

COSEWIC
Assessment and Status Report

on the

Hill's Thistle
Cirsium hillii

in Canada



THREATENED
2004

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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COSEWIC Assessment Summary

Assessment Summary – November 2004

Common name

Hill's Thistle

Scientific name

Cirsium hillii

Status

Threatened

Reason for designation

This is a perennial herb restricted to the northern midwestern states and adjacent Great Lakes that is found in open habitats on shallow soils over limestone bedrock. In Ontario, it is found at 64 extant sites but in relatively low numbers of mature flowering plants that are estimated to consist of fewer than 500 individuals. Some populations are protected in national and provincial parks, however, the largest population is at risk from aggregate extraction. On-going risks are present from shoreline development, ATV use, and successional processes resulting from fire suppression within its habitat.

Occurrence

Ontario

Status history

Designated Threatened in November 2004. Assessment based on a new status report.



COSEWIC
Executive Summary

Hill's Thistle
Cirsium hillii

Species information

Hill's thistle is a short (25 to 60 cm tall) perennial thistle with a deep, hollowed, clustered root system. The leafy stems are soft, ridged, and either sparsely hairy or with woolly hairs; with 1 or 2 short branches near the top terminating in one to several large heads (3.5 to 5 cm) with deep pink-purple, or occasionally white, flowers.

Distribution

Hill's thistle is endemic to North America, with a range that is centred in the Great Lakes region. Its distribution ranges from southern Ontario, through Michigan, Wisconsin, Minnesota, Iowa, Illinois, and Indiana. The Canadian range is restricted to southern Ontario, with a total of 64 extant stations supported, primarily along the shores of Manitoulin Island and the west side of the Bruce Peninsula.

Habitat

Throughout its range, Hill's thistle is found in a variety of open, dry, sandy, fire-prone habitats, including such communities as gravel hill or bluff prairies, dry mesic to mesic sand prairies, pine barrens, oak barrens, sand dunes, oak savannah, and open woods. In Michigan, Wisconsin, and Ontario, it is also known from alvar grasslands. One essential aspect of the habitat of Hill's thistle is its need for open, or relatively open conditions. From 41 Ontario stations with habitat information cited, the most commonly noted dominant species in the ground layer with Hill's thistle is poverty oat grass (*Danthonia spicata*), with bearberry (*Arctostaphylos uva-ursi*) the most commonly noted associate, followed by the lichen *Cladina rangiferina*, bracken fern (*Pteridium aquilinum*), and little bluestem (*Schizachyrium scoparium*). Jack pine (*Pinus banksiana*), white spruce (*Picea glauca*), and white cedar (*Thuja occidentalis*) are the trees most often noted as dominant in the habitat, and common juniper (*Juniperus communis*) is the most noted dominant shrub, followed by creeping juniper (*Juniperus horizontalis*). Shoreline areas of woodland alvar on Manitoulin Island and the associated islands, and the west shore of the Bruce Peninsula, are critical to the long-term maintenance of Hill's thistle in Canada. These woodland alvars have existed historically in a landscape shaped by natural disturbances such as drought and fire.

Biology

Hill's thistle is a relatively short-lived perennial, generally persisting two or three years but usually no more than four or five. Flowers are produced one or two seasons after the establishment of the basal rosette, most typically in three-year-old plants. Reproduction also occurs vegetatively by adventitious buds that form along the lateral roots and give rise to basal rosettes. Seed production generally is abundant and the seeds are wind-dispersed, but excessive litter accumulation is thought to interfere with successful germination, and seedlings may be poor competitors for the available light and space. Loss of the historic, natural fire regime has also enhanced the degree of litter accumulation on historic habitats and has resulted in canopy closure of the openings that the species requires. Both flowers and seeds are vulnerable to insects and perhaps fungi. In Ontario, flowering occurs from mid-July through August.

Population sizes and trends

A total of 70 sites have been recorded for Hill's thistle; six of these are now believed to be extirpated. Of the 64 extant sites, 36 have been recorded with quantitative data. For these, the total number of plants counted is at least about 4000, with about 250 of these flowering, about 3700 as vegetative rosettes, and 86 with no distinction made between reproducing plants and basal rosettes. Forty-five (113) of the flowering plants recorded during the 2002 field surveys occurred at one station, Site 35, which is licenced for aggregate extraction, and where there was evidence of site preparation for this activity at the time of the field work. Nearly all of these population counts are from 1995 to 2003, with only three prior to this, thus rendering long-term trend analysis impossible. Of the 36 sites with good population data, only 13 of these support populations with greater than 100 plants. The largest documented population is Site 57, with 1175 plants counted in 2003, including 35 plants that had flowered. It was estimated that this site may have had as many as 1500 plants. The largest populations are likely known; however some significant populations may still be undetected at the other 28 stations. The Canadian population likely consists of at least 5000 plants (flowering plus vegetative). The total number of plants in Canada capable of reproducing in any year is estimated at 10% of the total, about 500 plants. The total area of occupancy is estimated at 30 square km and the extent of occurrence for the 64 extant sites is estimated at 3,000 square km.

Limiting factors and threats

The species is subject to several limiting factors, the most important of which are the fact that its prime habitat, alvar, is very restricted and in decline, and the increasing degree to which these shoreline areas are being converted to permanent estate residences. What remains of this specialized alvar habitat is being lost to succession, in the absence of natural disturbance regimes, in particular fire, which served to maintain the open character of these sites. The site with the largest number of mature plants is under licence for aggregate extraction.

Existing Protection or Other Status Designations

The species is recognized as Globally Vulnerable (G3); it is Critically Imperiled (S1) in Illinois, Indiana, and Iowa; Vulnerable (S3) in Michigan, Minnesota, Wisconsin and Ontario; with a national rank in Canada of Vulnerable (N3).



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 5th 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 agencies (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 members and the co-chairs of the species specialist and the Aboriginal Traditional Knowledge subcommittees. The Committee meets to consider status reports on candidate species.

DEFINITIONS (NOVEMBER 2004)

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 it is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for atleast 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 wildlife species for which there is inadequate information to make a direct, or indirect, assessment of its 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.



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

COSEWIC Status Report

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SPECIES INFORMATION

Name and classification

Scientific name:	<i>Cirsium hillii</i> (Canby) Fernald
Synonymy (Kartesz 1994):	<i>Cirsium pumilum</i> spp. <i>hillii</i> (Canby) Moore & Frankton <i>Cirsium pumilum</i> var. <i>hillii</i> (Canby) Boivin
Common name:	Hill's Thistle, Hill's Pasture Thistle, Prairie Thistle, Hollow-rooted Thistle
Family name:	Asteraceae (aster family)
Major plant group:	Dicot flowering plant

Specimens collected in 1890 along the dunes of Lake Michigan at Pine Station (now probably within the city of Gary) Lake County, Indiana, were studied extensively by Reverend Ellsworth J. Hill, who concluded that they were distinct from the eastern *Cirsium pumilum* s.str. (Moore & Frankton 1966). On the basis of Hill's collections and notes, the Lake Michigan plants were described in 1891 by William M. Canby as *Cnicus hillii*. The species was then revised to *Carduus hillii* in 1894 by Porter, and finally to *Cirsium hillii* in 1908 by Fernald. Subsequently, the status of the two entities, *Cirsium pumilum* of the north-eastern United States, and *C. hillii* of the north central US, was in dispute for some time. In 1917 Petrak refused to recognize *C. hillii* as distinct and treated both eastern and interior plants under *C. odoratum* (Barton) Petrak, and in 1930 Peattie also considered them as conspecific in his Flora of the Indiana Dunes. Several other authors expressed doubts with respect to treating the two as separate species (Moore & Frankton 1966). In 1966 Moore and Frankton concluded, after analyses of 350 herbaria specimens, that two subspecies should be recognized: *C. pumilum* (Nutt.) Spreng. ssp. *pumilum* and ssp. *hillii* (Canby) Moore & Frankton. This conclusion was based on the lack of sharp definition in range or characters between the populations, the absence of chromosome number difference, and the strong probability that no sterility barrier existed (Moore & Frankton 1966). In 1972 Dr. Bernard Boivin relegated the entity to varietal status, publishing it as *Cirsium pumilum* (Nutt.) Sprengel var. *hillii* (Canby) Boivin. A white-flowered form is recognized, and was named forma *candidum* by Boivin from a collection made in 1874, prior to the species even being described, but was subsequently referred to as *f. albiflorum* (Scoggan) E.G. Voss, on the basis of a 1952 collection by Voss from Michigan.

Although generally accepted as *Cirsium hillii* today, Penskar (2002) states that, "the taxonomic standing of *Cirsium hillii* remains of some question, and may require further investigation to clarify if this species is truly distinct from *Cirsium pumilum*. Cusick (1995) in fact believes that even according *C. hillii* varietal or subspecific status may be dubious, and states that, "It might be more practical to subsume *C. hillii* under *C. pumilum* as a single entity".

Cirsium hillii and *Cirsium pumilum* can be distinguished on the basis of several characters. *C. hillii* is a polycarpic perennial species (The Nature Conservancy 1990) while *C. pumilum* is a biennial. The leaves of *C. hillii* are less deeply lobed and the

marginal spines finer and shorter, and the spines of the outer phyllaries are shorter and narrower than those of *C. pumilum*. Plants of *C. hillii* are shorter than those of *C. pumilum*, and less often branched. The achenes of *C. hillii* are usually larger than those of *C. pumilum*, although exceptions have been noted (Moore & Frankton 1966).

All Canadian collections are referable to *C. hillii*, with *C. pumilum* having never been discovered in Canada.

Type Specimen: Collected by E.J. Hill, labelled "Sandy ground, Lake Co., Indiana, July 9, 1890" and stamped "College of Pharmacy Herbarium", now resides at The New York Botanical Garden.

Description

The description for *Cirsium hillii*, adapted from Higman & Penskar (1999) and Cusick (1995) is as follows: A generally short (25 to 60 cm tall) perennial thistle with a deep, hollowed, clustered root system with tuberous swellings. The leafy stems are soft, ridged, and either sparsely hairy or with woolly hairs; with 1 or 2 short branches near the top terminating in one to several large heads (3.5 to 5 cm) with deep pink-purple, occasionally white, flowers. The leaves are elliptic-oblong and form a basal rosette with only a few progressively smaller leaves on the stem. The leaf margins are typically undulating to very shallowly lobed and can sometimes exhibit slightly woolly hairy tendencies on the underside of the leaf, but is often smooth on both surfaces.

Moore and Frankton (1966 & 1974) provide detailed technical descriptions of *C. hillii*.

DISTRIBUTION

Global range

Cirsium hillii is endemic to North America, with a range that is centred in the Great Lakes region. Its distribution ranges from southern Ontario, through Michigan, Wisconsin, Minnesota, Iowa, Illinois, and Indiana (Penskar 2001) (see Figure 1). References to the occurrence of the species in Ohio were determined to be in error as a result of field searches and herbarium investigations by Allison Cusick (1995), and earlier references to its distribution in Pennsylvania appear to have all been revised to *C. pumilum* (e.g. NatureServe 2001, Penskar 2001).

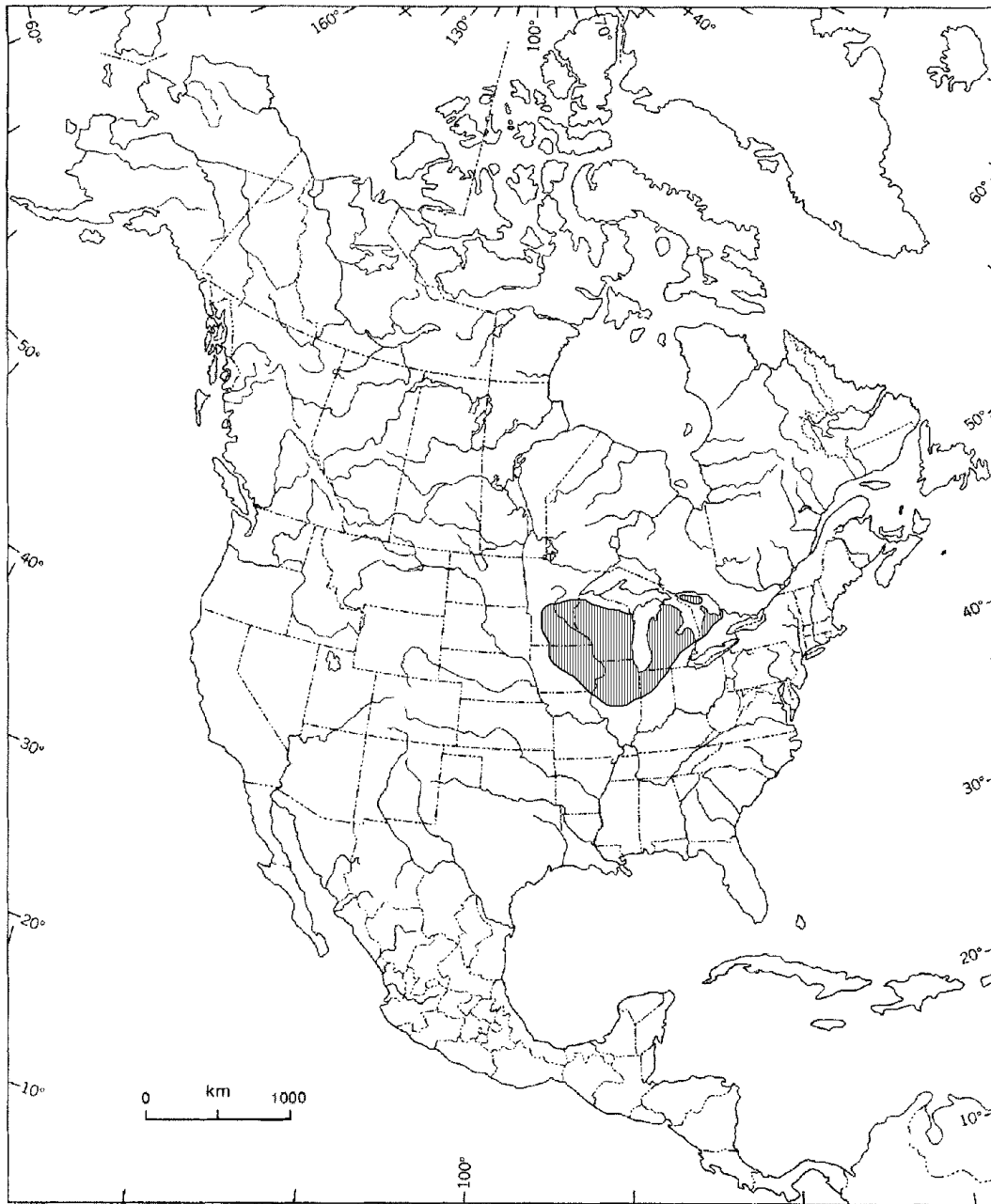


Figure 1. Global distribution of *Cirsium hillii* (updated from White & Maher, 1983).

Canadian range

The Canadian range is restricted to southern Ontario (Figure 2), where it is found only in Bruce and Simcoe Counties, and Manitoulin District. A total of 64 extant stations have been recorded, primarily along the shores of Manitoulin Island and the west side of

the Bruce Peninsula. Other extant stations are known from Cockburn Island (1), Barrie Island (1), Clapperton Island (2), Amedroz Island (1), Great La Cloche Island (2), Little La Cloche Island (1), La Cloche Peninsula (1), Squaw Island (1), Club Island (1), Fitzwilliam Island (1), and Simcoe County (1). Despite the fact some of these stations are technically “historical” according to the NHIC standard of 20 years, they have been retained in this report as extant, for the reason that to the best of our knowledge no one has revisited these remote sites, and there is no reason to believe the populations have been extirpated. Morton & Venn’s records for Clapperton, Amedroz, Squaw, and Club, for example, from the 1970s and early 1980s, would fall in this category. A total of six stations are either known or believed to be extirpated, with four of these from the Lake Huron Shore of Bruce County. One station is treated as a historical population of unknown status: Cove Island. An additional five stations are considered to be erroneous: Cape Crocker, Flowerpot Island, and the Fishing Islands in Bruce County, and Johnson’s Harbour in Grey County, and reports from Manitoba.

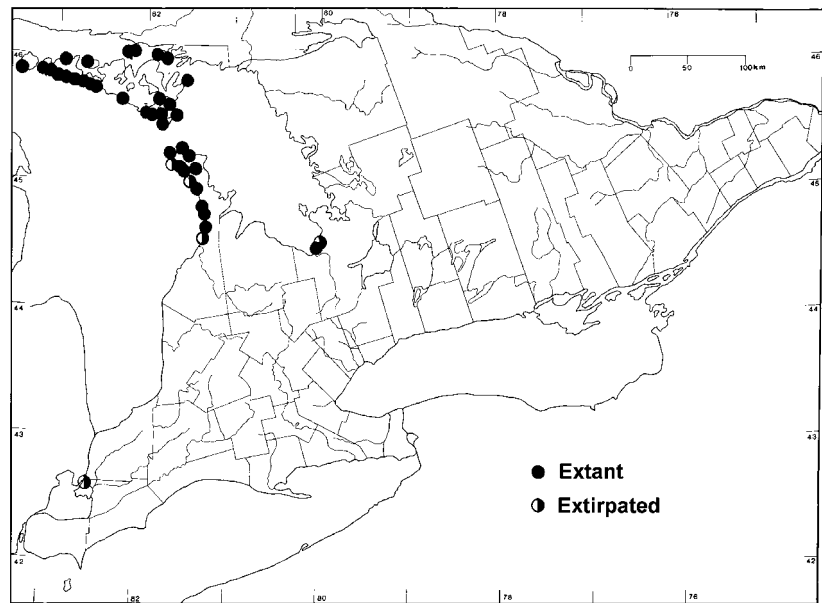


Figure 2. Canadian distribution of *Cirsium hillii*.

The extent of occurrence in Canada is estimated at 3,000 square km, and there has been a decline in this area over the past one hundred years with cessation of natural fire and development in shoreline alvars and open woodlands (and loss of the Walpole Island population). The area of occupancy is difficult to assess, as the 64 known stations for the species have not been fully documented as yet. However, using the recent figure of 112 square km of alvar of reasonable quality remaining across the entire Great Lakes basin (The Nature Conservancy, 1999), it seems appropriate to use 30 square km as the area of occupancy for *Cirsium hillii* in Ontario. The area of occupancy is in decline, due to reasons noted for decline in the extent of occurrence,

and as described in the Limiting Factors and Threats section. Declines in area of habitat (area of occupancy) have been noted at Sites, 32, 33, 35, 44, 46 and 55. No extreme fluctuations in area of occupancy are known.

HABITAT

Habitat requirements

Throughout its range *Cirsium hillii* is found in a variety of open, dry, sandy, fire-prone habitats, including such communities as gravel hill or bluff prairies, dry mesic to mesic sand prairies, pine barrens, oak barrens, sand dunes, oak savannah, and open woods (Higman & Penskar 1999, Penskar 2001). In Michigan, Wisconsin, and Ontario, it is also known from alvar grasslands.

In Minnesota, the species occurs in relatively disturbed sites, in association with many non-native, invasive species, such as Kentucky bluegrass (*Poa compressa* and *P. pratensis*) and Sweet white clover (*Melilotus alba*) (Penskar 2001). E.J. Hill, who discovered the species, noted this tendency as well in 1910, observing that, in the prairie areas south and west of Chicago, it grew in, "railway enclosures fenced off from the surrounding prairie before the land had been touched by the plow. Here it is one of the few native denizens of the prairie that seems able to compete with an introduced vegetation. It may return again to ground from which it had been excluded by cultivation, when this is seeded down for a time for pasture or meadow, and left a few years untilled. It thus takes on the character of a pasture or meadow thistle, and grows successfully beside the white and the red clover, timothy, and the most common meadow and pasture grasses of drier grounds, *Poa pratensis* and *P. compressa*." Cusick (1995) actually noted that, "The name "pasture thistle" is appropriate, since the plants are avoided by grazing animals and therefore stand out in grazed pastures." In Ontario *C. hillii* has been noted in association with *Poa compressa*, *Melilotus alba*, *Ambrosia artemisiifolia*, *Centaurea maculosa*, *Daucus carota*, *Hypericum perforatum*, and *Chrysanthemum leucanthemum*.

One essential aspect of the habitat of *Cirsium hillii* is its need for open, or relatively open conditions. For example, in Michigan, Penskar (2001) notes that, "Within the extensive jack pine barrens of the Lower Peninsula, *C. hillii* thrives best in the most open fire-prone areas, where it occurs in prairie-like communities." He also refers to its prime habitat within the oak-pine barrens in the Upper Peninsula as being, "openings in relatively small colonies within a relatively large savanna remnant." All of the Ontario stations have an open aspect to them, alvars, savannahs, or woodland, although these communities may be 'degraded' with lack of disturbance. Jones (1996) has noted from the population on Great La Cloche Island that, "It does not grow in amongst broad-leaved plants or anything directly overtop of it." Schaefer (1995) noted *C. hillii* at Barney Lake, Bruce County, in open alvar grassland, but that a majority of the plants observed were actually in an 80% shaded woodland of cedar, poplar & spruce, with *Pteridium aquilinum* dominating the understory (*C. hillii* was 2nd dominant) and occurring along an overgrown path.

It has been suggested that historically, at least in the eastern portion of its range, *C. hillii*, “may have survived along the buffalo traces where trampling and grazing provided adequate habitat disturbance.” (The Nature Conservancy 1990). There are several references in the Ontario records to disturbance-related habitats. For example Jones (1995) refers to the population at Evansville High Pavement on Manitoulin as, “Also grows in spots of exposed dirt. In this area it seems to be growing in and along a 4-wheeler trail, so perhaps it likes some disturbance.” Another essential aspect relates to the fact that the species does not germinate well in a thick duff layer (see below). The Nature Conservancy (1990) notes that, “Thin-soil prairie ridges and sand prairie/savanna sites (which provide habitat for the bulk of extant occurrences [in the US]) appear to provide appropriate germination and development sites without significant animal-induced disturbance regimes.”

Of the 41 stations in Ontario for which habitat information has been noted, it is found in the following habitats: limestone pavement-alvar meadow; Jack Pine-*Juniperus communis* treed alvar shrubland or savannah; small patches in white spruce dominated forest; jack pine-trembling aspen alvar; open jack pine-white cedar woods; jack pine-trembling aspen-*Juniperus communis* alvar; white cedar-white spruce-*Juniperus horizontalis* open alvar grassland; white cedar-dominated upland coniferous and mixed forest; jack pine-white spruce-balsam fir woodland; openings in white cedar-white spruce forest; white cedar-tamarack-white spruce-black spruce open woods; white cedar-tamarack woodland; white cedar-white spruce-trembling aspen alvar; red oak-white pine savannah on dunes; and sand dunes at edge of woods. It has also been noted on the Bruce Peninsula in coniferous woods over old dolostone shingle or cobblestone beaches (Owen Sound Field Naturalists, 2001; see Figures 3 & 4. At the other end of the spectrum, it also occurs in open alvars, including ones just above the Lake Huron high water line on the Bruce Peninsula (Owen Sound Field Naturalists, 2001), or at Fisher Harbour on Little La Cloche Island (see Figure 5).

The above communities are always supported by a substrate of limestone bedrock or sand. Usually the sites are relatively dry, although the author observed a small population at Site 55 in 2002 that was in a moist, sandy alvar nested within a white cedar-tamarack woodland, in association with such wet meadow species as *Tofieldia glutinosa*, *Aster umbellatus*, *Solidago ohioensis*, and *Potentilla fruticosa* (see Figure 6).



Figure 3. Closeup of *Cirsium hillii* at Coal Oil Point, Bruce County (8 August 2002).



Figure 4. Closeup of basal rosette of *Cirsium hillii* at Coal Oil Point (8 August 2002).



Figure 5. Numerous fruiting *Cirsium hillii* in open alvar at Fisher Harbour, Little La Cloche Island (6 August 2002).



Figure 6. *Cirsium hillii* in moist, sandy opening within white cedar-tamarack woodland at Pike Bay Alvar, Bruce County (6 August 2002).

Jones (2000) characterizes typical *C. hillii* habitat on Manitoulin Island, based on her observations at numerous stations, as, “Openings within jack pine or spruce-dominated savanna-woodland with *Juniperus communis*, ground cover of *Cladina rangiferina*, *Carex richardsonii* or *Danthonia spicata*, *Arctostaphylos uva-ursi*. Other associates are *Geum triflorum*, *Schizachyrium scoparium*, *Linnaea borealis*, *Pteridium aquilinum*, *Vaccinium angustifolium*, *Oryzopsis asperifolia*, *Senecio obovatus*, and mosses *Dicranum* sp., *Hypnum* sp. Substrate is coarse loamy sand to sandy loam or sand on bedrock. Can be adjacent to pavement alvar. Burn evidence can be present to old or very old, to no visible evidence at all of recent fire.” On the Bruce Peninsula, Johnson (pers. comm. 2002) considers typical *C. hillii* habitat as, “Open, scrubby, conifer woods on bedrock.” He also provides an excellent, detailed characterization of typical habitat along the shores of the Bruce peninsula from his work at Site 52. He notes *C. hillii* habitat as, “In very open woods (usually coniferous, never deciduous) (including near-alvars), less often in true open alvars, thus often in alvars and near-alvars, and always where canopy very open to absent. White cedar (most often dominant), tamarack, white spruce, and black spruce are the main trees present. The most frequent ground cover associates include: *Carex eburnea*, *Juniperus horizontalis*, *Iris lacustris*, *Arctostaphylos uva-ursi*, and *Schizachyrium scoparium*. Apparently always where the forest burned in the early 1900s. Always dry. Usually on dolostone bedrock, although by far the most populous site (2001) was on small dolostone stones. Always where undisturbed (except that 2 plants were along trails), but populations mainly small.” (Johnson 2002). On the Bruce Peninsula it has been noted as occurring up to six or seven km inland (Owen Sound Field Naturalists, 2001).

Frequently associated species in the US sites include typical prairie/savanna grasses such as big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), Indian grass (*Sorghastrum nutans*), poverty grass (*Danthonia spicata*), hair grass (*Deschampsia flexuosa*), June grass (*Koeleria macrantha*), and a variety of goldenrods, asters, and other prairie forbs (Higman & Penskar 1999). In Ontario, again from the 41 stations with habitat information cited, a total of 26 herbaceous associates have been noted, 1 lichen, 2 mosses, 7 shrubs, and 11 tree species. *Danthonia spicata* is most commonly noted as the dominant species in the ground layer with *C. hillii*, with *Arctostaphylos uva-ursi* the most commonly noted associate, followed by the lichen *Cladina rangiferina*, *Pteridium aquilinum*, and *Schizachyrium scoparium*. Jack pine, white spruce, and white cedar are the trees most often noted as dominant in the habitat, and *Juniperus communis* is the most noted dominant shrub, followed by *Juniperus horizontalis*.

Shoreline areas of woodland alvar on Manitoulin Island and the associated islands, and the west shore of the Bruce Peninsula, are critical to the long-term maintenance of *Cirsium hillii* in Canada. These woodland alvars have existed historically in a landscape shaped by natural disturbances such as drought and fire. The landscape is also shifting rapidly, on Manitoulin Island, and to a greater degree on the Bruce Peninsula, as estate homes and condominiums are developed in the prime shoreline sites. With this development comes a cessation of natural fires and the usual habitat degradation associated with subdivisions. Only six stations of *C. hillii* are believed to be extirpated, with the reasons for their demise less than conclusive. Although the species appears to persist in some remnant sites, the pressure to control fire near human habitation will increase the likelihood of succession to woodland and therefore of loss of the population.

Trends

Alvar and savannah habitats have been lost on Manitoulin Island and the Bruce Peninsula over the past 100 years, the result of forest succession and concurrent suppression of natural periodic fire, clearing of land for agriculture, increasing use of open shoreline areas (old & new) for housing and recreation (including ATVs), and extraction of sand for commercial uses. The south shore of Manitoulin Island and the west shore of the Bruce Peninsula are highly desirable locations to live and this fact will almost certainly have implications for the privately held populations of *C. hillii*. The projected population increases for southern Ontario would indicate that this trend of growth in north Bruce County and Manitoulin Island is likely to increase (Western Ontario Smart Growth Panel, 2003). Of the 64 extant stations for *C. hillii*, about 20 are either fully or partially protected in public or private parks or reserves.

Protection/ownership

Of the 64 extant stations for *Cirsium hillii*, the ownership breakdown is as follows:

- 36 are privately owned by single or multiple landowners;
- 11 are publicly owned by government conservation organizations, e.g., either as provincial or national park (Sites 9, 15, 39, 44, 48, 49, 60, 61, 62, 63 and 64)

- 4 are privately owned by conservation NGOs (Site 50 by the Federation of Ontario Naturalists and Sites 42 and 54 by the Nature Conservancy of Canada);
- 5 are owned by First Nations
- 8 are split between public and private ownership (Sites 4, 13, 14, 16, 22, 33, 47 and 53).

Of the six extirpated sites, all are privately owned. Ownership of each site is noted within the “Extant Populations” section.

Of the 11 stations either within full public ownership or owned by conservation NGOs, management or active protection which would benefit *Cirsium hillii* is known to be occurring only at Site 60, a Provincial Park site.

The majority of the extant stations (36) are in private hands. Another seven of the stations are partly held in private. Some of these 43 sites are recognized as provincially significant Areas of Natural and Scientific Interest (ANSI), for example that at Site 52. ANSIs are currently Category 2 within the Provincial Policy Statement for Ontario, this category permitting development and site alteration, “if it can be demonstrated that there will be no negative impacts on the natural features or on the ecological functions for which the area is identified.” (Ontario Government, 1997). As required by the Planning Act, local planning authorities “shall have regard to” policy statements issued under the Act. Fortunately, some of the highest quality and most populous stations of *C. hillii* are within public ownership, for example Sites 9, 15, 44, and 60.

BIOLOGY

General

The Nature Conservancy noted in 1990 that “Information is lacking on all phases of the life cycle of Hill’s Thistle. More is needed to be known about the biology and life history of *C. hillii* in order to manage it appropriately.” In his 2001 “Rangewide Assessment of Hill’s Thistle” for the US Fish & Wildlife Service, Penskar noted that “Internet and literature searches revealed virtually no information or citations concerning research or monitoring of this species. These searches, though conducted several times, cannot be considered definitive, but do highlight the paucity of information on this Midwestern taxon.” Penskar concluded by proposing that “Natural history studies of virtually any aspect of the biology and ecology of the species are recommended to augment and guide experimental management programs.” For the present study, the author found the situation with our basic knowledge of *C. hillii* unchanged.

Reproduction

Cirsium hillii is a relatively short-lived perennial, generally persisting two or three years but usually no more than four or five (Ostlie and Bender, 1990). Flowers are

produced one or two seasons after the establishment of the basal rosette (see Figure 4), most typically in three-year-old plants (Higman & Penskar 1999). Reproduction also occurs vegetatively by adventitious buds that form along the lateral roots and give rise to basal rosettes. Several lateral shoots may be produced by a single plant (The Nature Conservancy 1990, Higman & Penskar 1999). The primary taproots die along with the remainder of the plant after flowering, and in some instances lateral shoots are produced prior to death and these grow in the following years (The Nature Conservancy 1990, Higman & Penskar 1999).

Seed germination in natural and controlled environments is reported as low (Ostlie and Bender, 1990). This has been cited as the primary cause for the rarity of *C. hillii* by field researchers, suggesting that, "Excessive litter accumulation may interfere with successful germination and seedlings may be poor competitors for the available light and space. Loss of the historic, natural fire regime has enhanced the degree of litter accumulation on historic habitats" (Ostlie and Bender, 1990). In greenhouse trials, Henderson reported a 10 to 20 percent germination rate with sowing seeds in flats, while Wade found that seeds sown into ¼ inch of soil in a greenhouse environment also germinated poorly. However, he found that naturally-dispersed seeds produced a significantly higher level of germination. Henderson suggests that the low rate of germination in *C. hillii* may be an artifact of low seed viability, while Wade adds that low light levels may also be responsible (Ostlie and Bender, 1990). A prescription for germination of seeds is to: "Sow at 68°. If no germination occurs, move to 39° for four weeks, recycle, 14 to 30 days. Resents root disturbance" (Anonymous 2001).

Roberts and Chancellor (1979) conducted some interesting germination experiments on seven species of *Cirsium* and *Carduus*, including *Cirsium eriophorum*, *C. palustre*, *C. vulgare*, and *C. arvense*. They concluded that, "More than 90% of all the seedlings of *Carduus* and *Cirsium* species emerged within a year after sowing and the survival of achenes in cultivated soil was relatively short. Chepil (1946) in Canada found that achenes of *Cirsium arvense* persisted for 1 to 2 years in 7.5 cm of cultivated soil, and, when achenes were placed 1 cm deep in soil in the Netherlands, none was viable after 10 months (Bakker 1960). The survival of achenes in this species is greatly prolonged, however, when buried deeper than this in undisturbed soil. Bakker found that achenes buried some 40 cm deep showed no change in the capacity for germination during 4 years, while some buried achenes remained viable for 21 years in the US (Toole & Brown 1946) and 26 years in Denmark (Madsen 1962). These results suggest that achenes of *C. arvense* possess only short-lived innate dormancy, but that, when dormancy is enforced (Harper 1957), the period of survival can be considerable. This may also be true for other species of *Carduus* and *Cirsium*." From their studies Roberts and Chancellor (1979) were also able to conclude that, "All six species of *Carduus* and *Cirsium* showed a similar pattern: a variable, usually small, percentage of achenes germinated in the first autumn but the main emergence occurred in the following spring. Although long-term survival may be possible in undisturbed soil, at least with *C. arvense*, persistence in a surface layer of cultivated soil was relatively short." (While these results may not be transferrable to *Cirsium hillii*, they are included here because of the paucity of information on the species, as noted earlier.)

Cirsium hillii is known to be pollinated by four species of long-tongued bees: *Bombus pensylvanica* and *Psithyrus variabilis* in the *Apidae*, and *Megachile montivaga* and *Megachile pugnatus* in the *Megachilidae* (Hilty 2003).

Seed production generally is abundant (TNC 1990, Higman & Penskar 1999).

From notes by field researchers and personal observations by Allen in 2002, the main apparent factor affecting the ability of the species to reproduce is the closing in of the surrounding forest and resulting decrease in available light to plants of *C. hillii*. This stress is exemplified at sub-populations at Sites 44 and 60, with basal rosettes in evidence in the shaded environments, but no evidence of reproducing individuals.

Survival

Both flowers and seeds are vulnerable to insects and perhaps fungi (TNC 1990).

Physiology

Moore & Frankton (1966) noted that across its range *Cirsium hillii* flowers from the second week of June through to the second week of September, with the peak occurring from mid-June to the end of July. In Ontario, flowering occurs from mid-July through August (Moore & Frankton 1974) (see Figure 8). From his work on the species in the Chicago area, Hill considered the season for the species as lasting six weeks, being virtually out of flower by July 25. By this date most plants were noted as already having shed their seed, and by the first of August the stems were generally withered and dry (Hill 1910).



Figure 7. *Cirsium hillii* habitat in large opening on dunes within red oak-white pine savannah at Wasaga Beach Provincial Park (July 1997).



Figure 8. *Cirsium hillii* going to seed with previous year's seed head in foreground. Wasaga Beach Provincial Park (July 1997).

All of the Ontario populations occur on calcareous sandy soil or on dolostone bedrock.

Movements/dispersal

In their 1967 study of seven species of *Cirsium* (including *pumilum* ssp. *hillii* and *pumilum* at that time), Moore and Frankton concluded that "Of this group of species, only the eastward migrant [*C. pumilum*] shows a change in chromosome number from the ancestral 34 and it may be that the reduction to 30 entailed genetic change that made eastward migration possible. The somatic number 30 has been reported for nine collections of *C. pumilum* s.l. from widely separated locations representative of the range and it appears that the new karyome has remained stable."

At maturity, the seed head breaks off and is blown away (TNC 1990) with the result that the seeds of *Cirsium hillii* are wind-dispersed.

Behaviour/adaptability

Cirsium hillii is a species that is dependent on natural disturbance in order to maintain its critical habitat, primarily fire, but also drought. Natural wildfire has been suppressed for at least one hundred years throughout its range. With this altered disturbance regime, Penskar (2001) has concluded that the principal threat to the species in the US "...appears to be the continued decline of remaining habitat through plant succession, canopy closure, and shading. This has led to the highly increased vulnerability of colonies to stochastic events as well as numerous human pressures, the latter including such activities as encroachment through development, herbiciding, grazing, impacts from recreational land use and development, certain agricultural and forest management practices, and maintenance activities related to the upkeep of railroad, pipeline, and road right-of-way." In Ontario the scenarios are basically the same. The importance (and evidence or lack) of fire has been noted for the Ontario stations by Jones (2000), Morton (2002), and Johnson (2002). Much of the Bruce Peninsula was burned in catastrophic fire over one hundred years ago, and the importance of fire in today's *C. hillii* habitat is reinforced by the statement by Johnson (2002), in referring to site 52, that, "[*C. hillii* is] Apparently always where the forest burned in the early 1900s." Fernald (1930) was impressed with Great Cloche Island and notes excursions into "much burned Manitoulin Island." (pers. comm. Morton 2002). Today there is "essentially no burning" on Manitoulin Island (pers. comm. Morton 2002). The other natural disturbance that has benefited *C. hillii* is the fluctuations in Great Lakes water levels, and this has served to keep habitat open along the shores of Lake Huron, particularly in the alvar habitats (pers. comm Morton 2002).

The species is susceptible to severe drought, as presumed at Cook Prairie in Indiana as the primary cause of final extirpation of the largest state population (Penskar 2001); other factors included mowing, herbiciding, siltation due to agricultural runoff, compaction and destruction by heavy equipment, and skidding. At several of the Ontario stations the affinity of the species to human disturbance along trails and tote roads has been noted, and these are often either the only location where plants can be located, or where fruiting plants can be found. Brunton (1989) for example noted that at site 60, "The plants seen were all growing singly and all were on the stabilized edge of fire roads through the dry forests of the high dunes under red oak-pine forest cover." Similarly, Jones (2001) noted at Site 22 that, "Road bisects the small patches of habitat where thistles occur, but this may actually be helping the thistles by providing an open, fern-free area."

It has not yet been determined whether Hill's thistle is simply resilient to, or actually benefits from, furrow planting in the jack pine plantations of Michigan directed at maintaining the endangered Kirtland's Warbler, as well as other timber management practices in that state. Furrow planting followed by a 50-year rotation of jack pine is believed to be a threat to Hill's thistle (Penskar 2001).

The species can tolerate environmental degradation, noted earlier with the references to its ability to re-establish in agricultural pastures and compete, apparently

successfully with white and red clover, timothy, and *Poa pratensis* and *P. compressa* (Hill 1910), as well as its ability to survive in grazed areas (Cusick 1995). In Illinois *C. hillii* has demonstrated the ability to persist in degraded prairie remnants within cemeteries, where it is maintained by mowing which discourages woody plant establishment and succession, but also prevents the species from flowering (Penskar 2001).

C. hillii does not contend well with other invasive species, and has been noted as vulnerable to black locust (*Robinia pseudoacacia*), honeysuckles (*Lonicera* spp.), and weedy thistles (Penskar 2001).

In a report by The Conservancy (Ostlie and Bender, 1990), it was stated that the recovery potential of *Cirsium hillii* was uncertain. At the time success with transplants of the species had been mixed, with many efforts ending in failure. Wade found transplants to be typically successful, provided they were moved while still in the rosette stage (Ostlie and Bender, 1990). He utilized both the bare-root and root ball methods. Henderson successfully moved plants from freshly ploughed prairie with good success.

POPULATION SIZES AND TRENDS

For this report, the term population is used to refer to the basic unit, and is defined as, "A group of individuals that reproduce with one another and produce offspring" (Primack 1993). This term, when applied to *Cirsium hillii*, does not imply any genetic isolation between populations, as the species likely experiences few barriers to genetic exchange between proximal populations along the west shore of the Bruce peninsula and the south shore of Manitoulin Island, other than of course, the fragmentation of its prime habitat, i.e., it is pollinated by long-tongued bees and its seeds are wind dispersed. The term station, site, or population, is thus used interchangeably to refer to one or more populations of *C. hillii* that are separated from other populations by at least one km of unoccupied or unsuitable habitat. This is the definition used by the Natural Heritage Information Centre (NHIC) for an Element Occurrence (EO), thereby facilitating comparisons with, and additions to, that dataset. All populations were plotted on topographical maps in NAD 27, using the information collected by the author, e.g., pers. comm. with Morton & Johnson, and referencing these against the NHIC Element Occurrence Summaries for each population. The criteria regarding 'lumping' or 'splitting' to define a population was then applied, with those records within one km proximity treated as sub-populations. In some cases populations beyond the one km cutoff were included, because of known imprecision with the location of that particular record.

A total of 70 sites have been recorded for *C. hillii*; six of these are now believed to be extirpated. Of the 64 extant sites, 36 have been recorded with quantitative data (Table 1), nearly all of these population counts are from 1995 to 2003, with only three prior to this, all in the 1980s, thus rendering long-term trend analysis impossible. Of the 36 sites with good population data, only 11 of these support populations with greater than 100 plants (Sites 4, 14, 15, 16, 19, 32, 35, 44, 54, 57, and 60). The most populous

documented station is Site 57, with 1175 plants, including 35 flowering, tallied by Johnson in 2003. However, it was estimated that this site could have as many as 1500 plants. Site 9 is perhaps the most abundant station for *C. hillii* on Manitoulin Island (Morton pers. comm. 2002), with extensive prime habitat that has not been fully quantified as yet for *C. hillii*. The population counts must be used with the caveat that they are often incomplete counts, as several were recorded during surveys that were not specific to *Cirsium hillii*, and the fact that the species can be quite difficult to quantify in its typical habitat of openings within the contiguous forested landscape. These qualifiers, where recorded by the observers, are noted in Table 1.

Table 1. <i>Cirsium hillii</i> Population Information Summary for Ontario Stations.		
Site	Number of plants	Observer(s)
#3	57 (15 flowering, 42 rosettes)	Jones, 1995
#4	107 (mostly rosettes) ("If entire habitat were more thoroughly searched, the #s would be much higher.")	Jones, 1996
#6	12 (no breakdown) 39 (1 flowering, 38 rosettes) several rosettes	Jones, 1995 Jones, 2000 Morton & Venn, 2002
#9	13 (all rosettes) about 2 dozen (no breakdown) Morton (2002) considers this to be perhaps the most abundant station for <i>C. hillii</i> on Manitoulin Island	Jones, 2000 Allen <i>et al.</i> 2002
#11	ca 20 plants (2 in flower)	Oldham, 1994
#12	"rare"	Oldham, 1994
#13	"rare"	Oldham, 1994
#14	104 (only a few seed heads, mostly rosettes) 46 (all rosettes)	Jones, 1995 Jones, 2000
#15	180 (all rosettes) 347 (all rosettes) ("The 347 is representative of a few places where rosettes were counted along trail. Actual total number is much higher for whole area").	Jones, 2000 Jones, 2000
#16	121 (1 seed head, 120 rosettes) 14 (all rosettes)	Jones, 2000 Jones, 2000
#17	70 (1 seed head, 69 rosettes)	Jones, 1995
#18	ca. 20 plants (no breakdown)	Oldham, 1989
#19	187 (4 flowering, 183 rosettes)	Jones, 1996
#22	ca. 30 (no breakdown) 31 (8 fruiting heads, 23 rosettes)	Oldham, 1994 Jones, 2000
#23	17 (3 flowering, 14 rosettes + many small seedlings)	Jones, 1996
#24	13 (1 in bud, 12 rosettes)	Jones, 2000
#25	several rosettes ("but plant is probably more widespread")	Morton & Venn, 1981
#32	152 (2 flowering, 150 rosettes)	Jones, 1996
#33	10 (5 flowering, 5 rosettes)	Allen & Allen, 2002
#35	157 (113 flowering, 44 rosettes)	Allen & Allen, 2002
#37	"rare"	Morton & Venn, 1973
#39	"scarce & rarely flowers"	Morton & Venn, 1987
#41	60 (5 in seed, 55 rosettes)	Schaefer, 1995
#42	"rare"	Schaefer, 1995

Site	Number of plants	Observer(s)
#44	30 (all rosettes) 250 (1 flowering, 249 rosettes)	Johnson, 1984 Allen, 2002
#45	1 (rosette)	Schaefer, 1996
#46	39 (14 flowering, 25 rosettes)	Allen, 2002
#47	2 (both flowering)	Oldham, 1995
#48	3 (2 in seed, 1 rosette)	Schaefer, 1995
#50	4 (all rosettes)	Johnson, 2002
#51	30 (2 flowering, 28 rosettes)	Johnson, 2002
#52	75 (10 flowering, 65 rosettes) (a number of additional sub-populations are actually present)	Johnson, 2001
#53*	57 (1 fruiting, 56 veg in many separate sub-populations)	Johnson, 2003
#54*	183 (8 flowering/fruiting, 175 vegetative) in 5 sub-populations	Johnson, 2003
#55 -	31 (minimum) (3 flowering, 28 rosettes) 14 (6 flowering, 8 rosettes)	Schaefer, 1995 Allen & Allen, 2002
#57*	19 (2 flowering, 17 rosettes) 1175 counted but 1300-1500 est. with 35 having inflorescences	Johnson, 1985 Johnson, 2003
#59	"Rare and local"	Oldham, 1997
#60	443 (7 flowering, 436 rosettes)	Wasaga Park, 2001 Johnston & Bieniek, 2003
#61* New locality EO ID:1768	23 all vegetative	Johnson, 2003
#62 * New locality EO ID: 5123	43 all vegetative	Johnson and Macdonald, 2003
#63 * New locality EO ID:?	9 (1 flowering/fruiting, 8 vegetative)	Johnson, 2003
#64 * New Locality EO ID:1777	34 (3 fruiting, 31 vegetative) in two sub-populations	Johnson, 2003

*Supplementary data added in February 2004, subsequent to the completion of this report, based on fieldwork by J.W. Johnson in Sept. 2003 (courtesy OMNR).

For *Cirsium hillii* it is very difficult to detect trends through time with individual sites, due to the relatively few records with quantitative data, and the uncertainty in knowing whether a population or sub-population surveyed was in fact the same as one surveyed a few years previous. This is especially the case with a species such as *C. hillii*, which often occurs in small openings, imbedded in rather extensive forests, and it becomes a challenge to record the precise opening or openings, and the problem is compounded by the ephemeral nature of these openings as they grow in and openings are created elsewhere by disturbance. The recent advent of GPS technology will greatly assist this situation, with the majority of recent surveys on the species possessing very precise locations.

A total of 36 of the 64 extant stations have been surveyed quantitatively, with nearly all of these counts made in the last eight years. The largest population at Site 57 consists of 1175 individuals, including only 35 mature flowering/fruiting plants in 2003. The total number of plants counted for the 36 sites surveyed is about 3915, with 253 of these being mature flowering plants, 3,662 rosettes, and 86 with no distinction made between

reproducing plants and basal rosettes (There may be some overlap in the 'counting' of sub-populations, but for the most part the quantifications of populations represented separate sub-populations). It is quite striking that of the 253 flowering plants recorded, 45% of these (113 plants) are at one station, Site 35, which is licenced for aggregate extraction, with the site being prepared at the time of field surveys in 2002. The largest populations are likely known, however some significant populations may still be undetected at the other 28 stations. The Canadian population likely consists of at least 5,000, or perhaps somewhat more, plants (flowering plus vegetative) when taking into consideration the total estimated number at Site 57 and additional undetected sites. The total number of plants in Canada capable of reproducing in any year is estimated at 10% of the total; the total mature, reproducing individuals may be in the order of 500+ plants.

From his rangewide status assessment, Penskar (2001) concluded that "Although *Cirsium hillii* is an endemic Midwestern taxon far from being demonstrably secure, it is not sufficiently rare nor endangered throughout its range to merit consideration for federal listing at this time. Despite its extreme rarity in Iowa, Indiana, and to some extent Illinois, there are numerous records of viable populations within the remainder of its range, including Ontario, Michigan, Wisconsin, and Minnesota. Within states such as Michigan, the stronghold for Hill's thistle rangewide, this species persists well even though as a special concern or "watch-list" plant it has no legal protection, and can be expected to persist well into the future. Moreover, there are likely additional large to moderately large populations that will be discovered through ongoing inventory in Michigan and elsewhere. Overall, the current G3 rank assigned by The Nature Conservancy is well justified, based on the current data." However, Penskar adds a cautionary note, stating that, "Even though there is insufficient merit for recommending federal listing, Hill's thistle remains vulnerable to continued decline in many portions of its range without determining the most appropriate management strategies. It is clear that the biology and ecology of this species is rather poorly known. Without intervention through active management and a better understanding of the natural history of this species and its habitat, it is very possible that Hill's thistle could significantly decline over the next several decades."

A downward trend in Ontario populations appears inevitable, for the reasons cited in the section on Limiting Factors and Threats. Locally, however, in some areas, as along sections of the south shore of Manitoulin Island (Jones pers. comm. 2003), and on the Bruce Peninsula, from Dorcas Bay to Little Pine Tree Point, it could be considered common (Owen Sound Field Naturalists, 2001). As with the US populations, new populations will continue to be discovered and 'new' sub-populations will be added to the existing stations. However, a cautionary note is also warranted for the 60 extant stations. To control, let alone reverse this trend, with respect to development pressures in the shoreline alvars, lack of fire disturbance in the species' habitat, and successional closure of open habitats supporting *Cirsium hillii*, will pose a considerable challenge.

Extirpated populations

Hopkins Bay, St. Edmunds Township, Bruce County. First recorded in 1949 by H.A. Senn *et al.* (coll at DAO) from "Hopkins Bay, 3 ½ kms south of Tobermory, upper beach, wooded". No observations since and believed extirpated. The site is private property.

Pine Tree Point, St. Edmunds Township, Bruce County. Probably first observed in 1934 by Krotkov (coll at TRT) from "open woods" and not recorded since a 1948 collection (DAO) by C. Frankton *et al.* from "burned over limestone barrens". Site investigated 8 August 2002 and very end of Pine Tree Harbour Road is posted "No Trespassing" and fenced (owner Bauman). Shoreline of White Cedar on alvar is all carved up into new lots for sale. There is complete exclusion of public access down Pine Tree Harbour Road. Also investigated the alvar on the north side of Pine Tree Harbour Road. This appeared to be good habitat, and was quite extensive, with quite open white cedar, tamarack, white birch, with *Schizachrium scoparium* dominant in the herbaceous layer, and *Danthonia spicata*, *Juniperus horizontalis* and *Potentilla fruticosa* common, but no *C. hillii* could be found. There is good alvar on the south side of the road, from Concession 6-7 west, but this was posted "No Trespassing" so was not accessed. "For sale" signs were erected on individual lots.

Fishing Islands, Amabel Township, Bruce County. John Macoun collected *C. hillii* on these islands in 1874 "In dry thickets", with no mention as to the specific island (coll at CAN). There have been no other confirmed records for the Fishing Islands since Macoun's.

Sauble Beach South, Saugeen First Nation Reserve, Amabel Township, Bruce County. First observed in 1950 from "South Sauble Beach" by J.H. Soper & Shields (coll at CAN, TRT). Last observed in the 1980s by J.W. Johnson, with no abundance or habitat information. No observations since and believed to be "probably extirpated" (Johnson pers. comm. 2002).

Walpole Island First Nation, Lambton County. Last noted in 1914 by Dodge (1914) as, "occasional in prairie-like ground on Squirrel Island. Apparently rare." Dodge does not seem to have made a voucher, as no collection exists at MICH. Not observed by Gaiser (1966) or during the Natural Areas Inventory (Woodliffe & Allen 1988). If *C. hillii* ever existed on Squirrel Island, it certainly does not currently, as little remnant savannah exists on Squirrel Island, and this was covered intensively during the inventory work in the 1980s.

Wasaga Beach, Nottawasaga Bay Shore, Simcoe County. This station was known in the 1970s by A.A. Reznicek (pers. comm. in Brunton 1989). It is believed to have been destroyed by recreational development which is quite prevalent in the area.

Historical populations of unknown status

Cove Island, St. Edmunds Township (location is approximated from Morton's description). Morton & Venn (1987) cite a record for Cove from Cuddy and Norman (1972) as "needing confirmation". Morton (pers. comm 2003) notes that, "[The record] could be correct because there is a suitable bit of alvar behind one of the exposed bits of shore on the west side of Cove about half way up the coast." Not recorded since 1972 (Promaine pers. comm. 2003).

Black Creek Provincial Park, Estnor Township, Bruce County. First observation 1 July 1982 by I.D. Macdonald as "scattered in various locations and observed in several communities, from Stokes Bay to Myles Bay." (Macdonald 1982). Also observed in the 1980s by J.W. Johnson, with no abundance information provided. Searched unsuccessfully for *C. hillii* 8 August 2002 by G.M. Allen, including *Juniperus communis*-*Pteridium aquilinum* openings; back dunes of *Schizachyrium scoparium* and *Danthonia spicata* in white spruce; and the frontal dunes backing the parking lots with very narrow dunes backing onto closed mixed forest. However the areas to the west toward Shute Point, and north toward Stokes Bay were not surveyed, and *C. hillii* could certainly be present here. Publicly owned as a Provincial Park by the Ministry of Natural Resources.

Erroneous reports

Flowerpot Island, Bruce County, is erroneously reported as an Element Occurrence in the NHIC database, with the source cited as Morton & Venn (1987). There is no such reference in *The Flora of the Tobermory Islands*, and in personal communication with Dr. Morton (2003), when queried on the record, he stated that "The only location for Hill's Thistle on the Tobermory Islands that I know of is on the alvar on Bear's Rump Island. There is no suitable habitat for it on Flowerpot."

Cape Crocker (Nawash) First Nation, Bruce County. NHIC notes that, "Varga's (1995) report references the NHIC database as the source of the pre-1949 observation, however no record of this observation can be located." Not found by Varga in 1992 and 1995 field surveys (Varga *et al.* 1995).

Johnson's Harbour, Grey County. Although a separate EO in the NHIC database, the "Comments" in the NHIC EO summary sheet for "Johnston's Harbour, Bruce County" note that, "A 1933 collection record by Krotkov labelled "Johnson's Harbour" has been included in this EO – the ARVPO database listed it as 'Johnson Harbour' northeast of Owen Sound. Johnson's (1982) report may contain a recent record of *C. hillii* at this location, but this report is presently unavailable at the NHIC." Joe Johnson has no knowledge of this record of Krotkov's from "Johnson's Harbour" in Grey County, nor is he aware of any other records from Grey County (pers. comm. Johnson 2003). This record is thus considered to be Krotkov's record from "Johnston's Harbour" in Bruce County.

Fishing Islands, Wildman's Island, Amabel Township, Bruce County. The species has been reported from the Fishing Islands, in Bruce County (Parker et al. 1985), specifically from Wildman's Island. The record of *C. hillii* from this study is believed to be erroneous, as there was apparently no collection made, and no specimen was ever verified by Joe Johnson, who was acting in that capacity for the project (Johnson, pers. comm. 2003).

Cirsium hillii was cited for Manitoba by Fernald in Gray's Manual of Botany (1950). Scoggan, in his Flora of Manitoba (1957) pointed out that the related species *C. drummondii* was the basis of reports of *C. hillii* in Manitoba. Subsequently, Moore and Frankton (1966) concurred, stating that, "We question the reported occurrence [of *C. hillii*] in Manitoba, and believe that these refer to the related species *C. drummondii*." In the intervening years no records of *C. hillii* have been confirmed from Manitoba.

Potential sites for investigation

The following sites are offered as having good potential for supporting *Cirsium hillii* (all UTM's are NAD 27). I have provided the originator of the suggested site in brackets.

Great La Cloche Island – There is extensive alvar habitat as yet unexplored for *C. hillii* through the southern portions of the island (Dr. J.K. Morton and Judith Jones).

Little La Cloche Island – I was able to investigate the alvars at either end of the island during the 2002 fieldwork, but was not able to visit the south end at Mary Point, also suggested by Dr. Morton.

Providence Bay, Manitoulin Island - Habitat to the west and east of town at UTM's 399400 5057300; 399800 5058000; 301700 5057700; and 302700 5057600 affords good potential for *C. hillii*, and would help bring some precision to this record (Dr. J.K. Morton).

Shrigley Bay, Manitoulin Island – No records of *C. hillii*, despite good habitat supported (Judith Jones).

Barrie Island – Good alvar at extreme west end of the island between Salmon Bay and Sturgeon Bay was not checked during fieldwork (Dr. J.K. Morton).

Wikwemikong First Nation Reserve - South end supports good habitat that should be checked for *C. hillii* (Judith Jones).

Wikwemikong First Nation Reserve– Possible good alvar surrounding the bay on the east side of James Bay (Dr. J.K. Morton).

LIMITING FACTORS AND THREATS

1) Limited habitat

The species is restricted to alvar and savannah habitats along the shore of Lake Huron and Georgian Bay. These vegetation types constitute some of the most threatened in North America, and in Ontario. More widespread and extensive historically, the prime habitat in southern Ontario today faces a multitude of stressors, some of which are virtually impossible to reverse, such as population growth.

2) Successional change and lack of disturbance:

All of the extant stations are subject to increased levels of succession in the absence of natural fire, and this trend toward more shaded habitats has been particularly noted in the last few decades by observers, e.g., Morton at Site 9, Beecroft at Site 60. With the exception of Fisher Harbour, the number of flowering plants did not exceed 15 at any site. Although this is a snapshot, it nonetheless raises serious questions regarding the current reproductive potential of populations and the factors that may be contributing to the low flowering rate. Some of the stations were composed entirely of basal rosettes when last surveyed, e.g. Sites 4 or had a very low number of flowering plants, such as at Site 44, a Parks Canada site, where less than one percent of the population was observed by the author as reproducing. There appears to be only a limited program to restore natural fire to these systems. It is likely that a much more ambitious program would be required to maintain the current distribution and abundance of Hill's thistle.

3) Shoreline development:

The majority of the stations, 35, are in private hands, in one of the most scenic shoreline areas in the province. Development is encouraged by the municipalities in these areas; development has occurred on a scale that would not have been easily envisioned just a decade ago. Carter Bay on Manitoulin Island is a case in point (6,000 acres on 17 kms of shoreline, encompassing the best quality dune system in the province), and Gauley Bay on the west side of the Bruce Peninsula, are realities today. With the projected growth in southern Ontario, people will continue to demand permanent estate residences in the same shoreline areas supporting Hill's Thistle. Five of the stations have been noted as threatened with residential development (Sites 3, 6, 51, 52, & 55).

4) Aggregate demand:

The alvar habitats supporting *Cirsium hillii*, are also favoured by the aggregate industry for limestone extraction. The station discovered in 2002 at Site 35, supporting about 45% of the known reproducing plants in the province, will probably be extirpated in the next couple of years for crushed limestone extraction. Of the three stations on Great La Cloche Island and Little La Cloche Island, Site 33 and 35 are under licence for

extraction of the limestone (La Cloche Quarry Licence #3863 issued 29 May 1990). Both islands are owned by the same individual, and his licence applies to those areas of Great La Cloche and Little La Cloche south and southeast of Highway #6 (pers. comm. Hallaiken, 2004). This constitutes an area of some 20 square kms, much of which is prime alvar.

5) Invasive species:

Some invasive species may have a potential impact on *Cirsium hillii* in Ontario. The following invasive species were noted by the author in or very proximal to the populations during 2002 fieldwork: white sweet clover, *Melilotus alba* (at Great La Cloche Island); spotted knapweed, *Centaurea maculosa* (at Little Eagle Harbour-Coal Oil Point. These invasives could be especially troublesome in alvar, savannah, and woodland habitats on sandy soils.

6) ATVs and trail bikes:

Problems with ATV and trail bike use have been noted at several of the stations, including Site 60, where ATV use was believed to be the cause of extirpation of a sub-population. On the other hand, some of the sites on Manitoulin have not yet been affected but this is likely to change as more people take up residence. The alvars lend themselves well to this activity, and it will likely be a major stressor at many of the sites in the next few years.

7) Conversion to agriculture:

This is a minor threat to Hill's Thistle, and unless the current agricultural practices change in southern Ontario, the alvar habitats should not become prime agricultural land in the foreseeable future. The population of Hill's Thistle recorded by Dodge in the early part of the last century on Squirrel Island was probably extirpated by conversion to agriculture, as was nearly all of the natural vegetation on the island outside of the marshes.

8) Deer browse:

The overall palatability and impact of deer browse on mature plants of *Cirsium pitcheri*, observed at Site 44 by the writer in 2002, are unknown. However, Manitoulin Island is well known for its high populations of White-tailed Deer. In the case of another Ontario thistle, the endangered Pitcher's thistle, *Cirsium pitcheri*, deer browse was identified as a significant limiting factor in Pinery Provincial Park, Ontario (Maun 2000).

SPECIAL SIGNIFICANCE OF THE SPECIES

Cirsium hillii is a globally rare species of open, generally dry, grassy alvar sites in Ontario. Alvar habitats are restricted in their distribution in Ontario and are at risk in the province.

EXISTING PROTECTION OR OTHER STATUS

Global heritage status rank: G3 (Vulnerable - Vulnerable globally either because very rare and local throughout its range, found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extinction or elimination. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals (assigned 26 December 1997) (NatureServe 2001).

Global heritage status rank reasons: Scattered populations in remnant prairie or similar communities. Despite its extreme rarity in Iowa, Indiana, and to some extent Illinois, there are numerous records of viable populations within the remainder of its range, including Ontario, Michigan, Wisconsin, and Minnesota. Additional populations are likely to be found through ongoing inventory. Presently, there are approximately 141 viable populations rangewide. On the other hand, Hill's thistle remains vulnerable to continued decline in many portions of its range if no managing strategies are determined and implemented (Penskar, 1997; NatureServe 2001).

National rank (US): N3 (Vulnerable in the nation either because rare and uncommon, or found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extirpation. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals (assigned 17 December 1994; NatureServe 2001).

US & Canada State/Province heritage status ranks: S1 (Critically imperiled) in Illinois, Indiana, and Iowa; S3 (Vulnerable) in Michigan, Minnesota, Wisconsin and Ontario (NatureServe 2001).

National rank (Canada): N3 (Vulnerable in the nation either because rare and uncommon, or found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extirpation. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals (assigned 8 November 1996; NatureServe 2001).

Ontario rank: S3 (Vulnerable in the province either because rare and uncommon, or found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extirpation. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals (assigned 18 October 1994; NHIC 2001).

OMNR Designation: None

Ontario general status: Sensitive (assigned 19 April 2000, NHIC 2001)

TECHNICAL SUMMARY

Cirsium hillii
Hill's thistle

Chardon de Hill

Range of Occurrence in Canada: Ontario

Extent and Area Information	
<ul style="list-style-type: none"> • Extent of occurrence (EO)(km²) (Based on GIS calculation of a polygon in which all points at outer limits of range are included) 	3,000 km ²
<ul style="list-style-type: none"> • Specify trend in EO 	Stable currently with decline historically
<ul style="list-style-type: none"> • Are there extreme fluctuations in EO? 	No
<ul style="list-style-type: none"> • Area of occupancy (AO) (km²) (Estimated as noted in text of report) 	30 km ²
<ul style="list-style-type: none"> • Specify trend in AO 	Decline
<ul style="list-style-type: none"> • Are there extreme fluctuations in AO? 	No
<ul style="list-style-type: none"> • Number of known or inferred current locations 	64
<ul style="list-style-type: none"> • Specify trend in # 	Decline from 70 to 64 (mainly historical losses)
<ul style="list-style-type: none"> • Are there extreme fluctuations in number of locations? 	No
<ul style="list-style-type: none"> • Specify trend in area, extent or quality of habitat 	Declining
Population Information	
<ul style="list-style-type: none"> • Generation time (average age of parents in the population) 	3 years
<ul style="list-style-type: none"> • Number of mature individuals 	About 500 flowering plants estimated
<ul style="list-style-type: none"> • Total population trend: 	Unknown
<ul style="list-style-type: none"> • % decline over the last/next 10 years or 3 generations. 	Unknown
<ul style="list-style-type: none"> • Are there extreme fluctuations in number of mature individuals? 	No
<ul style="list-style-type: none"> • Is the total population severely fragmented? 	Likely not
<ul style="list-style-type: none"> • Specify trend in number of populations 	6 of the 70 populations known have been extirpated but mainly prior to the last several decades
<ul style="list-style-type: none"> • Are there extreme fluctuations in number of populations? 	No
List populations with number of mature individuals in	See Table 1
Threats (actual or imminent threats to populations or habitats)	
Main threats: Aggregate demand; Limited habitat (restricted to alvars, savannahs, and open woodlands); Successional change & lack of disturbance; Shoreline development; ATVs and trail bikes; Conversion to agriculture Minor or potential threats: Invasive Species (mainly of potential threat); Deer browse	
Rescue Effect (immigration from an outside source)	
<ul style="list-style-type: none"> • Status of outside population(s)? USA: Rare (S1 or S3) in all six US states where it occurs 	
<ul style="list-style-type: none"> • Is immigration known or possible? 	Possible
<ul style="list-style-type: none"> • Would immigrants be adapted to survive in Canada? 	Likely
<ul style="list-style-type: none"> • Is there sufficient habitat for immigrants in Canada? 	Probably
<ul style="list-style-type: none"> • Is rescue from outside populations likely? 	Possible but not likely
Quantitative Analysis	Not applicable
Current Status	COSEWIC: Threatened November 2004

Status and Reasons for Designation

<p>Status: Threatened</p>	<p>Alpha-numeric code: Met criterion for Endangered, C2a(i), but designated Threatened, C2a(i); D1, because the species is not at imminent risk of extirpation due to the occurrence of numerous sites, some in protected areas.</p>
<p>Reasons for Designation: This is a perennial herb restricted to the northern midwestern states and adjacent Great Lakes that is found in open habitats on shallow soils over limestone bedrock. In Ontario, it is found at 64 extant sites but in relatively low numbers of mature flowering plants that are estimated to consist of fewer than 500 individuals. Some populations are protected in national and provincial parks, however, the largest population is at risk from aggregate extraction. On-going risks are present from shoreline development, ATV use, and successional processes resulting from fire suppression within its habitat.</p>	
<p>Applicability of Criteria</p> <p>Criterion A (Declining Total Population): Not met (Insufficient data)</p> <p>Criterion B (Small Distribution, and Decline or Fluctuation): Not met (Too many sites and no fragmentation or extreme fluctuation in population size)</p> <p>Criterion C (Small total population size and decline): Meets Endangered C2ai with <2500 mature individuals and no population with >250 flowering plants but recommended as Threatened. Imminent extirpation is unlikely because of the occurrence of numerous sites, presence of about 1/3 of the populations in protected areas, few recent losses and not all sites have been completely surveyed. However, significant risks are present to the largest population containing mature plants and there is on-going degradation of habitat through successional changes and shoreline development.</p> <p>Criterion D (Very Small Population or Restricted Distribution): Meets Threatened D1 with <1000 mature plants</p> <p>Criterion E (Quantitative Analysis): Not met (Insufficient data)</p>	

ACKNOWLEDGEMENTS AND AUTHORITIES CONTACTED

Meetings with three people were critical to bringing some clarity and substance to the known records for the COSEWIC report. The report writer wishes to sincerely thank Dr. John Morton, Judith Jones, and Joe Johnson, for taking the time to pore over topographical maps and share their intimate knowledge of the numerous stations of Hill's Thistle which they have personally surveyed over a combined 60 years of botanical explorations on the Bruce Peninsula and the Manitoulin Islands. In the writers' preparations for bringing in the greater precision to Morton and Venn's 'Manitoulin' records necessary for this report, Joan Venn's provision of the printouts for Hill's Thistle records from their database of the Floras of Manitoulin Island and adjacent islands and the Tobermory Islands was indispensable.

Special thanks are due the Saugeen First Nation Band for permission to access the Chief's Point First Nation Reserve in order to survey the historical population recorded there. In particular, the writer would like to thank Herman Roote and Kirk Roote of the Saugeen First Nation Land Management and Leasing Department for granting access permission to Al Winters and Joe Johnson, and for accompanying them in the field surveys of September 2003.

The writer would also like to express his thanks to Bob Gray of the Ministry of Natural Resources, Owen Sound; Mike Oldham and Kelly Ramster of the NHIC, Peterborough; and Marilyn Beecroft, Central Zone, Ontario Parks, for providing several reports pertinent to the study. Mike made available the NHIC file on the species, including several Rare Species Field Reporting Forms completed for the species, and Kelly also provided all of the pertinent Element Occurrence summaries. Wasyl Bakowsky provided two GPS coordinates from our visit to Burnt Island Alvar in 2002 and Paul Jurjans was most accommodating in converting any UTM's in NAD 83 to NAD 27. Susan Hallaiken, Aggregates Clerk for the Ministry of Natural Resources in Sudbury, kindly provided information on the quarry licence for Great La Cloche and Little La Cloche Islands. The writer also thanks Dr. Erich Haber for his management of the contract for this report, for his excellent editorial suggestions on the text, for his incorporation of changes requested by reviewers, and for his improvements made to the quality of the maps and photographs.

Ilo-Katryn Maimets, York University Library, was extremely helpful in accessing the York University and University of Toronto databases to search for papers on Hill's Thistle and in suggesting 'good sites' in general to search. The loan of topographical maps for parts of Manitoulin and associated islands by Will Kershaw and Krista Carre of the Sudbury Office of Ontario Parks is greatly appreciated. The help of Nancy Sather, Minnesota Conservation Data Centre, and Kim Mitchell, U.S. Fish & Wildlife Service, Division of Endangered Species, Minnesota, in obtaining a copy of the Hill's Thistle status report for that state is much appreciated. And once again, Dr. Tony Reznicek was most helpful in answering the authors questions pertaining to some of the stations.

Finally, the writer would like to thank his daughter, Sydney Allen, who for the third straight year acted as his field assistant for COSEWIC fieldwork. In 2002, she bravely agreed to go "on the road" with me for two weeks in August, the first week of which was spent hunting down Hill's Thistle. Sydney's search image for the species, and her ability to discern reproducing plants from basal rosettes, and to call them out, was very helpful. Judith Jones is thanked for her generosity in offering a campsite on her front lawn and the use of her kitchen to Sydney and me during fieldwork on Manitoulin Island, as is Mrs. Florence Balderston, for offering lodging at her home in Wiarton during fieldwork on the Bruce.

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- Dr. A.A. Reznicek. 2002-2003. Professor and Curator of the Herbarium. University of Michigan, Ann Arbor, Michigan 48109 .

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BIOGRAPHICAL SUMMARY OF REPORT WRITER

Gary Allen received an Honours B.E.S. in 1979 and an M.A. in Regional Planning and Resource Development in 1984, both from the University of Waterloo. From 1981 to 1984, he worked as an Interpretive Naturalist at Point Pelee National Park, and from

1984 to the present he has worked for the Ministry of Natural Resources, always in the Natural Heritage Program, with postings in Toronto, Chatham, Richmond Hill, Simcoe, and currently, Midhurst. His responsibilities as Natural Areas Ecologist in Midhurst District are primarily Areas of Natural and Scientific Interest (ANSIs), Species at Risk, and Wetlands, and he is a member of the Provincial Wetlands Committee (WETT), the Lake Huron Coastal Dune Grasslands Recovery Team, and the Eastern Fox Snake & Eastern Hognose Snake Recovery Team. He has prepared COSEWIC status reports on *Liatris spicata* (1988), *Liparis liliifolia* (1986), *Aristida basiramea* (2003), and an update on *Liatris spicata* (2000).

COLLECTIONS EXAMINED AND FIELDWORK CONDUCTED

No herbarium collections were examined for this status report, since label data had been compiled previously as part of the Rare Vascular Plants Atlas of Ontario Project, and by others for different projects. Distributional, and other information, was accessed using the hard copy file for *Cirsium hillii* at the Natural Heritage Information Centre in Peterborough. This included Rare Species Field Reporting Forms prepared in 2001 by J. Jones from 2000 fieldwork, and a printout of M.J. Oldham's records of *C. hillii* from Ontario.

Fieldwork to verify localities for the status report was conducted by the author from August 5 to August 8 2002 on Manitoulin Island and the Bruce Peninsula at Sites: 34, 32, 33, 44, 46, and 55. Brief visits were made to Sites 9 and 12 in June of 2002, with incidental observations of *Cirsium hillii*.

As well, unsuccessful searches were carried out for this report in suitable habitat by the author on the following sites (UTMs are NAD 27):

Great La Cloche Island - 6 August 2002 at UTM 0438620 5094052 in a degraded alvar dominated by *Danthonia spicata* and *Schizachyrium scoparium*, but with *Ambrosia artemisiifolia* throughout.

Little La Cloche Island – 6 August 2002 at UTMs 0440925 5093106 and a good quality shoreline alvar at 0440907 5093711.

Carter Bay, Manitoulin Island – 7 August 2002 at several stops along the access road to the shoreline dunes.

Northwest of South Baymouth – 7 August 2002 with several forays off Hwy #6 to locate the *C. hillii* populations.

NOTE: Surveys conducted on contract for the Ontario Ministry of Natural Resources in September 2003 (following the completion of this report) identified 4 new sites and documented additional data for three other known sites; all new data have been added to this report (E. Haber, Feb 2004).