pitcher's Thistle population is on municipal and private land in the Manitoulin District. Habitat for the species has not yet been regulated anywhere. The Ontario *Provincial Parks and Conservation Reserves Act (2006)* mandates that parks and conservation reserve lands are managed to maintain the ecological integrity of habitats for native species, including species at risk.

In the United States, Pitcher's Thistle is ranked nationally as vulnerable, critically imperilled in Illinois and imperilled in Indiana and Wisconsin. It is also ranked vulnerable in Michigan. Pitcher's Thistle is designated Threatened and legally listed as such under the U.S. *Endangered Species Act* and is ranked globally as vulnerable.

TECHNICAL SUMMARY

Cirsium pitcheri

Pitcher's Thistle

Chardon de Pitcher

Range of occurrence in Canada (province/territory/ocean): Ontario

Demographic Information

<p>Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines(2008) is being used) Note: in this monocarpic species, mature individuals die after fruiting.</p>	Typically 3-11yrs
<p>Is there an [observed, inferred, or projected] continuing decline in number of mature individuals? OVERALL INCREASE— total Canadian population is not declining</p>	No
<p>Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]</p>	N/A
<p>[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations]. Overall increase is due to new discoveries of existing populations previously undetected and increases at some populations.</p>	Unknown
<p>[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].</p>	Unknown
<p>[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.</p>	Unknown
<p>Are the causes of the decline clearly reversible and understood and ceased? No overall decline.</p>	N/A
<p>Are there extreme fluctuations in number of mature individuals? Trigger for transition to flowering is still not understood. Numbers of mature plants fluctuate widely. Fluctuations may be triggered by hot, sunny weather. "Extreme fluctuation" (by an order of magnitude as defined by IUCN) does not apply for this DU or species.</p>	No, based on monitoring data from Pinery Prov. Park and Inverhuron Prov. Park

Extent and Occupancy Information

<p>Estimated extent of occurrence Points for all populations were plotted using GoogleEarth Pro. A polygon with no concave sides was drawn around these points, and the area of the polygon was calculated by the software. This includes a great deal of Lake Superior and Lake Huron. Actually, a narrow crescent-shaped polygon from Pukaskwa National Park across south shore of Manitoulin Island and south to Pinery Provincial Park would be more accurate, and would be roughly 835 km x 100 m in width = 83,500,000 m² or 83.5 km² plus an additional 0.5 km² for Western and Great Duck Islands.</p>	<p>43,438 km² The actual value is closer to ~835 km of linear shoreline habitat with widths of 50-500 m wide (42-418 km²).</p>
<p><i>Index of area of occupancy (IAO)</i> Number of 2 x 2 km squares that are occupied by the species on 1:50,000 scale topographic maps (32=128 km²).</p>	136 km ²
<p>Is the total population severely fragmented? More than half of the total number of plants is in secure, viable populations, although the total population consists of numerous scattered and isolated populations.</p>	No

Number of "locations" (as per definition, in relation to threat) The majority of populations have limited significant threats as evidenced by the overall population increase with only five of 30 populations showing declines. The use of locations is likely not applicable under such conditions. If applied, however, the threats and different timelines for threats and different management regimes being used, or lack of such, would likely result in >10 locations.	Not applied or if rationalized then likely >10
Is there an [observed, inferred, or projected] continuing decline in extent of occurrence?	No
Is there an [observed, inferred, or projected] continuing decline in index of area of occupancy?	No
Is there an [observed, inferred, or projected] continuing decline in number of populations?	No
Is there an [observed, inferred, or projected] continuing decline in number of locations? Use of location has not been applied.	n/a
Is there an [observed, inferred, or projected] continuing decline in [area, extent and/or quality] of habitat? Habitat at some sites is becoming unsuitable due to natural succession; however, habitat is being created at other sites due to sand deposition.	No
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations (as per definition, in terms of threat)? Use of location has not been applied.	n/a
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each population)

Population	N Mature Individuals
Note: In this monocarpic species, mature individuals die after fruiting. See tables 3, 4 & 5 for individual population sizes.	
Total: The total number of mature individuals varies from year to year, but may exceed the critical value of 10,000 in any given year, given that some fraction of non-flowering individuals with large rosettes could be considered to be mature individuals.	11,739 plants flowered and died in 2008; 35,886 rosettes may continue into 2009 but the actual number of mature individuals can be determined only after rosettes flower. Perhaps 25% of rosettes (~9000) will flower in 2009.

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	None available
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Threats (actual or imminent, to populations or habitats)

Main threats: Only five populations are declining due to threats. At these sites the main threat is natural succession compounded by browsing, invasive species, or ATV use.

Rescue Effect (immigration from an outside source)

Status of outside population(s)? U.S.: Threatened	
Is immigration known or possible?	Unknown
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Yes
Is rescue from outside populations likely?	Very unlikely

Current Status

COSEWIC: Special Concern (November 2010)
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Status and Reasons for Designation

Status: Special Concern	Alpha-numeric code: n/a
Reasons for Designation: This globally vulnerable endemic thistle of the Great Lakes occupies a small area including a series of sandy shoreline habitats from southeastern Lake Huron to Pukaskwa National Park on the north shore of Lake Superior. The species' core range in Canada occurs along the southern margin of Manitoulin Island and nearby islands. Increases in population size and number have occurred over the past decade due to increased surveys. This species is at continued but reduced risk because of its specialized life history of flowering and reproducing only once at age 3-11 years before dying, its mainly small populations that undergo fluctuation, and ongoing habitat impacts from a variety of causes. Such threats as recreational ATV use in the species' habitat, presence of an exotic grass (Common Reed) and spread of woody plants into its habitat affect various populations.	

Applicability of Criteria

Criterion A (Declining Total Population): Not applicable. No overall declines and populations also fluctuate.
Criterion B (Small Distribution, and Decline or Fluctuation): Not applicable. EO, if linear shoreline habitat is used, and IAO are both within limits, but populations are not severely fragmented and the applicability of number of locations is in doubt; some decline in quality of habitat is ongoing but no extreme fluctuations are evident.
Criterion C (Small Total Population Size and Decline): Not applicable. No continuing decline demonstrated.
Criterion D (Very Small Population or Restricted Distribution): Not applicable. Population size is too large and IAO exceeds limits.
Criterion E (Quantitative Analysis): None available.



COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2010)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.



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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

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Pitcher's Thistle

Cirsium pitcheri

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and classification

Scientific name: *Cirsium pitcheri* (Torr. ex Eaton) Torr. & A. Gray

Common name: Pitcher's Thistle, Chardon de Pitcher

Family: Asteraceae (aster family)

Major plant group: Eudicot flowering plant

The taxonomy has not changed since the first COSEWIC report by Keddy (1987). Pitcher's Thistle is listed as above in the Flora of North America (Keil 2008).

Morphological description

Pitcher's Thistle is a perennial herb usually seen as a ring of basal leaves (a "rosette") generally 15-30 cm in diameter. The plants have a distinct whitish-green colour from the layer of fine hairs that covers the surface of the leaves. The leaves are narrow and deeply divided, with a spine at the tip of each linear division.

After its first year as a seedling, Pitcher's Thistle spends the next 3-11 years as a rosette. At some threshold (energy stored in root tissue has been suggested by D'Ulisse and Maun 1996), Pitcher's Thistle produces an upright stem (~50-100 cm tall) with 1–many spiny, urn-shaped heads of white or pale pink flowers. The heads are similar in shape to those of other thistles in the genus *Cirsium*, such as the familiar Bull Thistle (*C. vulgare*). After pollination, shiny, dark brown, seed-like fruits (or cypselas) develop inside the head, each fruit attached to a fluffy pappus. Pitcher's Thistle has no means of vegetative reproduction (Figure 1).



Figure 1. Life stages of Pitcher's Thistle. A. Seedlings; B. Rosette; C. Flowering. (Photos by Judith Jones).

Pitcher's Thistle differs from other species of thistle in its whitish green leaf colour; in being prickly only on the flower head and at the leaf tips; in its white or pale pink flower colour; and in being found only on sand dunes and beaches on the Great Lakes.

Population spatial structure and variability

Two studies have addressed genetic variation in Pitcher's Thistle; one using microsatellite variation in Canadian populations (Gauthier *et al.* 2010, based on Coleman (2006) and the other using isozyme variation in U.S. populations (Loveless and Hamrick 1988). Geographic sampling in these two studies is completely non-overlapping.

Gauthier *et al.* (2010) analyzed 286 individuals from 17 Canadian populations. Populations sampled were from Manitoulin Island (12 populations) and nearby sites on Great Duck (2) and Cockburn Islands (2), with the additional sample from Pukaskwa National Park on Lake Superior. Nine to 28 individuals were sampled per population. Populations from southeastern Lake Huron were not included. They analysed seven nuclear and three chloroplast microsatellites (Gauthier *et al.* 2010). No chloroplast DNA variation was detected, which is not unexpected for a fairly narrow endemic.

The seven nuclear microsatellite loci revealed low levels of genetic diversity across this set of populations, as estimated by the number of alleles per locus (range 1.86-3.29), as well as expected (average 0.389) and observed (average 0.252) heterozygosities (Gauthier *et al.* 2010). Significant heterozygote deficiencies were detected in 15 populations. Despite low levels of diversity, levels of differentiation among populations were relatively high. F_{st} values ranged from 0.110 to 0.594, with the greatest differentiation found between Pukaskwa and other populations. Samples from this population also included three loci that are fixed for one allele, the lowest level of allelic diversity (1.86 allele per locus), and the highest frequency of unique (private) alleles (0.231) (Gauthier *et al.* 2010). It should be noted that a number of other populations contained private alleles, indicating that these too share relatively little gene flow. This led the authors to conclude that the distinctness of the Pukaskwa population is most likely attributable to geographic isolation and genetic drift (Gauthier *et al.* 2010).

Coleman (2006) included data from five of the seven loci used by Gauthier *et al.* (2010), and also included analysis of population structure. This analysis was not included in Gauthier *et al.* (2010) because the data violated assumptions for random mating (J. Freeland, pers. comm. 2010).

Loveless and Hamrick (1988) also detected low levels of variation in U.S. populations, with populations of Pitcher's Thistle being less variable than samples of the more widespread, closely related *Cirsium canescens*.

Designatable units

Designatable units are not applied. Gauthier *et al.* (2010) detected evidence of genetic differentiation between the Pukaskwa populations and the remaining samples. However, the differences were in highly variable, neutral markers and it is difficult to extrapolate the potential for significant differentiation in adaptive traits from these. Gauthier *et al.* (2010) and Loveless and Hamrick (1988) interpreted differences among populations as evidence of drift in isolated populations. Further, genetic studies have yet to include samples from U.S. and Canadian populations, and thus it is unclear whether the distinction of Pukaskwa populations would be as distinct with more complete sampling.

Special significance

Pitcher's Thistle is a Great Lakes endemic and is an indicator of the quality of dune or beach habitat. There is no Aboriginal traditional ecological knowledge (ATK) known for this species (Flamand, pers comm. 2008; King, pers. comm. 2001) although dunes have been used as landing places for canoes and boats for millennia.

DISTRIBUTION

Global range

Pitcher's Thistle is endemic to sand dunes and sandy beaches on Lakes Michigan, Huron, and Superior. The northernmost populations are on Lake Superior at Pukaskwa National Park (Ontario). The southernmost populations are on the Lake Michigan shore at the Indiana Dunes (National Lakeshore and State Park), and on the Lake Huron shore at Port Franks, just south of Pinery Provincial Park. The core of the species' range is along the northern shores of Lakes Michigan and Huron (see Figures 2 and 3).

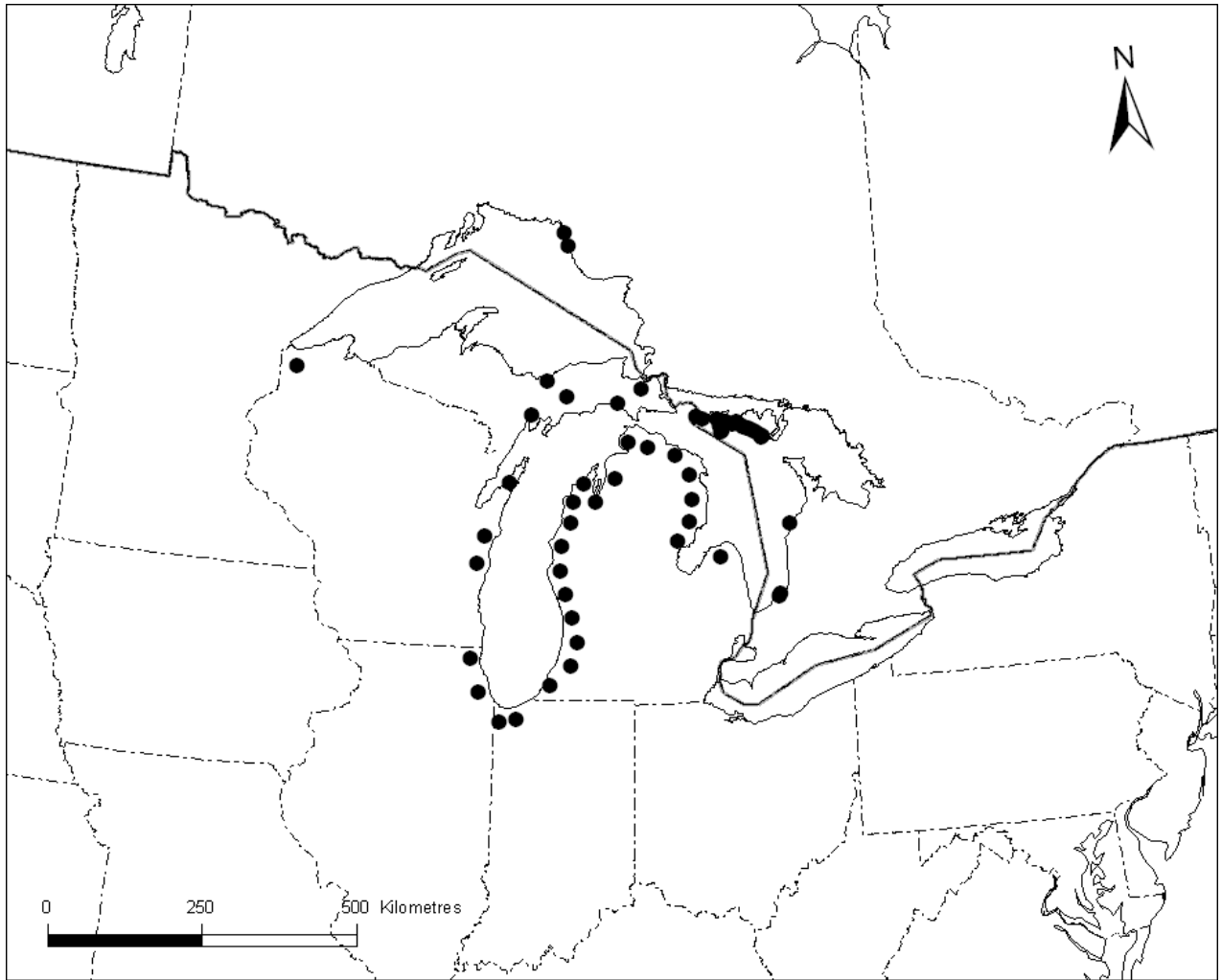


Figure 2. Global range of Pitcher's Thistle.

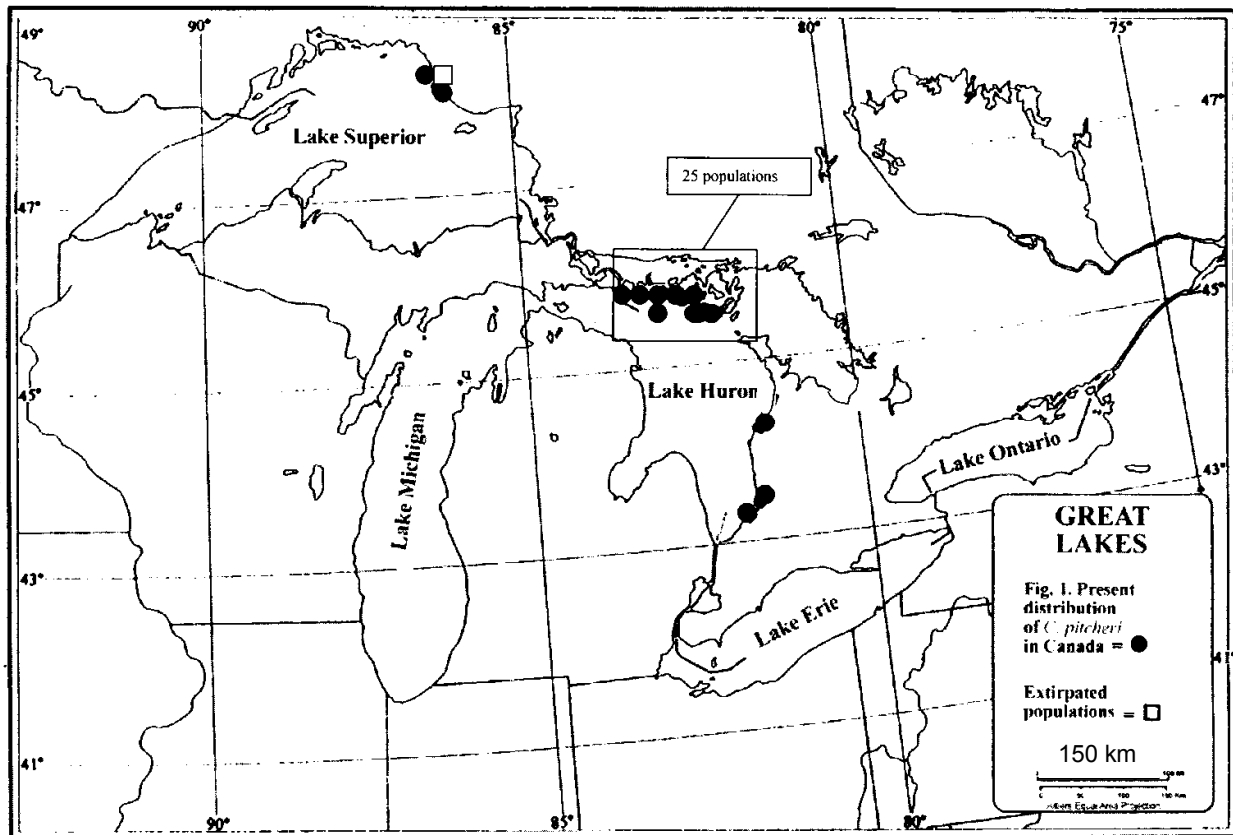


Figure 3. Range of Pitcher's Thistle in Canada. Small open square indicates an extirpation since the last status report. (Source: fieldwork by Jones, 2001-2009.)

According to Jalava (2008) more than 25% of the geographic range of Pitcher's Thistle occurs in Canada, but the percentage of the global population present in Canada is less than 10%. Based on the most current information (Jones 2008), 15% of global occurrences occur in Canada, but this does not take into consideration the number of individuals at each site. Therefore, a conservative estimate would give Canada a maximum of 15% of the global population if all Canadian occurrences are as big or bigger than U.S. sites. Table 1 shows the number of occurrences of Pitcher's Thistle by jurisdiction. Occurrences are separated from each other by at least 1 km, and all individuals within a single occurrence are within 1 km of another plant.

Table 1. Distribution of Pitcher's Thistle occurrences by jurisdiction.

(Information on U.S. populations comes from U.S. Fish and Wildlife Service, 2002.)

Jurisdiction¹	Number of occurrences	% of global occurrences
Michigan	156	77
Ontario	30	15
Wisconsin	9	4
Indiana	8	4
Total:	203	100

¹Pitcher's Thistle was also formerly known in Illinois from 14 historic locations; however, habitat no longer exists in the majority of these places. The species has been reintroduced to one site at Illinois Beach State Park. As of 2002 the site was still extant (USFW, 2002).

Canadian range

All 30 extant Canadian occurrences are in Ontario (Table 2). There are two occurrences (one has been introduced from native seeds and is increasing in size) in Pukaskwa National Park along Lake Superior, and 28 occurrences along Lake Huron. Of the Lake Huron occurrences, 20 are on the south shore of Manitoulin Island, five are on islands surrounding Manitoulin including Great Duck, Western Duck, and Cockburn Islands, and three occurrences are along southeastern Lake Huron: Inverhuron Provincial Park, Pinery Provincial Park, and straddling the Pinery Provincial Park boundary at Port Franks. Pitcher's Thistle is extirpated from Kettle Point/Ipperwash (last seen 1937), Sauble Beach (last seen 1941) and presumably from other parts of southern Lake Huron although large areas of suitable habitat still exist (see Appendix 1).

Table 2. Canadian occurrences of Pitcher's Thistle by region.

Region	Number of sites
Pukaskwa National Park	2
Manitoulin Island	20
Other islands around Manitoulin Is.	5
Southern Lake Huron	3
TOTAL:	30

(Occurrences are separated from each other by at least 1 km or more.)

Maun (1999) included a population of Pitcher's Thistle on Georgian Bay based on a 1936 collection (at the Department of Agriculture herbarium, Ottawa (DAO)) by Marie-Victorin from "Wasaga Beach, comté de Simcoe: Port Francis au bord du Lac Huron". There are several reasons to doubt this record actually came from Wasaga Beach (Oldham, pers. comm. 2008) including: conflicting information on the label such, as "Port Francis" and "bord du Lac Huron", when Wasaga Beach is on Georgian Bay; other mislabelled Marie-Victorin collections; the record not being plotted in the Atlas of Rare Vascular Plants of Ontario (Argus *et al.* 1982-1987); no other records from Wasaga Beach for this distinctive plant despite considerable fieldwork; and no other records for the species anywhere on Georgian Bay. It is much more likely the collection came from Port Franks. Regardless, from fieldwork in the area in 2002-03 (Jones 2003, 2002) and extensive work along the Georgian Bay coast (Reznicek 1972; White 2007; Kamstra and Spisana 2009; and Brunton 1989) it can be said with great certainty that Pitcher's Thistle is not present at Wasaga Beach or anywhere on Georgian Bay.

In overall geographic range, the distribution of Pitcher's Thistle is highly fragmented. The Pukaskwa populations are separated by 100s of kilometres from the next closest population in Michigan and even further from the nearest Canadian populations in the Manitoulin Region. This geographic isolation is reflected in the low genetic diversity of the Pukaskwa populations, even relative to the low diversity of Canadian populations on the whole (Gauthier *et al.* 2010; Coleman 2006). Populations on southern Lake Huron are 100s of km removed from those in the Manitoulin region or from those on the Michigan side of Lake Huron.

However, it is questionable whether severe fragmentation can be applied across the entire range of the species in Canada based on the COSEWIC/IUCN definition. More than 50% of mature plants occur in large viable populations in the Manitoulin region. Although the sizes of individual areas occupied by the numerous small populations were not tabulated, it can be inferred that together these likely account for the majority of the total area of habitat occupied by the species.

The extent of occurrence (EO) for the total Canadian population is 43,438 km², based on a polygon with no concave sides drawn around all points. This includes much of Lake Superior and Lake Huron for this terrestrial species. The species occurs in a linear distribution along the lakeshores, so a narrow crescent-shaped polygon from Pukaskwa National Park across south shore of Manitoulin Island and south to Pinery Provincial Park would be more accurate, and would be roughly 835 km long by ~100 m in width = 83.5 km² with an additional 0.5 km² for Western and Great Duck Islands. The index of area of occupancy (IAO) for the total Canadian population based on 2 km squares is 136 km².

Search effort

Survey work throughout the Canadian range (but especially in the Manitoulin Region) has occurred in the last nine years (Jones 2001-2005, 2006a-b, 2007, 2008). Maun (1998) listed only six sites from the Manitoulin region: Providence Bay, Carter Bay, Square Bay, Carroll Wood Bay, and Sand Bay. Currently, there are 20 sites known on Manitoulin Island and five sites on surrounding islands. Fieldwork in this region has significantly increased the known size of the total Canadian Pitcher's Thistle population without expanding the geographic range much.

The likelihood of finding additional sites is low, as nearly all of the sandy areas on the southern Lake Huron shoreline, as well as those on the north shore of the North Channel, have been extensively searched. On the south shore of Manitoulin Island there remain some small areas that have not been visited, but if Pitcher's Thistle were to be found there, these areas would be within already-known occurrences. Sites that were searched and where Pitcher's Thistle is not found are listed in Appendix 1.

In the Manitoulin Region, most populations have been monitored annually since 2001. Annual monitoring at Pukaskwa National Park has occurred since 1981 (Vance 2008; Promaine 1998). Monitoring of the southern Lake Huron populations has been occasional since 1999 but was done in 2008 for this status report.

HABITAT

Habitat requirements

Pitcher's Thistle is found only on sand dunes and sandy beaches. This species is not weedy and is never found in pastures, gardens, or agricultural fields. Optimal Pitcher's Thistle habitat is open, dry, loose sand with sparse or no vegetation immediately surrounding or shading the thistles. Pitcher's Thistle is found in dune grassland communities dominated by Marram Grass (*Ammophila breviligulata*), Long-leaved Sand Reed (*Calamovilfa longifolia* var. *magna*), Great Lakes Wheat-grass (*Elymus lanceolatus* spp. *psammophilus*) or Little Bluestem (*Schizachyrium scoparium*), usually in the part of the habitat where these grasses occur.

Within the dune ecosystem, rosettes of Pitcher's Thistle appear to tolerate a wide range of microclimates. Otfinowski (2002) assessed numerous microclimate factors within dune ecosystems, including air temperature, soil temperature, wind velocity, light intensity, edaphic factors (sand particle size, organic matter, pH, particle size, etc.), plant associates, sand movement, and many other parameters, and found that rosette growth was not correlated with any particular factor. On the other hand, anecdotal information from annual monitoring suggest that reproductive success (amount of flowering, seedling establishment) is low in marginal conditions with little open sand.

Large dune habitats of Pitcher's Thistle may have a series of linear ridges and troughs which run parallel to the water's edge, or they may have a complex (labyrinthine) structure of humps and valleys. Small beach habitats (many sites on Manitoulin Island) consist of only a single low ridge of dry, loose sand and grasses, backed by forest. Habitat depth (from water's edge back to forest) ranges from ~25 m to ~500 m, and ranges in length from 25 m to >1 km. This refers specifically to size of habitats occupied by the species. Larger areas of unoccupied, apparently suitable habitat do exist.

Pitcher's Thistle habitat is dynamic due to effects from wind, water, and ice. These factors move sand causing the build-up of mounds, burial of vegetation, exposure of roots, and blowouts. The requirement by Pitcher's Thistle for open loose sand requires a trade-off in the risk of burial. Pitcher's Thistle seedlings tolerate single sand burial episodes up to 15 cm and repeat burials of 4-8 cm, and burial increases total leaf area and numbers of leaves in buried seedlings (Maun *et al.*, 1996). Moderate burial is required for germination, but high levels of burial reduce germination (Rowland and Maun 2001; Hamze and Jolls 2000).

At sites where the habitat is no longer dynamic, vegetation is able to stabilize the sand and eventually covers the ground with plants and dried leaf debris until there is no bare sand. At this point the habitat becomes unsuitable for Pitcher's Thistle.

When dynamic processes are active, there can be some habitat created in counterbalance to the habitat loss from succession. In the early 2000s the water level in Lake Huron dropped to a near record low, exposing large areas of damp strand along the water's edge. At many sites this zone was soon filled with a dense cover of rushes and bulrushes (*Juncus* spp. and *Scirpus* spp.) which trapped blowing sand. Five years later, a new ridge of sand has begun to form over top of this vegetation. The new ridge is sparsely vegetated, and Pitcher's Thistle is moving into this new habitat.

Dune habitats are not fragmented in the same way forests or prairie remnants may be. Dunes and beaches have a natural, discontinuous presence along the shores of the Great Lakes, but this distribution is not considered fragmented. Rather, this distribution must be one of the habitat features to which the species, theoretically, has adapted. However, at some dune sites, some vegetation may have been removed or natural dune processes may have been disrupted. Currently, this type of localized fragmentation has only a small effect on Pitcher's Thistle. Roughly half the sites on Manitoulin Island have the back dune and forest edge subdivided and built up with cottages, and some landowners have altered habitat with planted lawns, patios, etc. causing micro-fragmentation. In spite of this, Pitcher's Thistle numbers continue to increase at most of these sites.

Large areas of apparently suitable habitat not occupied by the species occur in several regions. On southern Lake Huron, large dunes exist at Kettle Point, Ipperwash, Sauble Beach, and Christian Island, and smaller sandy beaches such as Chantry Dunes, and Nottawasaga Beach (Appendix 1).

Habitat trends

The amount of habitat has stayed roughly the same since 1999 although there have been some changes in quality. At three major sites (Carter Bay, Providence Bay, and Pinery Provincial Park) quality has improved by restricting foot traffic to designated paths and preventing ATV use. At six sites, habitat is becoming unsuitable due to natural increases in vegetation cover. Quality has stayed more or less the same at the remaining sites although there are episodic problems that cause localized damage. However, these rarely result in complete habitat destruction and tend to be reversible if the threatening activity is curtailed. Still, there may be a slow, overall degradation of habitat occurring from human use at some sites, although at present this does not appear to be affecting Pitcher's Thistle much.

On Manitoulin Island, roughly half of the dune sites are subdivided and have cottages in the back dune or dune forest. There has been some additional development and filling in of lots, but on the whole there has not been a major change since 1999. At this time, there is still much remote beach habitat not accessible by road.

Lower water levels in Lake Huron have affected habitat quality at some sites. A wide zone of new beach became exposed at the water's edge, causing both positive and negative effects. On the down side, some Pitcher's Thistle populations ended up 20 m or more removed from the wave-wash zone that keeps the habitat dynamic, so these sites are becoming vegetated more quickly than in the past. On the positive side, at many sites a new dune hump has formed over the recently exposed strand creating excellent new habitat.

BIOLOGY

Life cycle and reproduction

Pitcher's Thistle is a monocarpic perennial, meaning it produces one set of seeds and then dies. It may live 3-11 years as a rosette before flowering and setting seed. Flowers are bisexual. Most flowering takes place from mid-June through July. Seeds are estimated to be viable for up to 3 years (Maun 1999). Pitcher's Thistle has no means of vegetative reproduction.

Pitcher's Thistle is self-fertile, but self-pollination is much less effective at producing seed than open pollination. At Pukaskwa Nation Park flower heads were bagged to prevent open pollination, and the resulting seed set was much lower than for non-bagged heads (Keddy 1982).

A wide array of insects visit Pitcher's Thistle including: bumble and other apid bees, megachilid bees, anthophorid bees, small and large halictid bees, as well as butterflies, skippers, flies, wasps, honey bees and several types of beetles and true bugs (Keddy and Keddy 1984; Loveless 1984). Paiero *et al.* (2005) list the following species as having been collected on *Cirsium pitcheri* in Ontario: *Mellinus abdominalis* (Hymenoptera: Crabronidae); *Agapostemon splendens*, *Lasioglossum* spp., and *Halictus rubicundus* (Hymenoptera: Halictidae); *Megachile* sp. and *Coelioxys* sp. (Hymenoptera: Megachilidae); *Allograpta obliqua*, *Syrphus ribesii*, and *Toxomerus marginatus* (Diptera: Syrphidae); and *Coccinella septempunctata* (Coleoptera: Coccinellidae); *Philaenus spumarius* (Hemiptera: Cercopidae), unidentified mealybugs (Hemiptera: Pseudococcidae); and *Vanessa cardui* (Lepidoptera: Nymphalidae). Thus, the presence of pollinators is probably not limiting.

Keddy (1982) reported that seedling mortality at Pukaskwa National Park was related to microhabitat. Mortality was highest in open sand and lowest in debris. However, there is a trade-off between germination and mortality because germination was highest in open sand areas.

Physiology and adaptability

The habitat of Pitcher's Thistle provides high levels of light, heat, and exposure, as well as extremes of drought, lack of nutrients, and unstable substrate. Otfinowski (2002) showed that growth was not linked to any single habitat factor, so it is assumed that the species has a complex set of requirements among these factors.

Dispersal

Individual seeds are wind-dispersed and have a pappus that acts like a parachute. Most seeds land within 0-4 m of the parent plant (USFW 2002; Keddy 1982). The entire seed head may break off and disperse as a unit because dense clumps of seedlings are often seen. Clumping of seedlings could potentially also arise as the result of wind-drift. Individual seeds do not float; however, it has been speculated that seed heads may on occasion be dispersed by water. Coleman (2006) showed that long-distance dispersal of as much as 99 km occurs occasionally. However, this probably does not happen often because there is much suitable habitat where no Pitcher's Thistle is present. Furthermore, there are several Manitoulin locations where all thistles are clustered at the eastern end of the beach (probably due to prevailing westerly winds). If long-distance dispersal were common, influx into the western end of these beaches should occur as a result of dispersal from sites to the west. This has not been observed in 7 years of monitoring.

Interspecific interactions

Pitcher's Thistle has mycorrhizal fungi associated with its roots (Maun 1999). White-tailed Deer (*Odocoileus virginianus*), Snowshoe Hare (*Lepus americanus*), and Canada Geese (*Branta canadensis*) browse all parts of Pitcher's Thistle, sometimes to the extent that only a central nub of tissue is left. Pitcher's Thistle can survive at least one episode of severe browsing and resume growing the following year. Survival rates for repeat browsing are not known. It is not known whether browsing delays time to maturity. Plume moths (*Platyptilia carduidactyla*) feed on ovaries and immature seeds, reducing seed set (Keddy 1982); however, whether such feeding is a limiting factor is unknown. Additionally, most thistle seeds provide a nutritious food source to small rodents, birds, and insects.

Adaptability

Pitcher's Thistle is highly restricted to a specific habitat, where extremes of heat, light, drought, lack of nutrients, shifting substrate, burial, and sand blasting occur. There are at least four other dune species that have the same white-green colour, which arises from a layer of fine hairs on the surface of the plant. This may in some way protect plants from the extremes of the dune environment. Because seeds are viable only for three years, a long-lived seed bank is probably not involved in adaptability.

Pitcher's Thistle has been grown in greenhouses and successfully used for transplantation at Pinery Provincial Park (Rowland and Maun 2001).

POPULATION SIZES AND TRENDS

Sampling effort and methods

Of the 30 known populations, the majority were surveyed in 2008. Jones visited 20 of the 30 sites during 2008. She visited the two Pukaskwa National Park sites in 2007, and has visited the remaining 8 sites within the last four years.

At Pukaskwa National Park each individual plant is numbered, tagged, and monitored throughout its life span. The life stage of the plant is noted (seedling, rosette, mature), as is the substrate in which the plant is growing.

On Manitoulin Island, a standardized monitoring protocol (developed by the Pitcher's Thistle Dune Grasslands Recovery Team) is used. The entire site is searched, every thistle counted and life stage noted. A list of threats including ATV use, browsing, trampling, succession, human structures, erosion or blowouts, invasive species, and any other noticeable factor, is scored from 0 (least severe) to three (most severe). Additional notes describe any changes that have occurred at the site, damage to the population, or new threats.

A network of volunteers monitors between 8 and 12 sites every year. For populations with fewer than 100 thistles, every thistle is counted and its life stage noted. For populations with >100 thistles, the first 100 thistles are counted and life stages noted. After that, the entire site is surveyed and blocks of 100 thistles are tallied to form an estimate for the total population at the site.

At the two largest sites, Carter Bay and Desert Point, a transect protocol is used. Workers walk a number of transects across the habitat on a compass line from the water back to the trees. They count every thistle visible and record its life stage. Generally, a transect covers a swath ~25 m wide. The area actually surveyed is then tallied (e.g. six transects x 25 m = 150 m surveyed), and then multiplied by (inverse of) the fraction of the total habitat covered. On southern Lake Huron, the same standardized monitoring protocol was used in 2008. At Pinery Provincial Park and Port Franks, Jones was assisted by five members of park staff.

Almost all dune grassland sites on Lake Huron, as well as Pukaskwa National Park have been surveyed since 2000. Data collected included ELC community, list of associate plant species, details on threats, characteristics of the habitat boundary or transition zone, and UTM coordinates for obvious ("abrupt") boundaries.

Abundance

The total Canadian population of Pitcher's Thistle in 2008 was 50,435 plants (vegetative and flowering (Tables 3, 4, and 5)). However, the plants that flowered (11,739) have died, so the number of plants that survived from 2008 into 2009 is 38,696 (rosettes and seedlings), albeit with new seedlings from seeds produced in 2008 (and possibly 2006-7 because seeds are viable for up to three years).

Table 3. Abundance in Pukaskwa National Park in 2008.

Site	Total	Rosettes	Flowering	Seedlings
Pop. #1	110	80	16	14
Pop. #2	331	211	4	116
Crescent Beach	extirpated: (1 plant in 2005; no plants seen since)			
Total	441	291	20	130

Table 4. Abundance on southern Lake Huron in 2008.

Site	Total	Rosettes	Flowering	Seedlings
Pinery PP	34	23	11	0
Inverhuron PP	147	92	37	18
Port Franks	52	45	2	5
Total	233	160	50	23

Table 5. Abundance in the Manitoulin Region in 2008.

Site	Total	Rosettes	Flowering	Seedlings
1	92	71	7	14
2	49	40	5	4
3	10,689	5991	4482	216
4	>1000			
5	4463	3025	1324	114
6	242	204	38	
7	1322	933	362	27
8	4110	2761	1003	346
9	4133	3327	629	177
10	~520	346	~30	141
11	971	872	43	56
12	47	20	0	27
13	7971	6968	738	265
14	138	108	13	17
15	8	7	1	0
16	81	66	5	10
17	156	105	30	21
18	5	5		
19	158	135	5	18
20	39	33	0	6
21	167	123	17	27
22	145	123	15	7
23	12,588	9608	2860	120
24	525	456	51	18
25	142	108	11	23
Manitoulin Region	49,761	35,435	11,669	1654
Total				
Total Canadian	50,435	35,886	11,739	1807
Population				

Seven (or more) years of data show that the number and proportion of plants that flower in any given year fluctuate greatly. The trigger for flowering in this monocarpic species is still not understood; therefore, there is no way to estimate how many rosettes will become mature in 2009 or how many years each one still requires before maturing. Weather conditions (hot, dry years) may be one factor that spurs Pitcher's Thistle to flower. Flowering was exceptionally common in 2007 and 2008, but it is unknown if this trend will continue. Since mature plants die after fruiting, the number of extant rosettes may be the best indication of the status of the species because it indicates the potential for the species to survive to maturity in the future. In addition, a greater number of rosettes improves the likelihood of more than one plant flowering and thus of out-crossing. The length of time for a plant to reach maturity is also a good indicator of species status, but such data exist only for the population at Pukaskwa N.P. where each individual plant is monitored.

Fluctuations and trends

Fieldwork since 2000 has significantly increased the size of the total known Canadian population of Pitcher's Thistle from ~10 sites to the current 30. In addition, annual monitoring has documented a multi-year increase in the number of individuals in most populations. In the total Canadian population, 14 sites have exhibited a steady increase in numbers; eight have natural fluctuations from flowering and die-off; three are stable; and five reflect serious declines due to threats.

Trend data were established from total numbers of plants (seedlings, rosettes, and flowering plants) at each site. Although flowering plants die, the total number of plants is still a very useful indicator because it shows natural fluctuations from flowering and die-off, and allows increases or declines beyond these fluctuations to be seen.

Summary of trends

Pukaskwa National Park

Population #1 is in steady decline and could be extirpated in the next 5-8 years.

A subpopulation of this population (by some referred to as 'Population #3') was extirpated sometime after 2005.

Population #2 was introduced and initiated from seeds obtained from extant Population #1 in 1991 prior to the extirpation of the subpopulation located along the same sandy bay at a different beach within the park but only 500 m distant (Nantel pers. comm. 2010 based on information from G. Allen, Parks Canada). This population is increasing in size. Because it originated from a native population and occurs within the range of the species, it is included for assessment as per COSEWIC's guidelines on manipulated populations.

Southern Lake Huron

- Two populations increasing; one population declining
- All are small populations of <200 plants
- Two populations extirpated (Sauble Beach and Kettle Point) likely post-1963

Manitoulin Island and Surrounding Islands

- 12 populations steady increase (6 of these with increases of 200-800%)
- Seven populations with natural fluctuations, but are up overall, some at all-time highs
- Three populations with poor data appear stable
- Only three populations are declining due to threats
- Total for this region is around 48,000 individuals

Pukaskwa National Park

(Population #1)

A flash flood in 1985 destroyed ~70% of this population, reducing it to 254 thistles in 1986. After that, reduced numbers fluctuated in natural cycles of flowering and die-off until 1998, but since then there has been a steady decline of ~20-50 plants per year. It is not known if this is due to seedling or rosette mortality. There was a slight recovery in 2005 and 2006, but numbers have continued to drop since then, down to 110 in 2008. The habitat is no longer adjacent to active beach but is now behind ~30 m of alder wetland. The habitat is becoming highly vegetated, and there is little open, loose sand.

A subpopulation of Population #1 is extirpated. From a high of 81 plants in 1995, there was a steady decline every year. No new seedlings were seen after 1999. Between 2001 and 2002, numbers dropped from 20 plants to two plants. In 2005, only one plant survived, and since then no plants have been seen. The habitat is thickly overgrown and no open sand is present. Because viable seeds last only three years, this subpopulation is considered extirpated.

(Population #2)

This population was intentionally planted in 1991 about 25 km north of Population #1 as a rescue effort after the loss of much of a subpopulation of Population #1. From the original 27 plants originating from seeds collected at Population #1, the numbers have increased steadily (with some mortality in 2002-3) to a high of 333 in 2008. More than one third of this number are new seedlings. The habitat has much open, loose sand and a good diversity of typical dune associates. The population was assessed by Vance (2008) as stable and in good health.

For this region, human threats, such as trampling, have been effectively curtailed with fencing and signage. Thus, the primary threats at Pukaskwa are natural ones: flooding/sand deposition and succession. Without intervention, Population #1 will probably disappear due to natural succession.

Southeastern Lake Huron

Pitcher's Thistle was historically recorded in this region from Sauble Beach and Kettle Point, both of which are extirpated. There are no records from either site after 1949, although Guire and Voss (1963) listed Sauble Beach and Ipperwash/Kettle Point (as well as Inverhuron, and Pinery Provincial Park) as extant sites. Maun found no Pitcher's Thistle at Ipperwash/Kettle Point in 1998. Jones (2003, 2002) found no Pitcher's Thistle at Ipperwash, Kettle Point, or Sauble Beach, or at 27 other sites on southern Lake Huron, although suitable habitat still exists in many places.

Pinery Provincial Park

Monitoring has been done on and off since 1987. Initial monitoring (Maun 1998) found 50 plants present. A large number of seedlings in 1994 brought numbers to a high of 283 plants, but since then there has been a steady decrease. Maun (1998) attributed the decrease to browsing by White-tailed Deer; however, Alistair Mackenzie (pers. comm. 2008) noted that in 9 years he has seen little evidence of deer browse but has observed insect infestation on flower heads and rosettes. The number of thistles at The Pinery has continued to decline in spite of annual culls from 1998 to 2007, which greatly reduced deer numbers. In 2008, 34 thistles were present, only one of which was in a fenced, nature reserve area. See Table 6.

Table 6. Number of Pitcher's Thistles present in Pinery Provincial Park by year.

1987	1992	1993	1994	1995	1996	1997	1998	2000	2004	2008
50	33	76	283	115	82	93	56	50	67	34

Inverhuron Provincial Park

Recreational pressure on this population was high in the past. However, the habitat and the number of thistles seem to have improved somewhat from construction of stairs to cross the dunes and from interpretive signage. In 2008, two plants set seed at the very back of the dunes adjacent to a large area of open, suitable habitat, so it is expected that Pitcher's Thistle may expand into this new area. In the inland dune area, Pitcher's Thistle appears to be moving into the ample habitat after being heavily impacted by ATVs. Although the long-term data show large fluctuations in the population, the overall trend seems to be an increase since 2000 despite intermittent drops in numbers (Table 7).

Table 7. Number of Pitcher's Thistles in Inverhuron Provincial Park by year.

1986	1993	1995-1999	2000	2002	2004	2008
100	15	50-66	84	128	250	147

Port Franks

This site has been monitored on and off as part of Pinery Provincial Park, but there are few data that separate out this site. The size of the population appears to have increased from 24 in 2000 (Deb Jacobs, pers. comm. 2008) to a current size of 52. The population appears healthy and the habitat has much open, loose sand. Some potential threats are present (trampling, ATVs, non-native species).

Manitoulin Island and surrounding islands

Manitoulin Region populations have been monitored since 2001. For the last 4 years, some populations have been monitored by a network of trained volunteers using a standardized protocol. A number of populations of varying sizes have been monitored annually by Jones since 2001.

Of the 25 populations in this region:

- 12 populations steadily increased since 2001 ranging from small increases to >800%
- seven populations have natural fluctuations, but are up overall with some sites at all-time highs
- three populations have poor or short-term data but appear to be stable
- only three populations are declining due to threats: succession compounded by browsing

Most of the populations in this region have increased in numbers, and five have undergone dramatic increases of 200-800%. This increase has happened naturally, with little human intervention, protective actions, reduction of threats, or public education. The species obviously has the capacity to increase in numbers, but it is still not known why numbers were so low when monitoring began in 2001.

Rescue effect

Rescue effect is nearly non-existent among Canadian regions or between the Canadian and U.S. parts of the range. Even with the possibility of dispersal over as much as 99 km, the populations on Lake Superior are hundreds of km from the next nearest populations, and too far away to be able to receive seeds or pollen from other populations. Within the Lake Superior region, there could theoretically be some exchange of material, but this is probably unlikely because one population has disappeared and a second is declining.

All southern Lake Huron populations are hundreds of km from American or Manitoulin populations, too far to exchange material. Only the Pinery and Port Franks sites could exchange material, but again, this is unlikely because both populations are small and the Pinery population is declining.

Within the Manitoulin Region, exchange of genetic material has been shown to take place over as much as 99 km (Coleman 2006). However, this is unlikely to occur with much frequency.

THREATS AND LIMITING FACTORS

Limiting factors are generally seen as intrinsic problems that are not usually caused by human activities but may be exacerbated by them. Jalava (2008) lists a combination of abiotic and biotic limiting factors for Pitcher's Thistle including:

- Sand movement/burial
- Changing lake levels that cause habitat changes
- Climate changes that may affect growth and reproduction rates
- Predation and herbivory
- Monocarpic life cycle with greater chance of mortality prior to reproduction
- Seed ecology with limited germination and viability
- Low genetic diversity
- Metapopulation dynamics with variable gene flow and loss or creation of patches.

Some of these, such as sand movement/burial and changing lake levels that cause habitat changes are also normal processes that help maintain suitable habitat for the species and may not be detrimental to the species over the long term.

Threats have been monitored annually in the Manitoulin Region since 2005. Threats are scored for both intensity and extent on a scale of 0 (not present) to 3 (most severe). A standard set of criteria was developed for each score for each threat. For example, for ATV use, 0 = none; 1 = use is detectible; 2 = some vegetation appears damaged by ATVs; and 3 = loose sand present from trails or ripped vegetation present.

Plume moth infestation has been monitored as a threat at Pukaskwa National Park since 1981, but does not appear to have a large effect on populations. Succession is not directly monitored at Pukaskwa, but type of substrate (sand, grass, debris) is documented for every plant. At Population #1, there is little remaining open sand, and Silverberry (*Elaeagnus commutata*, a native species) is spreading rapidly, taking up much of the remaining available habitat. Threats for other populations were assessed in site visits in 2008 using the criteria developed for Manitoulin Region monitoring (Table 8).

Table 8. Threats to Pitcher's Thistle and their severity by site (from 2008 monitoring data and Jalava, 2008).

THREAT LEVELS: H=high, M=Medium, L=low, blank=not present

Occurrence	THREATS							
	ATVs	Browse	Trampling	Succession	Human Structures	Erosion/ Blowouts	Alien Spp.	Small Pops.
Pukaskwa National Park				H			H	M
Inverhuron PP	L	L	L	M	L	L	M	H
Pinery PP		L	H			M		M
Port Franks	H		M	L	M	M	M	M
Manitoulin site #1		L						
#2	M			H			M	
#3	M	L	M	L		H		
#4	M		L	H			M	
#5		M		H	M			
#6	M		L	L				
#7	L		L	L			L	M
#8			L	L	L	L	M	
#9—east half	M	M		M	L	M		
#9—west half	H	H		L		H		
#10	M		H	L	L			
#11								
#12				L		L	L	
#13	M	H			L	L		
#14	M	M		M			L	
#15		H		H			M	H
#16	L			M				
#17				M				
#18		H		H				H
#19	L	L						M
#20	H	H	L	L		L	L	
#21				M				M
#22		L		H				
#23		H						
#24				M				
#25		H		M				

Although it is not currently a threat to Pitcher's Thistle, invasion by the European race of the Common Reed (*Phragmites australis*) is a serious concern on many southern Lake Huron beaches. The presence of plants of the invasive race of Common Reed was documented at least at two sites on Manitoulin Island in 2009.

Note that although a number of threats have been documented, many populations have increasing numbers. For four of the five declining populations, succession, or succession compounded by browsing or small population size, is causing the decline. The cause of the decline at the fifth population (The Pinery) is still not completely understood, but trampling, erosion, and small population size have been documented. The degree to which low genetic diversity affects seed set and reproductive rates is still unknown. All terrain vehicle (ATV) use continues to be a widespread problem in the Manitoulin Region, but the intensity of usage and the severity of the threat have been reduced at many sites.

PROTECTION, STATUS, AND RANKS

Legal protection and status

COSEWIC previously assessed Pitcher's Thistle as Endangered in May 2000, and it is currently listed as endangered on Schedule 1 of the federal *Species at Risk Act* (SARA). SARA legally protects Pitcher's Thistle on federal lands (national parks, Department of National Defence lands, First Nations, etc.). Critical habitat for the species is protected under SARA after it is identified in a recovery strategy or action plan and protected by a ministerial order. The Pitcher's Thistle – Dune Grasslands Recovery Strategy (Jalava 2008) has not yet been finalized, but it will include a critical habitat definition for both sites in Pukaskwa National Park. This will include all suitable occupied habitat plus an adjacent 15 m strip at the back of the dunes to allow for dynamic interaction between dunes and forest to continue. Further management planning to effectively protect critical habitat at Pukaskwa will be prepared.

Pitcher's Thistle is listed on Schedule 3 of the Ontario *Endangered Species Act, 2007* (ESA) as a transition species to be listed as Endangered. The ESA provides protection to the species from killing, harming, taking, collecting or selling. Habitat for the species will be protected on June 30, 2013, unless a habitat regulation is created prior to that date. The Ontario *Provincial Parks and Conservation Reserves Act (2006)* mandates parks and conservation reserves to manage lands to maintain the ecological integrity of habitats for native species including species at risk.

Non-legal status and ranks

Pitcher's Thistle is ranked as N2 (nationally imperilled) in Canada (NatureServe 2010). In Ontario, Pitcher's Thistle is ranked S2 or imperilled (Oldham and Brinker 2009).

In the United States, Pitcher's Thistle is designated Threatened and legally listed as such under the U.S. *Endangered Species Act*. The species is ranked N3 or nationally vulnerable, S1 (critically imperilled) in Illinois and S2 (imperilled) in Indiana and Wisconsin and S3 (vulnerable) in Michigan. The species is ranked G3 (vulnerable) globally (NatureServe 2010).

Habitat protection and ownership

Most of the Canadian Pitcher's Thistle population is on municipal and municipal/private land in the Manitoulin District. Private ownership occurs only at sites where the habitat is large enough to have sufficient depth to extend back behind the approximately 20 m (66') municipal right-of-way on the shoreline allowance.

Pitcher's Thistle habitat is protected within Pukaskwa National Park by fences, signage, and by a critical habitat designation under the federal *Species at Risk Act* (see Protection, Status and Ranks) once critical habitat is officially recognized for this species under the Act. Pitcher's Thistle is present in two provincial parks, but these areas have heavy recreational use and high levels of foot traffic. The Inverhuron site is somewhat protected by wooden stairs that prevent visitors from trampling vegetation and by interpretive signage. At Providence Bay, a municipal public beach, a boardwalk along half the beach deflects foot traffic from the dunes.

Roughly half of the sites in the Manitoulin Region have cottages present behind the beach. At a few places, cottagers are involved in stewardship and have erected signage and don't allow damaging activities to take place in front of their lots.

Ownership of sites are distributed as follows:

National Park	2 sites
Provincial Park	2 sites
Crown Land	1 site
Conservation Reserve	1 site
Municipal shoreline allowance	11 sites entirely municipal
Shared ownership (part municipal & private)	12 sites
Part provincial park, part conservation authority	1 site
Part private/provincial park/cons. authority	1 site
Area of Natural and Scientific Interest (ANSI)	2 municipal/private sites

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INFORMATION SOURCES

- Argus, G.W., K.M. Pryer, D.J. White, and C.J. Keddy (eds.) 1982-1987. Atlas of the Rare Vascular Plants of Ontario. 4 parts. National Museum of Natural Sciences, Ottawa Ontario.
- Brunton, D.F. 1989. Biological Inventory and Evaluation of Wasaga Beach Provincial Park and Adjacent Natural Areas, Simcoe County, Ontario. Prepared for Parks and Recreational Areas Section, Ontario Ministry of Natural Resources, Richmond Hill, ON
- Coleman, M. J. 2006. The conservation genetics of two endangered plants: *Cirsium pitcheri* and *Isoetes engelmannii*, using nuclear and chloroplast DNA. PhD thesis, Trent University, Peterborough, Ontario, 82 pp.
- D'Ulisse, A. and M.A. Maun. 1996. Population ecology of *Cirsium pitcheri* on Lake Huron sand dunes: II. Survivorship of plants. *Can. J. Bot.* 74:1701-1707.
- Flamand, T. pers. comm. 2008. Wikwemikong First Nation Lands Office.
- Freeland, J. pers. comm. 2010. Email correspondence with J. Whitton, COSEWIC non-government science member. July 2010. Associate Professor Department of Biology, Trent University, Peterborough, ON.
- Gauthier, M., E. Crowe, L. Hawke, N. Emery, P. Wilson, and J. Freeland. 2010. Conservation genetics of Pitcher's thistle (*Cirsium pitcheri*), an endangered Great Lakes endemic. *Botany* 88:250-257.
- Guire, K.E. and E.G. Voss. 1963. Distributions of distinctive shoreline plants in the Great Lakes Region. *The Michigan Botanist*. Vol 2:99-114.
- Haber, E. pers. comm. 2010. Co-chair, subcommittee for vascular plants (COSEWIC).
- Hamze, S.I. and C. L. Jolls. 2000. Germination ecology of a federally threatened endemic thistle, *Cirsium pitcheri* of the Great Lakes. *American Midland Naturalist* 111:1169-1194.
- Jacobs, D. pers. comm. 2008. Species at Risk biologist, Ontario Ministry of Natural Resources, Sudbury District.
- Jalava, J.V. 2008. Recovery strategy for Pitcher's Thistle (*Cirsium pitcheri*) – Lake Huron Dune Grasslands in Canada [Proposed] *Species at Risk Act* Recovery Strategy Series. Parks Canada Agency, Ottawa. Xi + 38 pp. + appendices.

- Jalava, J.V., W.L. Cooper, and J.L. Riley. 2005. Ecological survey of the eastern Georgian Bay Coast. Nature Conservancy of Canada, Toronto, and Ontario Ministry of Natural Resources, Peterborough. 180 pp. + cd-rom insert + maps.
- Jones, J.A. 2008. Report from monitoring Pitcher's Thistle in 2008. Unpublished report to Parks Canada Agency, Ottawa Ontario. 5 pp.
- Jones, J.A. 2007. Report from monitoring Pitcher's Thistle in 2007. Unpublished report to Parks Canada Agency, Ottawa Ontario. 8 pp.
- Jones, J.A. 2006a. Report from monitoring Pitcher's Thistle in 2006. Unpublished report to Parks Canada Agency, Ottawa, Ontario. 2 pp.
- Jones, J.A. 2006b. Dune grasslands on the North Shore of Lake Huron and North Channel Islands. Unpublished report to Parks Canada Agency, Ottawa, Ontario. 4 pp.
- Jones, J.A. 2005. Report from monitoring Pitcher's Thistle in 2005. Unpublished report to Parks Canada Agency, Ottawa, Ontario. 4 pp.
- Jones, J.A. 2004. Status of Pitcher's Thistle (*Cirsium pitcheri*) and dune grasslands in the Manitoulin Region. Unpublished report to Parks Canada Agency, Ottawa, Ontario. 6 pp.
- Jones, J.A. 2003. Report from the survey of 11 dunes sites. Unpublished report for Ontario Ministry of Natural Resources, Midhurst District. 4 pp.
- Jones, J.A. 2002. Survey of dune grasslands on Southern Lake Huron. Unpublished report for Ontario Ministry of Natural Resources, Midhurst District. 5 pp.
- Jones, J.A. 2001. Survey of Pitcher's Thistle and dune grasslands in the Manitoulin District. Unpublished report for Ontario Ministry of Natural Resources, Midhurst District. 4 pp.
- Kamstra, J. and S. Spisani. 2009. Life Science Inventory of Awenda Provincial Park. Unpublished report prepared for Central Zone, Ontario Parks, Ontario Ministry of Natural Resources, Huntsville, ON, ii + 89 pp.
- Keddy, C.J. 1987. Status report on Pitcher's Thistle, *Cirsium pitcheri*, a threatened species in Canada. Committee on the Status of Endangered Wildlife in Canada, 14 pp.
- Keddy, C.J. 1982. An ecological study of *Cirsium pitcheri* (Pitcher's Thistle) in Pukaskwa National Park. Unpublished report to Parks Canada Agency, Marathon, Ontario. 119 pp.
- Keddy, C.J. and P.A. Keddy 1984. Reproductive biology and habitat of *Cirsium pitcheri*. *The Michigan Botanist*, 23:57-67.
- Keil, D. 2008. Flora of North America: Volume 19, page 95: Asteraceae: *Cirsium*. Web site:
http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=107139&key_no=3
- King, E. pers. comm. 2001. Elder, Wikwemikong First Nation.

- Loveless, M.D. 1984. Population biology and genetic organization in *Cirsium pitcheri*, an endemic thistle. PhD thesis, University of Kansas, Lawrence.
- Loveless, M.D. and J.L. Hamrick. 1988. Genetic organization and evolutionary history in two North American species of *Cirsium*. *Evolution*, 42:254-265.
- Mackenzie, A. pers. comm. 2008. Ecologist, Pinery Provincial Park.
- Maun, M.A. 1999. Update COSEWIC status report on Pitcher's Thistle *Cirsium pitcheri* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. 14 pp.
- Maun, M.A. 1998. Confidential distribution, precise locations and population sizes of *Cirsium pitcheri* in Ontario. Unpublished report submitted to Ontario Ministry of Natural Resources and the Committee on the Status of Endangered Wildlife in Canada.
- Maun, M.A., H. Eberling, and A. D'Ulisse. 1996. The effects of burial by sand on survival and growth of *Cirsium pitcheri*. *Journal of Coastal Conservation*, 2:10-16.
- Nantel, P. pers. comm. 2010. Species at Risk program, Parks Canada.
- NatureServe, 2010. *Cirsium pitcheri*; On-line Explorer; accessed July, 2010. Web site: <http://www.natureserve.com>
- Oldham, M. J. pers. comm. 2008. Heritage botanist and herpetologist with the Natural Heritage Information Centre, Ontario Ministry of Natural Resources, Peterborough, ON.
- Oldham, M.J. and S.R. Brinker. 2009. Rare Vascular Plants of Ontario, Fourth Edition. Natural Heritage Information Centre, Ontario Ministry of Natural Resources. Peterborough, Ontario. 188 pp.
- Otfinowski, R. 2002. Heterogeneity of *Cirsium pitcheri* microenvironments on Lake Huron sand dunes. PhD thesis, University of Western Ontario, London. 135 pp.
- Paiero, S., S.Marshall, and M. Buck. 2005. Final report to Pitcher's Thistle Recovery Team (Dune Grasslands Arthropod Report). Unpublished report, 10 pp.
- Promaine, A. 1999. Threatened species monitoring: results of a 17 year survey of Pitcher's Thistle, *Cirsium pitcheri* in Pukaskwa National Park, Ontario. *Canadian Field Naturalist* 113 (2): 296-298.
- Reznicek, A.A. 1972. Giant's Tomb Island Plant Communities Survey, Awenda Provincial Park, unpublished report.
- Rowland, J. and M.A. Maun. 2001. Restoration ecology of an endangered plant species: establishment of new populations of *Cirsium pitcheri*. *Restoration Ecology* 9: 1-11.
- U.S. Fish and Wildlife Service. 2002. Recovery plan for the Pitcher's Thistle (*Cirsium pitcheri*). Region 3, Fort Snelling, Minnesota. VIII + 92 pp.

Vance, C. 2008. State of the park report: Pitcher's Thistle. Unpublished report for Pukaskwa National Park, Parks Canada Agency, Marathon, Ontario. 5 pp.

White, D.M. 2007. Species At Risk Survey at Awenda Provincial Park. Unpublished report prepared for Central Zone, Ontario Parks, Ontario Ministry of Natural Resources, Huntsville, ON, 14 pp.

BIOGRAPHICAL SUMMARY OF REPORT WRITER

Judith Jones, M.S., B.S., has been an independent biological consultant since 1995. Her work covers a broad range, including alvar ecosystems, inventories of natural areas, the sustainable harvest of Canada Yew (*Taxus canadensis*), environmental impact studies (EIS) of proposed developments in Southern Ontario, and recovery of species at risk. She is the author of several recovery strategies and sits on a number of recovery teams. She has been working on Pitcher's Thistle since 2001.

COLLECTIONS EXAMINED

No collections were examined for this update report.

Appendix 1. Sites searched where Pitcher's Thistle was not found.

All sandy habitats at the following sites were completely searched by two people working together.

Southern Lake Huron (2002-2003)

Ipperwash Beach
Port Franks restoration
Port Franks municipal
Point Farms
Point Clark-public access
Point Clark-lighthouse
Lurgen Beach
Scott Point
MacGregor Point
Chantry Dunes, Southampton

Bruce Peninsula (2002)

Sauble Beach
Chief's Point
Oliphant
Lyll Island
Black Creek

Manitoulin Island (2001, 2003)

Lonely Bay
Melville Bay
Portage Bay

Georgian Bay (2002-2003)

Craigleith

Wasaga Beach:

Beach #6

Beach #1 (spit)

Allenwood

New Wasaga

Tiny Township 13th Conc.

Nottawaga Beach

Cawaja Beach

Christian Island:

West Beach

Big Sand Bay

Stony Island

Beckwith Island E

Beckwith Island W

Hope Island

Giant's Tomb

Awenda Beach 1

Champlain at Marygrove

North Shore of the North Channel (2006):

Sixty-five sites with sandy shoreline between Great Cloche Island and Thessalon were identified by helicopter. All of these were visited on the ground and searched in their entirety by two or sometimes three people working together. Island sites were accessed by boat. Twenty-five sites supported dune grassland vegetation dominated by either Marram Grass or Needle Grass (*Stipa spartea*). Pitcher's Thistle was not found at any site.