COSEWIC
Assessment and Update Status Report

on the

Pitcher's Thistle
Cirsium pitcheri

in Canada

ENDANGERED
2000

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION DES
ESPÈCES EN PÉRIL
AU CANADA

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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.

Previous report:

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.

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COSEWIC
Assessment Summary

Assessment Summary – May 2000

Common name
Pitcher's thistle

Scientific name
Cirsium pitcheri

Status
Endangered

Reason for designation
An endemic of the Great Lakes shorelines found at only a few sites. It has a very limited area of occurrence with recent population losses and continued risk from low seed set and habitat degradation. It faces additional loss because of recreational use and development of its habitat.

Occurrence
Ontario

Status history
Designated Threatened in April 1988. Status re-examined and uplisted to Endangered in April 1999. Status re-examined and confirmed Endangered in May 2000. May 2000 assesment based on new quantitative criteria applied to information from the existing 1999 status report.

COSEWIC
Executive Summary

Pitcher's Thistle
Cirsium pitcheri

Description

Pitcher's Thistle (*Cirsium pitcheri*) is a perennial herb that bears 2-125 creamy-white flowering heads at the top of a slender white woolly stalk that reaches a height of about 1 m. The leaves are green above, densely woolly, with long white hairs below, and uniformly and deeply pinnately divided with each narrow division tipped by a spine. These characteristics distinguish this species from similar plants with divided leaves. Vegetative plants consist of a rosette of leaves.

Distribution

The species is a Great Lakes endemic that occurs in both Canada and the U.S. In Canada, Pitcher's Thistle occurs in only four areas - along the southeastern shore of Lake Huron, at one location along Georgian Bay, at several sandy bays along the shoreline of Manitoulin Island, and at one location along Lake Superior.

Habitat

The populations of Pitcher's Thistle are found in sandy habitats on the high beach, foredunes, blowouts and dune ridges along the Great Lakes. The species occurs as a minor associate among grasses such as *Ammophila breviligulata*, *Calamovilfa longifolia* and *Andropogon scoparius*. It is found most frequently in blowouts and within grass populations that receive about 2-3 cm of sand deposition annually. The plants grow best in open locations with maximum sunlight. They can withstand high surface soil temperatures.

General biology

The plant is a rosette-forming deep rooted monocarpic perennial, which may grow for 3 to 11 years before flowering and dying. The species has mycorrhizal fungi associated with its roots. The seed set within each flower head (capitulum) is only about 30%. Pitcher's Thistle does not reproduce asexually. The seeds mature in late summer and are dispersed individually by wind, aided by a weakly attached pappus, or as entire inflorescences which fall to the ground near the parent plant in late autumn. Seeds are large in size (12.5 mg per seed) and possess innate dormancy which is caused by a

hard seed coat as well as inhibitory compounds within the seed coat. Under artificial conditions, high germination rates are possible only when seeds are pre-treated either by surgically removing the seed coat or by nicking the seed on the radicle or cotyledonary end. After this pretreatment, seeds germinate over a temperature range of 15-30°C. Under natural conditions, germination of seeds occurs in spring after they have overwintered and undergone stratification and scarification through freezing and thawing of the substrate. The species provides diversity in the dune ecosystem and occupies bare areas between clumps of grasses.

Population size and trends

The once abundant populations at Ipperwash/Kettle Point area have been extirpated due to the loss of habitat. At Pinery Provincial Park, population size has fluctuated from 33 to about 115 plants. A very small population of about 60 plants also occurs at Inverhuron Provincial Park. The general trend in size of both of these populations is a decline. The largest population sizes are found in privately owned sandy bays on Manitoulin Island. Here too the populations are declining because of very high recreational pressure and/or the development of the properties for cottages. The population along Lake Superior is stable and is being monitored by Parks Canada.

Limiting factors and threats

Herbivory by white-tailed deer populations, habitat loss due to construction of cottages, commercial development, use of all-terrain vehicles and recreational use of sand dunes contribute to the loss of populations. Recreation affects plants by direct trampling, creation of paths, erosion of sand and excessive burial of plants. Excessive burial in sand increases the vulnerability of the species at three stages of growth: seeds, seedlings, and adult plants. Deeply buried seeds either do not germinate or if they do the seedlings are unable to emerge from the soil. Seedlings can survive up to 75% burial in sand but complete burial of seedlings is fatal. Large vegetative plants die when the sand deposition exceeds 25 cm.

Existing Protection

No protection has officially been provided to Pitcher's Thistle. However, Parks Ontario and Parks Canada are aware of the "endangered" status of the species. Rehabilitation efforts are underway at Pinery and Inverhuron Provincial Parks by Dr. A. Maun, University of Western Ontario. He also has a research program with very limited funds. The species can be saved through applied research studies on the Restoration Ecology of this species.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determines the national status of wild species, subspecies, varieties, and nationally significant populations that are considered to be at risk in Canada. Designations are made on all native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fish, lepidopterans, molluscs, vascular plants, lichens, and mosses.

COSEWIC MEMBERSHIP

COSEWIC comprises representatives from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biosystematic Partnership), three nonjurisdictional members and the co-chairs of the species specialist groups. The committee meets to consider status reports on candidate species.

DEFINITIONS

Species	Any indigenous species, subspecies, variety, or geographically defined population of wild fauna and flora.
Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)**	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)***	A species for which there is insufficient scientific information to support status designation.

* 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.

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.

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Update
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in Canada

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1999

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INTRODUCTION

Name and classification

Scientific name: *Cirsium pitcheri* (Torr. Ex Eat.) T. & G. (Family Asteraceae)
Common name: Pitcher's Thistle

There has been no change in the taxonomy since the first COSEWIC report by Keddy (1987).

Description

Pitcher's Thistle *(Cirsium pitcheri),* Asteraceae, is endemic to the shoreline beaches and sand dunes of the Great Lakes. It is a disturbance-dependent rare species adapted to live in dynamic and often stochastic sand dune habitats. The species was designated as ***"threatened"*** in Canada (see COSEWIC report by Keddy 1987; Burnett *et al.,* 1989). The bases of this designation were: (i) high demand for shoreline habitats for recreational activities (walking, picnicking, sunbathing, use of all-terrain vehicles [ATVs]), (ii) building of access roads to remote beaches, (iii) habitat loss because of cottage construction, and (iv) increasing demand for recreation on Great Lakes sand dunes. The field survey by Keddy (1987) revealed seedlings, vegetative plants of different sizes and flowering plants of *Cirsium pitcheri* on two locations along the southeastern shoreline of Lake Huron, one location on Georgian Bay, several locations on Manitoulin Island, and one location on the northeastern shoreline of Lake Superior. The largest populations were found on Manitoulin Island especially at Providence Bay. Once abundant populations of *C. pitcheri* have been extirpated from Kettle Point in Lambton county, Sauble beach in Bruce Peninsula and Michael's Bay (Manitoulin Island) and pressure on the remaining populations was on the increase. It was shown that the major threat to the population was a loss of habitat. It was projected in 1987 that these activities will lead to a decline of *C. pitcheri* populations, hence the species was designated as "threatened" (Keddy 1987). As you will see from the rest of this report, this prediction was well founded.

DISTRIBUTION

The geographical distribution in Canada has not changed appreciably since the publication of COSEWIC report by Keddy (1987). The map (Fig. 1) accurately shows the locations of occurrence of this species on shoreline sand dunes of Great Lakes in Canada. The populations are located in the foredune complexes at only two locations along the southeastern shore of Lake Huron, one location along Georgian Bay, several sandy bays along the shoreline of Manitoulin Island, and one location along Lake Superior.

Locality Citations: Precise locations and population sizes of *C. pitcheri* are on file with COSEWIC and the Ontario Government.

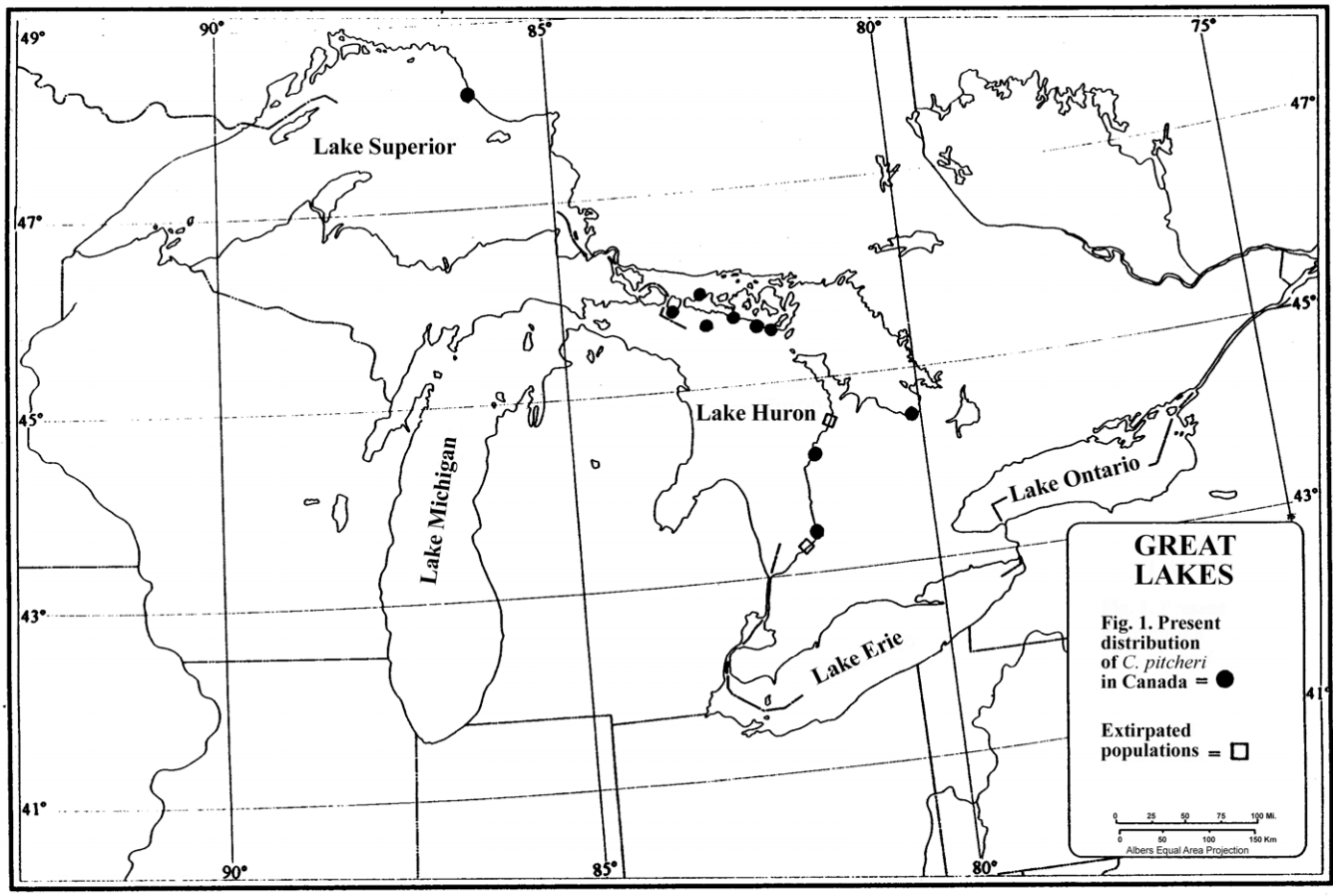


Figure 1. Present distribution of *Cirsium pitcheri* in Canada.

Protection

As far as I know, no protection has officially been provided to *C. pitcheri*. However, Parks Ontario has been aware of the “threatened” status of the species. It is very encouraging to note that the populations are being monitored at Pukaskwa National Park since 1981 (Promaine 1998).

HABITAT

Populations of *C. pitcheri* are found in sandy habitats on the high beach, foredunes, blowouts and dune ridges. The plants prefer sandy soils with texture of 39.4 to 76.7 % fine sand (<0.250 mm) and 19.7 to 56.2 % medium-grained sand (0.25-0.50 mm). In slacks the species can also grow in sandy soils with very coarse texture. Typical habitats of *C. pitcheri* are shown in Fig. 2 a, b, c. The species occurs as a minor associate among a large number of plant species at both the Pinery and Inverhuron Provincial Parks. At the Pinery, *Calamovilfa longifolia* and *Andropogon scoparius* were the most abundant grasses with low coverage of *Ammophila breviligulata* on the first dune ridge and occasional shoots on the

second dune ridge (Table 1). *Cirsium pitcheri* occurred most frequently in blowouts and within *C. longifolia* populations on the second dune ridge that were receiving about 2-3 cm of sand deposition annually. The species requires a moderate amount of sand movement and open bare areas among the vegetation. Mean percent bare sandy area at the Pinery ranged from 65.1 % on dune ridges to about 80 % in slacks (D'Ulisse and Maun 1996). The plants also occupied blowouts with 100 % bare area. At Inverhuron, *C. pitcheri* grows on the first dune ridge in association with two dominant grasses *A. breviligulata* and *C. longifolia*. The species richness was 42 at Inverhuron and 35 at the Pinery. Density of *C. pitcheri* was very low at the Pinery Provincial Park (0.02 m^{-2}) but it was even lower at Inverhuron Provincial Park: we did not encounter any plants on the transect lines although the species was present in the park. The populations in Manitoulin Island were larger and had a density of 0.14 m^{-2}. They occurred among populations of *A. breviligulata, Agropyron psammophilum, Populus balsamifera*, *Thuja occidentalis* and many other herbaceous species. The plants at all locations show high phenotypic plasticity in relative size at flowering and seed production per plant.

Table 1. Percent cover of vegetation of different species in different dune habitats at the Pinery and Inverhuron Provincial Parks Values in brackets indicate one standard deviation (from D'Ulisse and Maun 1996)

	Pinery Provincial Park			Inverhuron Provincial Park	
Species	**I Dune Ridge**	**Slack**	**II Dune Ridge**	**I Dune Ridge**	**Slack**
Ammophila breviligulata	8.3(9.1)	-	+	9.6(11.2)	11.5(16.1)
Andropogon scoparius	12.7(14.1)	8.8(10)	16.1(15.6)	-	-
Calamovilfa longifolia	13.2(13.1)	4.4(5.4)	12.9(12.1)	21.6(19.7) 11.6(12.9)	
Poa compressa	-	-	18.8(0)	-	4.5 (3.6)
Cakile edentula	2.5(0)	2.5(0)	-	-	-
Corispermum hyssopifolium	2.5(0)	2.5(0)	2.5(0)	+	2.5(0)
Cirsium pitcheri	+	2.5(0)	2.5(0)	+	+
Lithospermum caroliniense	2.5(0)	2.5(0)	2.9(1.6)	-	-
Juniperus communis	68.8(23.9)	4.6(3.6)	19.8(26)	-	6.3(3.4)
Juniperus virginiana	52.9(40.2)	44.6(39.8)	50.8(43.7)	-	32.9(47.4)
Populus balsamifera	4.2(2.9)	-	2.5(0)	19.7(16.2)	5.6(14.6)
Litter	14.0(12.5)	4.8(5.7)	17.7(14.5)	9.8(13.3)	19.5(21.5)
Bare Sand	63.5(23.9)	82.6(12.4)	59.6(26.2)	66.7(25.9)	53.9(26.9)

+ present nearby;
- absent

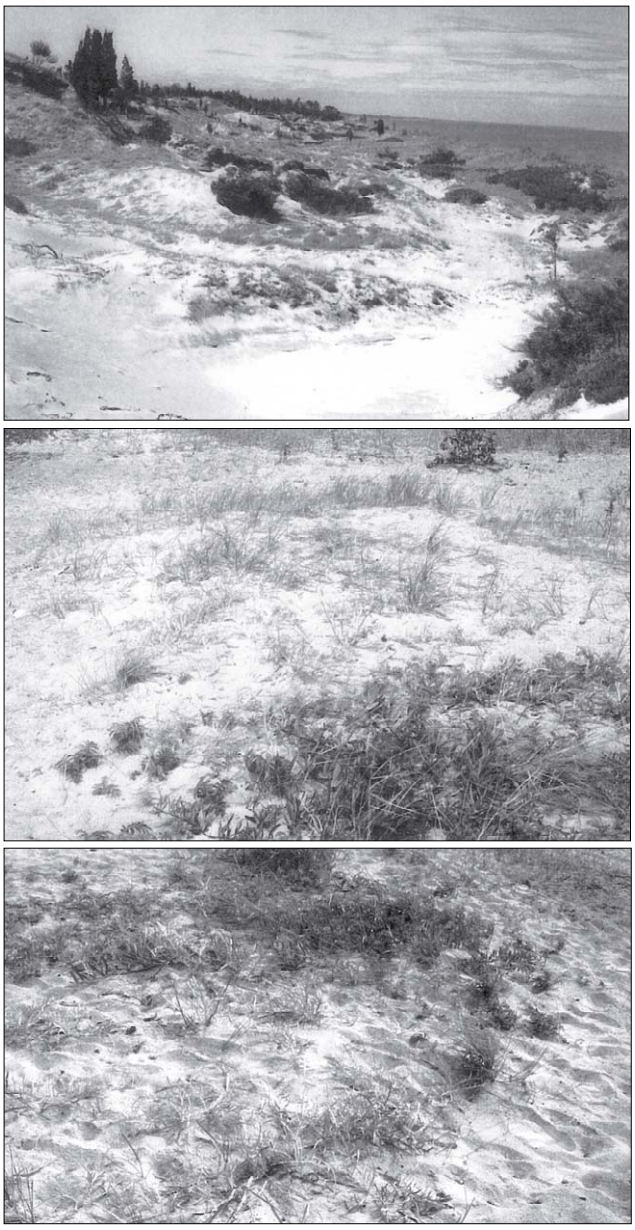


Figure 2. Typical habitats of *Cirsium pitcheri* at Pinery Provincial Park (a) and Providence Bay (b) in Manitoulin Island. Trampling of a site on the upper beach at Providence Bay is shown in (c).

BIOLOGY OF THE SPECIES

The life cycle of *Cirsium pitcheri* is presented in Fig. 3. It is a rosette-forming monocarpic perennial which may grow for 3 to 11 years before flowering and dying (Loveless and Hamrick 1988; McEachern 1992). Delayed reproduction in a monocarpic perennial is beneficial for two reasons, (i) increases the probability of flowering and (ii) enhances seed production. However, delayed reproduction increases the risk of mortality during the extended juvenile phase, slows down the population growth of the species due to reduced rates of colonization and establishment, and increases recovery time after catastrophes. The

species is predominantly outcrossing although selfpollination within a single flower head is possible (Loveless 1984). Genetic comparisons of 21 subpopulations showed that *C. pitcheri* had low genetic diversity and its putative progenitor *was Cirsium canescens*, a species prevalent in the sandhills of Nebraska (Louda and Potvin 1995).

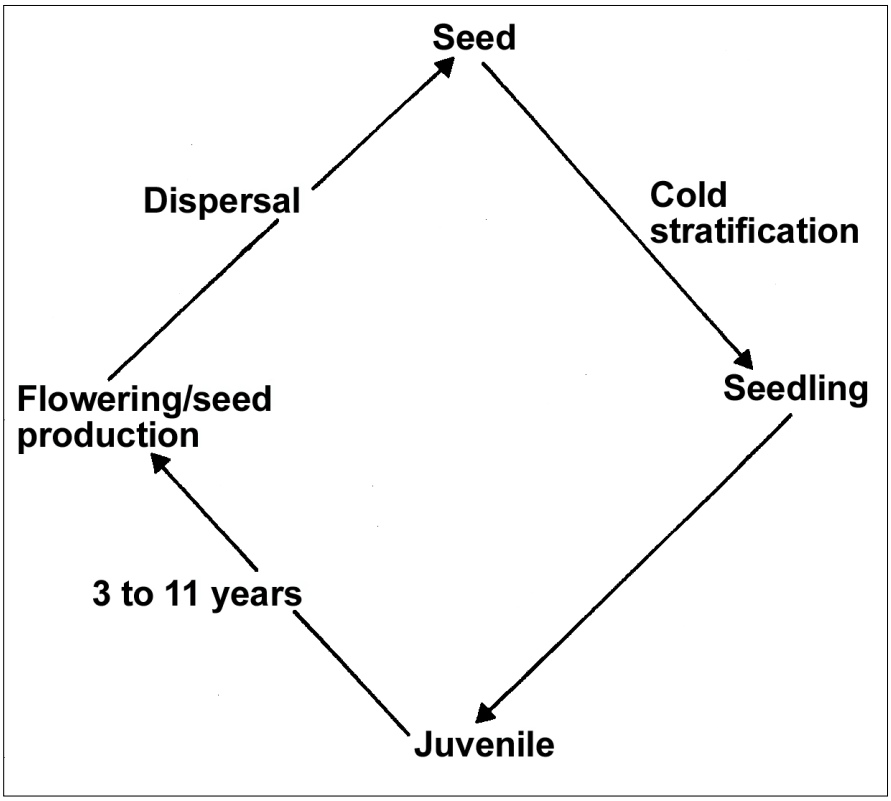


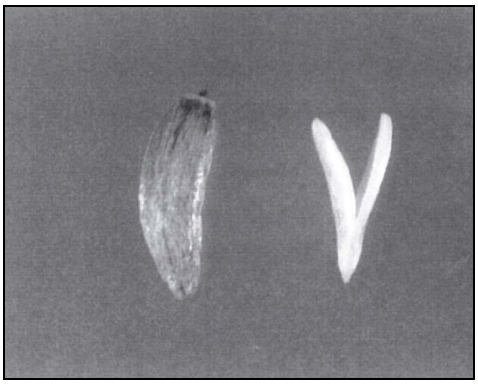
Figure 3. Life cycle of *Cirsium pitcheri* from seed to seed production and dispersal.

Dispersal

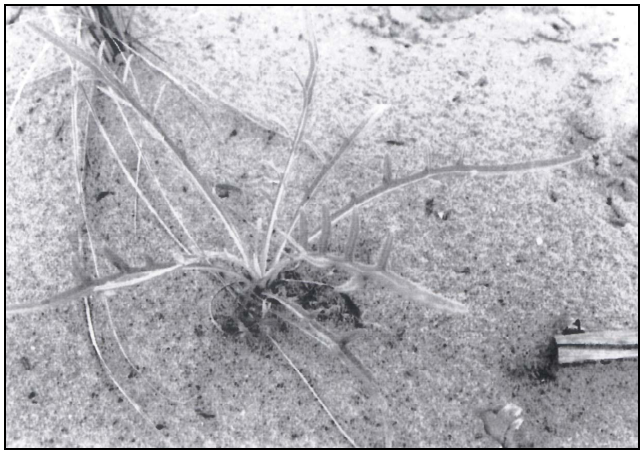
The achenes, henceforth called seeds (Fig. 4a), mature in late summer and are dispersed individually by wind, aided by a weakly attached pappus, or as entire inflorescences which fall to the ground with the parent plant in late autumn (Fig. 3). Seeds usually fall within 4 m of the parent plant (Bowles *et al.,* 1993).

Seed mass (weight per seed)

Mean seed mass was significantly different among populations. The seeds from the Pinery populations were heavier (12.5 mg; range 7-19 mg) than those of Inverhuron (11.5 mg; range 6.5-18 mg) and Providence Bay (7.1 mg; range 5.8-11.5 mg).



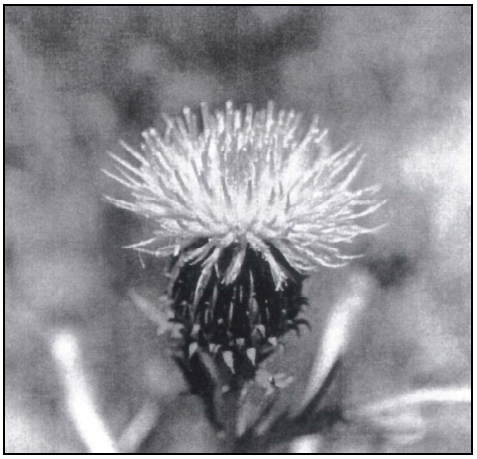
a) Seed b) Embryo



c) Vegetative rosette

d) Seedling

e) Flowering plant



f) A capitulum

Figure 4. a, b, c, d, e, f. Photographs of *Cirsium pitcheri* plants from seed to flowering.

Seed dormancy (Chen and Maun 1998)

Removal of the seed coat reveals a well developed embryo (Fig. 4b). Seed germination is epigeal and the seedling contains a pair of pale green cotyledons (Fig. 4d). The mature leaves of vegetative plants are pinnately divided (Fig. 4c) with each division tipped by a spine. At flowering, the rosettes produce slender tomentose stalks up to 1 m in height (Fig. 4e) bearing 2-125 cream-coloured flowering capitula (Fig. 4f). Seeds of *C. pitcheri* possess innate dormancy which is caused by a hard seed coat as well as inhibitory compounds within the seed coat. Seed germination requirements are very specific. High germination is obtained only when seeds are pre-treated either by surgically removing the seed coat or by nicking the seed on the radicle or cotyledonary end. After this pretreatment seeds germinate over a temperature range of 15-30°C, but the highest proportion of seeds germinate when temperatures are above 20°C. Under natural conditions, germination of *C. pitcheri* seeds occurs in spring after they have overwintered and undergone stratification and scarification through freezing and thawing of the substrate.

Burial of seeds and germination

The percent seed germination and emergence of seedlings from 2, 4, 6, 8, 10 and 12 cm burial depths were negatively correlated with depth (Chen and Maun 1999). Seedling emergence occurred from a maximum depth of 6 cm with most seedlings emerging from 2 cm depth. Thus excessive burial is detrimental to the emergence of seedlings.

Seedling establishment

Population size class distributions based on the number of leaves per plant showed that *C. pitcheri* populations were dominated by seedlings. The greatest mortality of seedlings occurs during summer months especially June and July. Seedling mortality within individual seedling plots ranged from 11-90% in 1993 and 0-70% in 1994 (D'Ulisse and Maun 1996). Thus, the establishment of seedlings in the first year of their life in undisturbed areas is similar to other sand dune biennials. The relative frequency of juveniles in each successive size class decreased from the smallest to the largest size class suggesting that major mortality episodes occur during the 3 to 11 years of their juvenile vegetative phase of growth. Herbivory, trampling, excessive burial, extreme cold winters, and sand erosion are the major causes of mortality.

Seed set in capitula

About 70 % of the seeds in capitula were <2 mg and did not contain an embryo. The remaining 30 % contained well-filled seeds. The number of florets per capitulum was positively correlated with its diameter (mm). A similar but a weaker relationship was also found between number of seeds and capitulum diameter. By June 21 1993, 9% of the capitula were open at the Pinery and seed dispersal began on July 8 1993. At Inverhuron, seed dispersal began on July 22 in capitula positioned on the top of a plant.

The number of capitula per flowering plant ranged from 4 to 30 and number of filled seeds per plant was about 200 to 400.

Transition probabilities

Transition probabilities of the Pinery population using the longest leaf length as an index of plant size, were constructed over two sampling seasons from August 1993 to June 1995 (D'Ulisse and Maun 1996). The data indicated that the probability of flowering from one year to the next was dependant on the size (based on longest leaf length) of the plant in the previous summer. The plants with longer leaf lengths were more likely to flower than the smaller ones. The probability of dying was greater in the smaller size classes for the August to June transition periods and no mortality occurred in the size classes greater than 15-20 cm.

POPULATION SIZE AND TREND

The general trend for the size of all the populations in Ontario is decreasing. The populations of the species are very small along Lake Huron. The once-abundant populations of the species at Ipperwash/Kettle Point area (Guire and Voss 1963) have been extirpated due to loss of habitat. A census in 1992 of juvenile plants in the open dunes at Pinery Provincial Park showed that only one small population of 33plants of *C. pitcheri* existed in 1993. Since then, the population size has fluctuated from 33 to about 115 plants. Only in 1994 the population size increased (to 283 plants), but subsequently the numbers decreased to 52 plants in 1998. A very small population also occurs at Inverhuron Provincial Park. This population consisted of 100 plants in 1986 (Keddy 1987) but decreased to only 15 in summer 1993. Since then the population has ranged from 50 to 66 plants. The recreational pressure on this population is very high.The largest population sizes are found in privately owned sandy bays on Manitoulin Island. However, the population sizes here are declining because of very high recreational pressure and the development of the properties for cottages. The population along Lake Superior is being monitored by the staff at Pukaskwa National Park. Records have been kept of the number of seedlings, and vegetative and flowering plants of this species since 1981 (Promaine 1998).

LIMITING FACTORS

Both biotic and abiotic factors affect the survival of populations. They increase mortality, delay reproduction, reduce total seed production of plants, decrease seedling establishment, prolong exposure to natural enemies, and increase the probability of extinction.

Biotic factors

Herbivory by white tailed deer (Phillips and Maun 1996) and plume moth is a critical limiting factor in survival, growth, and dynamics of plant populations (Louda 1994).

White-tailed deer

Due to an explosion of white-tailed deer (*Odocoileus virginianus*) populations at the Pinery the *Cirsium pitcheri* population is endangered.

Present deer population = 826 animals (Maun and Crabe 1995).

Sustainable population = 200 animals (Gedge and Maun 1992, 1994)

The animals graze leaves of both vegetative and flowering plants throughout the summer (D'Ulisse and Maun 1996). On flowering plants grazing ranged from the removal of a few capitula per plant to the complete removal of all capitula (Table 2). In 1993, 90% of the flowering plants were grazed and half of all the capitula produced in this population were consumed (Table 2). In addition, about half of the vegetative plants were grazed. In 1994 the damage was lower: 29 % of the flowering plants and 7% of the total number of capitula were grazed. Similarly, 31 % of the juvenile vegetative plants were partially or completely grazed. Since the predators of white-tailed deer have been extirpated from this area, deer pose a very serious stress.

Table 2. The number of flowering* and juvenile plants of *Cirsium pitcheri* grazed by white-tailed deer at the Pinery Provincial Park during the summer of 1993 and 1994

	1993		1994	
	Flowering	**Juvenile**	**Flowering**	**Juvenile**
Number of plants	11	34	7	65
Number grazed	10	17	2	20
% grazed	90	50	29	31
No. of capitula	138	--	30	--
No. grazed	68	--	2	--
% grazed	49	--	7	--

*The data for flowering plants only includes grazing on flower heads (capitula).
The percent of flowering plants in which leaves were grazed is 72 for 1993 and 43 for 1994.

Plume moth

Larvae damage the apical meristem and induce the formation of multiple stems (Stanforth, Louda and Bevill 1997). The damage may range from 0 to 42 % of the seeds on a plant (Keddy and Keddy 1984). Similar to the impact of white-tailed deer, insect herbivory may reduce seed output, increases time to maturation and reduces persistence of the species in more stabilized late successional habitats. However, the plume moth does not pose a serious threat to the Lake Huron populations.

Birds

We observed Goldfinches removing and consuming the seeds of *Cirsium pitcheri*. However, the bird damage is minimal.

Abiotic factors

Habitat loss

Development of sand dune habitats for recreational purposes and construction of cottages leads to a loss of habitat. Several areas along Lake Huron, Kettle Point, Ipperwash beach, Port Franks, Grand Bend and other sandy beaches along the Lake have been transformed into cottages. The Army Camp near Ipperwash has been used for training of army recruits and all terrain vehicles have destroyed all *C. pitcheri* habitats within the camp. A new commercial development is going to take place in Carter Bay, Manitoulin Island (Anonymous 1998). The area will be converted into an "Eco-Resort" consisting of a hotel, conference center with tennis courts, polo field and aquatic facilities. Visitors will have an opportunity to golf, kayak, fish, ski, hike, bow hunt, bike, canoe, or ride horseback. The population of *C. pitcheri* (n = 1000 plants) on the sand dune complex can not possibly withstand this kind of pressure.

Anthropogenic Impact

Recreational use of sand dunes affects populations in three ways. First, trampling kills plants directly (Fig. 2c). Second, trampling creates paths which enlarge over time because of erosion of sand thus exposing the roots of *C. pitcheri* and killing them. Third, the eroded sand is transported over the dune ridges and deposited on plants on the leeward sides of ridges which leads to excessive burial and eventual death of plants. Excessive burial in sand increases the vulnerability of the species at three stages of growth: seeds, seedlings, and adult plants. Deeply buried seeds either do not germinate or if they do the seedlings are unable to emerge from the soil. The ungerminated seeds may either decay in the soil or undergo enforced dormancy. After emergence the *C. pitcheri* seedlings may also be buried by sand to varying degrees in different microhabitats (Maun et al. 1996). Seedlings can survive up to 75% burial in sand but complete burial of seedlings is fatal. In vegetative juvenile plants the probability of dying was greater in the smaller size classes owing to lower energy reserves. Large vegetative plants die when the sand deposition exceeds 25 cm (Rowland 1999).

EVALUATION AND STATUS RECOMMENDATION

Evaluation

Populations of *C. pitcheri* are declining. Factors that impact the species are, (i) increased recreational use of sand dunes along the shorelines, (ii) subdivision of shoreline habitats for cottages and commercial ventures (iii) browsing by white-tailed deer, (iv) trampling by visitors to the beach, (v) use of all terrain vehicles on the beach (vi) erosion of sand (vi) excessive burial by sand and (vii) building of access roads to the beach.

Status recommendation

Previous status in Ontario – Threatened (Keddy 1987).

Recommended status – A status of **endangered** is proposed because the remaining populations are very small, the species has a very long life cycle (3 to 11 years), the natural survival rate of seedlings from germination to flowering is very low, the recreational pressure is on the increase, and browsing by white-tailed deer kills plants.

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