Species at Risk Act Recovery Strategy Series

Recovery Strategy for the Hill's Thistle (Cirsium hillii) in Canada

Hill's Thistle







Parcs Canada



About the Species at Risk Act Recovery Strategy Series

What is the Species at Risk Act (SARA)?

SARA is the Act developed by the federal government as a key contribution to the common national effort to protect and conserve species at risk in Canada. SARA came into force in 2003, and one of its purposes is *"to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity."*

What is recovery?

In the context of species at risk conservation, **recovery** is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed and threats are removed or reduced to improve the likelihood of the species' persistence in the wild. A species will be considered **recovered** when its long-term persistence in the wild has been secured.

What is a recovery strategy?

A recovery strategy is a planning document that identifies what needs to be done to arrest or reverse the decline of a species. It sets goals and objectives and identifies the main areas of activities to be undertaken. Detailed planning is done at the action plan stage.

Recovery strategy development is a commitment of all provinces and territories and of three federal agencies — Environment Canada, Parks Canada Agency, and Fisheries and Oceans Canada — under the Accord for the Protection of Species at Risk. Sections 37–46 of SARA (<u>http://www.sararegistry.gc.ca/approach/act/default_e.cfm</u>) outline both the required content and the process for developing recovery strategies published in this series.

Depending on the status of the species and when it was assessed, a recovery strategy has to be developed within one to two years after the species is added to the List of Wildlife Species at Risk. Three to four years is allowed for those species that were automatically listed when SARA came into force.

What's next?

In most cases, one or more action plans will be developed to define and guide implementation of the recovery strategy. Nevertheless, directions set in the recovery strategy are sufficient to begin involving communities, land users, and conservationists in recovery implementation. Cost-effective measures to prevent the reduction or loss of the species should not be postponed for lack of full scientific certainty.

The series

This series presents the recovery strategies prepared or adopted by the federal government under SARA. New documents will be added regularly as species get listed and as strategies are updated.

To learn more

To learn more about the *Species at Risk Act* and recovery initiatives, please consult the SAR Public Registry (<u>http://www.sararegistry.gc.ca/</u>).

Recovery Strategy for Hill's Thistle (Cirsium hillii) in Canada

2011

Recommended citation:

Parks Canada Agency. 2011. Recovery Strategy for Hill's Thistle (*Cirsium hillii*) in Canada. *Species at Risk Act* Recovery Strategy Series. Parks Canada Agency. Ottawa. vii + 84 pp.

Additional copies:

Additional copies can be downloaded from the SAR Public Registry (http://www.sararegistry.gc.ca/).

Cover illustration: Hill's Thistle at Lyal Island, by Jarmo Jalava

Également disponible en français sous le titre « Programme de rétablissement du chardon de Hill (*Cirsium hillii*) au Canada »

© Her Majesty the Queen in Right of Canada, represented by the Minister of the Environment, 2008. All rights reserved.

ISBN: 978-1-100-17325-2 Catalogue no: En3-4/87-2011E-PDF

Content (excluding the illustrations) may be used without permission, with appropriate credit to the source.

RECOMMENDATION AND APPROVAL STATEMENT

The Parks Canada Agency led the development of this federal recovery strategy, working together with the other competent minister(s) for this species under the Species at Risk Act. The Chief Executive Officer, upon recommendation of the relevant Park Superintendent(s) and Field Unit Superintendent(s), hereby approves this document indicating that Species at Risk Act requirements related to recovery strategy development (sections 37-42) have been fulfilled in accordance with the Act..

Recommended by:

Frank Burrows Superintendent, Bruce Peninsula National Park and Fathom Five National Marine Park, Parks Canada Agency

Approved by:

Clay

Kim St. Claire Field Unit Superintendent, Georgian Bay, Parks Canada Agency

Approved by:

Chief Executive Officer, Parks Canada Agency

All competent ministers have approved posting of this recovery strategy on the Species at Risk Public Registry.

DECLARATION

Under the Accord for the Protection of Species at Risk (1996), the federal, provincial, and territorial governments agreed to work together on legislation, programs, and policies to protect wildlife species at risk throughout Canada. The Species at Risk Act (S.C. 2002, c.29) (SARA) requires that federal competent ministers prepare recovery strategies for listed Extirpated, Endangered and Threatened species.

The Minister of the Environment presents this document as the recovery strategy for the Hill's Thistle as required under SARA. It has been prepared in cooperation with the jurisdictions responsible for the species, as described in the Preface. The Minister invites other jurisdictions and organizations that may be involved in recovering the species to use this recovery strategy as advice to guide their actions.

The goals, objectives and recovery approaches identified in the strategy are based on the best existing knowledge and are subject to modifications resulting from new findings and revised objectives.

This recovery strategy will be the basis for one or more action plans that will provide further details regarding measures to be taken to support protection and recovery of the species. Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the actions identified in this strategy. In the spirit of the Accord for the Protection of Species at Risk, all Canadians are invited to join in supporting and implementing this strategy for the benefit of the species and of Canadian society as a whole. The Minister of the Environment will report on progress within five years.

ACKNOWLEDGMENTS

Parks Canada Agency led the development of the recovery strategy. The strategy was prepared by J.A. Jones for the Bruce Peninsula and Manitoulin Island Alvar¹ Recovery Team. Thank you to all the members of the Recovery Team for their participation in this report, with a special acknowledgement to Jarmo Jalava (Consulting Ecologist, Paisley, Ontario) for providing Bruce Peninsula data and for extensive help with the document. Consultation with First Nations on the draft recovery strategy was led by Kim Borg and Aimee Johnson (Parks Canada), and the input from Walpole Island FN is greatly appreciated. Clint Jacobs and Jared Macbeth of Walpole Island First Nation were most helpful in providing comments on the draft recovery strategy, and also provided the textual references on Traditional Ecological Knowledge. Brian Hutchinson and Hilary Gignac are thanked as past co-chairs of the Recovery Team from 2001 to 2005, as is Kirsten Querbach for chairing from 2005 to 2009. Thanks are also due to those who participated in the crafting of the critical habitat maps for the Bruce Peninsula, Wasaga Beach Provincial Park, and Manitoulin Region during two workshops in October 2009 and April 2010: Mark

¹ "Alvar" is a Swedish word, originally used for the grasslands on the islands of Öland and Göteland in the Baltic Sea. In the Great Lakes basin, "alvar" refers to naturally open areas with shallow soils over relatively flat, limestone bedrock, with trees absent or at least not forming a continuous canopy (Reschke *et al.* 1999, Brownell and Riley 2000). There are several different kinds of alvars (just as there are different kinds of forests), and each type has a distinctive group of species present.

Carabetta (Ontario Nature), John Gerrath (Nature Conservancy of Canada), Bob Barnett (Escarpment Biosphere Conservancy), Anthony Chegahno (Chippewas of Nawash (Neyaashiinigmiig) First Nation), Will Kershaw (Ontario Parks), Eric Cobb (Ontario Ministry of Natural Resources), Jarmo Jalava, and Judith Jones. Mapping of the critical habitat at Wasaga Beach was only possible because of the kind provision of data by Keith Johnston and Marilyn Beecroft (Ontario Parks) and Burke Korol and Paul Jurjans (Ontario Ministry of Natural Resources). Access to the Natural Heritage Information Centre (NHIC) data, also for the purposes of the critical habitat mapping, was facilitated by Mike Oldham, Simon Dodsworth, and Martina Furrer.

STRATEGIC ENVIRONMENTAL ASSESSMENT STATEMENT

A strategic environmental assessment (SEA) is conducted on all Species at Risk Act recovery strategies, in accordance with the Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals (2004). The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond their intended benefits. Environmental effects, including impacts to non-target species and the environment, were considered during recovery planning, and the results of this evaluation are discussed further in Appendix A: Effects on Other Species and the Environment.

The implementation of this recovery strategy is not expected to have any negative effects on the environment or on non-target species, and in fact is expected to benefit many other species found in the same habitat. However, researchers carrying out field studies, and those conducting monitoring in alvar habitat, need to be cautioned on the potential problem of trampling from their foot traffic, and instructed how to prevent creating such impacts. Whether controlled burning is required to maintain and improve habitat is an important knowledge gap. If burning is found to be a necessary tool for recovery, then an additional SEA would need to be done on this action. This is addressed in Section 1.6 Knowledge Gaps.

PREFACE

This Recovery Strategy addresses the recovery of Hill's Thistle. In Canada, this species is found only in Ontario: on Manitoulin Island and surrounding islands, on the Bruce Peninsula, and at Wasaga Beach Provincial Park (Simcoe County).

The Parks Canada Agency, the Ontario Ministry of Natural Resources, and the Canadian Wildlife Service – Ontario Region, worked in cooperation to develop this recovery strategy, with the members of the Bruce Peninsula and Manitoulin Island Alvar Recovery Team, and in cooperation and consultation with stakeholders, and private landowners. All responsible jurisdictions reviewed and supported posting of the strategy. The proposed recovery strategy

meets SARA requirements in terms of content and process (Sections 39-41) and fulfills commitments of all jurisdictions for recovery planning under the Accord for the Protection of Species at Risk in Canada.

RESIDENCE

SARA defines residence as: a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating [Subs. 2(1)]. The concept of residence under the Species at Risk Act (SARA) does not apply to this species. Residence descriptions, or the rationale for why the residence concept does not apply to a given species, are posted on the SARA registry: <u>http://www.sararegistry.gc.ca/plans/residence_e.cfm</u>.

RECOVERY FEASIBILITY SUMMARY

Recovery of Hill's Thistle in Canada is considered feasible based on the criteria outlined by the Government of Canada (2009).

1) Individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance. There are several natural, large, actively reproducing populations of Hill's Thistle in locations with large areas of suitable habitat. This suggests that individuals are capable of reproducing at a rate sufficient to maintain and improve population sizes.

2) Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.

One of the main threats to Hill's Thistle is filling in of habitat, likely due to fire suppression. However, the most recent burning (at least for habitat in the Bruce Peninsula and Manitoulin Island regions) took place 100 or more years ago, so encroachment is a very slow process. In addition, although habitat patch sizes are shrinking, there are still a large number of sites. Therefore, there is enough habitat which can be restored or improved, and enough time to plan and implement management and restoration actions.

Reinstating intense, catastrophic wildfire into the human landscape in order to recover Hill's Thistle habitat would be a very difficult thing to do; however, other methods of maintaining existing habitat (e.g. low-level burning, cutting and clearing) may prove effective. This option still needs to be researched.

3) The primary threats to the species or its habitat (including threats outside Canada) can be avoided or mitigated.

Many threats can be avoided or mitigated through communications actions to increase awareness about the species, liaising with other groups and agencies, erecting signage, working with management of protected areas, and many other steps.

4) Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.

The Nature Conservancy's International Alvar Initiative (IACI) (Reschke *et al.* 1999) initiated recovery of alvar ecosystems and associated rare species using several of the steps that are now suggested here for Hill's Thistle, and experiences from the IACL show these techniques can be very effective.

EXECUTIVE SUMMARY

Hill's Thistle (*Cirsium hillii*) is listed as Threatened under Schedule 1 of the federal Species at Risk Act (SARA). In Ontario, it is listed as Threatened on the Species at Risk in Ontario (SARO) List under the Endangered Species Act, 2007 (ESA). The global rank of Hill's Thistle is vulnerable, and is completely restricted to the Great Lakes Region. The Canadian range of Hill's Thistle may account for as much as 50% or more of the global population.

Hill's Thistle is a perennial with a deep tap root or a cluster of roots with tuberous swellings. The leaf margins and flower heads are spiny. The plants live as sterile rosettes for the first two to several years, until they produce an upright stem with a single, large flower head. After flowering and setting seed, the plants die. In Canada, Hill's Thistle is only found in the Manitoulin Region, on the Bruce Peninsula, and at Wasaga Beach Provincial Park (Simcoe County). There are 93 known sites and upwards of 13,000 individuals.

This species requires dry, open, grassy ground with little canopy cover. The required habitat can be found within several different vegetation types including prairies, sand barrens, oak and jack pine savannas, alvars, openings in woodlands, and behind dunes.

Some habitat for Hill's Thistle probably originates from fire, but there is little evidence to suggest that repeat burning after the initial fire at these sites has occurred. Hill's Thistle often occurs in areas of historic-era disturbance; however, in Canada today Hill's Thistle is never found in recently disturbed areas. In marginally suitable habitat, a trail may provide habitat where there is no other open ground, but in high quality habitat, anthropogenic disturbance may be detrimental and is not recommended as a management tool at this time. Threshold levels at which disturbance becomes harmful have not been determined.

Limited habitat is the primary threat to Hill's Thistle. The limitation may be due to filling in of habitat due to fire suppression or loss of habitat from development (building and road construction). Other threats include heavy machinery use for ornamental stone removal and logging, trampling by pedestrians or mountain bikes, and indiscriminate use of all-terrain vehicles.

Recovery is considered feasible for Hill's Thistle. The goal is to maintain, over the long-term, self-sustaining populations of Hill's Thistle in its current range in Canada, by meeting population and distribution objectives targeted to recover the species to Special Concern or lower. The population and distribution objectives for Hill's Thistle are: 1) No continuing decline in total number of mature individuals, and 2) Populations are maintained in the four core areas the species occupies.

Critical habitat has been identified and mapped for 90 polygons at 17 sites on the Bruce Peninsula, at Wasaga Beach, and in the Manitoulin Region, and will contribute significantly to the recovery objectives. Other recovery tools will be used to meet the objectives, and these will be achieved through implementation of a suite of broad strategies and approaches.

One or more action plans will be developed by December 2015.

TABLE OF CONTENTS

RECOMMENDATION AND APPROVAL STATEMENT	i		
DECLARATIONi	i		
ACKNOWLEDGMENTSi	i		
STRATEGIC ENVIRONMENTAL ASSESSMENT STATEMENTii	i		
PREFACEii	i		
RESIDENCEiv	/		
RECOVERY FEASIBILITY SUMMARY	/		
EXECUTIVE SUMMARYv	i		
1. BACKGROUND 1	l		
1.1 Species Assessment Information from COSEWIC			
1.2 Species Status Information			
1.3 Description of the Species and Its Needs			
1.3.1 Species Description			
1.3.2 Species Needs	2		
1.4 Threat Identification	5		
1.4.1 Description of Threats	5		
1.4.2 Limiting Factors	7		
1.5 Actions Already Completed or Underway	7		
1.6 Knowledge Gaps	3		
2. RECOVERY)		
2.1 Population and Distribution Context)		
2.2 Population and Distribution Objectives	ĺ		
2.3 Broad Strategies and Approaches to Recovery	2		
2.3.1 Protection and maintenance of existing populations	3		
2.3.2 Reduction of threats to habitat	Ś		
2.3.3 Promoting site stewardship	ź		
2.3.4 Using monitoring information to guide recovery activities	1		
2.6.1 Comp memoring memoriation to galaci receivery detivities	1		
2.4 1 Information Used to Identify Critical Habitat	1		
2.4.2 Critical Habitat Identification	5		
2.4.2 Ontion Habitat Identification	, 7		
2.4.6 Activities Energy to Destroy entical Habitat	ł		
2.5 Habitat Conservation	,)		
2.6 Measuring Progress	-		
2.7 Statement on Action Plans	2		
	י 1		
$3. \text{ REFERENCES} \qquad 22$	t 2		
4. RECOVERT TEAM MEMDERS	י ר		
AFFENDIX A. Ellevis on the Environment and Other Species	ן ו		
AFFENDIA D. LISUUI TIIIS ITTISTIE JILES			
APPENDIA C. Siles where mill's mislie is considered Extirpated	, ,		
APPENDIX D: Maps of Critical Habitat	5		

1.1 Species Assessment Information from COSEWIC

Date of Assessment: November, 2004

Common Name: Hill's Thistle

Scientific Name: Cirsium hillii (Canby) Fern.

COSEWIC 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.

Canadian Occurrence: Ontario

COSEWIC Status History: Designated Threatened in November 2004. Assessment based on a new status report.

1.2 Species Status Information

Hill's Thistle is listed as Threatened and is on Schedule 1 of the federal Species at Risk Act (SARA). In Ontario it is listed as Threatened on the Species at Risk in Ontario (SARO) List under the Endangered Species Act, 2007 (ESA). The global rank of Hill's Thistle is G3 or Vulnerable (NatureServe 2009). The species is federally listed as a Species of Concern in the United States. It is currently listed as S1 or Critically Imperiled in Illinois, Indiana, and Iowa, and S3 or Vulnerable in Ontario, Michigan, Wisconsin, and Minnesota (NatureServe 2009). The range of Hill's Thistle is completely restricted to the Great Lakes Region, and the Canadian range of Hill's Thistle may account for 50% or more of the global population. See Section 2.1 Population and Distribution Context.

1.3 Description of the Species and Its Needs

1.3.1 Species Description

Hill's Thistle (*Cirsium hillii* (Canby) Fern.) is a perennial thistle with a single deep, hollow tap root or a cluster of roots with tuberous swellings. Spines are present along the undulating leaf margins and at the tips of the scales (involucral bracts) under the flower head. Hill's Thistle plants live as sterile rosettes of leaves for several years (maximum five years) up until the final

year when they produce an upright stem (25-60 cm) with a single, large flower head (3.5-5 cm in height) (NatureServe 2010). Flowering occurs from mid-June to mid-September with the main peak in July. Mature flowers are a rich mauve colour. Hill's Thistle also reproduces vegetatively with buds along lateral roots (Higman and Penskar 1999). After flowering and setting seed, the plants and the primary tap root usually die, although new rosettes produced from adventitious buds may continue to grow. Unlike some weedy thistle species, Hill's Thistle does not spread by rhizomes.

Hill's Thistle can be distinguished from other thistles by the stem, which is sparsely hairy to wooly and lacking wings or spines. As well, the leaves of Hill's Thistle are only shallowly lobed to wavy-margined and have fewer spines than those of other thistle species. The spines that are present on both the leaves and flower heads of Hill's Thistle tend to be shorter and finer than those of other thistles (COSEWIC 2004; Higman and Penskar 1999).

In The Flora of North America (Kell 2006), *Cirsium hillii* is not considered a distinct species but is treated as *Cirsium pumilum* (Nuttall) Sprengel var. *hillii* (Canby) B. Boivin. According to NatureServe (2009), *Cirsium hillii* is apparently very similar in appearance to *C. pumilum*, but *C. hillii* differs in being a monocarpic perennial species (living a variable number of years as a rosette before flowering, setting seed, and dying) possessing shallowly-lobed stem leaves with short prickles, and a single hollow, tuberous root. *C. pumilum*, in contrast, is a biennial that possesses a solid tap root and deeply lobed stem leaves with numerous prickles.

1.3.2 Species Needs

Biology

Little information exists in the literature on the biology of Hill's Thistle other than what is already presented in the species description above. Additional background on Hill's Thistle compared to other thistles can be found in Moore and Frankton (1974).

Habitat and Associates

Hill's Thistle requires habitat that is dry and open with little canopy cover (Figure 1a). The species is typically found in patches of open ground growing with low grasses, especially Poverty Oat Grass (*Danthonia spicata*), reindeer lichens (*Cladina rangiferina* and *C. mitis*), and scattered shrubs (Figure 1b). It is not found in dense vegetation or in situations where it is overtopped or crowded by other plants (Jones 1995-2008; COSEWIC 2004; Jalava 2004-2008; Janke *et al.* 2006; White 2007a). The tree canopy, if present, is predominantly coniferous and very open in a savanna or woodland situation.

The open and grassy habitat required by Hill's Thistle can be part of several different vegetation types, including prairies, sand barrens, oak and jack pine savannas, some types of alvars, in open woodlands, and at the backs of dunes (both current and relict) (Voss 1996; Penskar 2001; NatureServe 2009). Hill's Thistle has been considered by many to be an alvar species (Catling 1995; Brownell and Riley 2000); however it can occur in other vegetation types, provided the correct conditions are present. Many different vegetation community types that support Hill's Thistle have been documented.

Typical associates are native graminoids such as Poverty Oat Grass, Little Bluestem (*Schizachyrium scoparium*), Ebony Sedge (*Carex eburnea*), and Richardson's Sedge (*Carex richardsonii*), as well as reindeer lichens, Common Juniper, Bearberry (*Arctostaphylos uva-ursi*), Creeping Juniper, and Dwarf Lake Iris (*Iris lacustris*) (COSEWIC 2004; Jalava 2004-2008; Jones 1995-2008).

Soils

Soils range from sandy near the Lake Huron shore to silty and slightly alkaline on alvars. Soils are often shallow or may consist of no more than a mound of sand on top of flat limestone or dolostone bedrock.

The Role of Fire

Fire is probably required to create or maintain the habitat of Hill's Thistle. Many vegetation types in which the species occurs are considered "fire-prone" or "fire-dependent" (COSEWIC 2004; Penskar 2001; Higman & Penskar 1999) since fire prevents the accumulation of shrubs and trees. However, it is probably more accurate to say these vegetation types were created by fire. Jones (2000) showed that nearly all oak savannas in one region of Manitoulin Island were deciduous forests prior to a historic fire and were created in a single event, but almost none had burned a second time. A large number of alvars on the Bruce Peninsula and Manitoulin Island were burned in the past, but most of the burn evidence appears to be very old with no recent burning (in the last 50-70 years). In addition, a great deal of Manitoulin Island was burned prior to the first land surveys in the 1870s, but there have been very few fires since then (Jones and Reschke 2005; Jones 2000; Reschke *et al.* 1999). Finally, suitable habitat still exists now, more than 100-150 years after most major fires occurred in the habitat, so fire may be needed only on long cycles of time, perhaps every 100-200 years or more.

There is little evidence that frequent, low-level fire maintained the habitat historically. However, given the need for fire suppression to protect human life and property, it is possible that low-level controlled burning may be required to maintain habitat in the absence of canopy-reducing fires. The results of a controlled burn at Wasaga Beach Provincial Park in 2004 are inconclusive as to whether there was a benefit to Hill's Thistle (White 2007a; Korol pers. comm. 2007). Insights may be gained through ongoing monitoring at this site. As well, Jones (unpublished field notes 2007) observed five locations on Manitoulin Island that had undergone burning in the last five to 30 years near to extant Hill's Thistle populations. None of these burns resulted in the creation of vegetation similar to that in which Hill's Thistle is currently found.

Disturbance

Hill's Thistle often occurs in areas of very old disturbance such as sites of old burning or historicera logging. Hill (1910) observed the species in 1910 south and west of Chicago "in railway enclosures fenced off from the surrounding prairie before the land has been touched by the plow." He also noted that the species was able to spread into pastures and fallow agricultural fields. Nonetheless, these areas were likely not as disturbed, nor as weedy, as they are today and they probably still contained a significant component of native flora. Today in Canada, Hill's Thistle is never found in heavily disturbed areas or in fallow agricultural fields (Jones pers. obs.; Jalava pers. obs.; habitat data on file in NHIC database, NHIC 2009).



Figure 1. A. Typical Hill's Thistle habitat with open grassy ground. B. Basal rosettes of Hill's Thistle (centre) with its typical associates of Poverty Oat Grass (throughout background) and Bearberry (small, round shiny leaves, at centre top and bottom right).

Whether or not Hill's Thistle requires disturbance may depend on the quality of the existing habitat. For habitat that is becoming densely vegetated, it has been suggested that light disturbances, such as lightly used trails, may help keep small patches of ground open, thus creating or maintaining habitat for Hill's Thistle (COSEWIC 2004). Indeed, there are several observations of Hill's Thistle growing along trails (TNC 1990 cited in COSEWIC 2004; Jones 1995; Jalava pers. comm. 2009). In some cases where the vegetation is closing in, the trail is the only open ground remaining.

On the other hand, in large areas of good quality, open, grassy habitat, even light anthropogenic disturbance (such as occasional ATV use on a designated trail) can cause considerable damage, by bringing in weeds, creating ruts, disrupting soil, thus causing a general degradation of habitat (Jones unpublished field notes 2007). Therefore, while light disturbance may be useful in marginal habitat, in good quality habitat it may be detrimental. Furthermore, such anthropogenic disturbance would be very difficult to control and is not recommended as a tool to maintain habitat. Threshold levels at which disturbance becomes harmful have not been determined. Further study of techniques and processes to keep habitat open is recommended (see Knowledge Gaps, Table 2).

1.4 Threat Identification

Loss of suitable habitat from filling in of habitat due to fire suppression or from development are the primary threats to Hill's Thistle. These and other threats are presented in Table 1.

Threat	Manitoulin & Lake Huron Islands	North Channel & Georgian Bay Islands	Bruce Peninsula	Wasaga Beach
Limited Habitat	Н	Н	Н	Н
Development	Н	L	Н	N/A
Heavy Machinery	М	Н	М	N/A
Trampling	L	L	М	М
All-terrain Vehicles	М	L	М	L

Table 1. Current threats affecting Hill's Thistle by core area. Intensity of threats is: high (H), medium (M), low (L), or nil (N/A).

1.4.1 Description of Threats

1) Limited Habitat

Lack of suitable habitat has been identified as the primary threat to Hill's Thistle (Jones 1995-2008; COSEWIC 2004). The species is very restricted in its requirements for natural, dry, open, grassy patches. Suitable habitat was formerly much more widespread after extensive historic fires on Manitoulin Island and the Bruce Peninsula (Jones and Reschke 2005). Now, after more than 100 years of human suppression of the natural fire regime, filling-in of the vegetation has resulted in small isolated habitat patches, unsuitably low light levels, and higher competition for ground space and nutrients. Lack of wild fire also allows leaf litter to build up on the ground, which results in poor seedling establishment (Higman and Penskar 1999). Although habitat may

close in at a very slow rate, much of the remaining extant habitat is now at the point of becoming unsuitable due to the density of vegetation and the habitat patch size (<1/2 ha).

2) Development: Building and Road Construction

Most Hill's Thistle occurrences are near the Lake Huron and Georgian Bay shoreline in areas which are prime real estate for development. Even away from the shorelines, for example in the centre of Manitoulin Island, open grassy areas are frequently chosen as places to build cottages, hunt camps, and other structures because the open ground does not need to be cleared. Building and road construction destroy both habitat and individual plants.

3) Heavy Machinery for Ornamental Stone Removal and Logging

Driving heavy machinery in Hill's Thistle habitat destroys individual plants and compacts or displaces shallow soils leaving huge ruts. It also introduces weed species, which may reduce or eliminate the native species. Heavy machinery is used to remove erratic glacial boulders (which have economic value to the landscaping industry) from the habitat. Machinery for logging operations in forests adjacent to alvars frequently ends up crossing open habitat or being parked there. In addition, log landing areas are frequently located in open habitats adjacent to forests.

4) Trampling by Pedestrians or Mountain Bikes

Several populations in protected areas are located on hiking trails and can threatened by trampling, which can destroy the plants, displace soil, and bring in weeds. However, there are many situations where Hill's Thistle grows on trails that are maintained in a suitable state by a low level of human usage. This is especially true when the trail provides the only remaining suitably open ground. Therefore, managing intensity of usage to achieve the correct balance is needed, and detecting the point where usage becomes impactful is a key issue.

5) All-Terrain Vehicles (ATVs)

As with trampling, ATV use is a threat to Hill's Thistle when it occurs in sufficient intensity to damage or destroy plants, displace soil, cause ruts, or introduce weed species that reduce native species presence. Moreover, unlike larger vehicles, ATVs are not limited to trails, so the damage is often much more widespread. All-terrain vehicle use has probably caused the extirpation of at least one Hill's Thistle population (COSEWIC 2004). However, there are situations where Hill's Thistle is found along the edges of ATV trails because the trail is the only remaining open ground in an encroaching forest (Jalava pers. com. 2009; and field data on file in NHIC database). Whether a low level of ATV use may maintain habitat or damage it may also depend on the location or vegetation type. Dunes and alvar grasslands are particularly vulnerable to damage, and therefore may not withstand even light ATV use. Again, monitoring the level of usage is essential. See the discussion on disturbance in Section 1.3.2 for further explanation.

Other Potential Threats

1) Aggregate Extraction

The Bruce Peninsula is a prime location for the quarrying of limestone, and alvar habitats where there is little cover of bedrock are preferred sites for this type of development. Hill's Thistle plants located during the environmental work for the approvals process must be protected, but development of new quarries can cause loss of habitat. In the Manitoulin Region, Hill's Thistle occurs within two already-licenced quarries (International Alvar Conservation Initiative field notes 1996; COSEWIC 2002), but the current status of these populations is unknown. Development of new aggregates sites in the Manitoulin Region now requires a natural environment technical study as the region has been designated under the provincial Aggregates Act. Thus, Hill's Thistle plants should now receive more protection in that region.

2) Browsing or Damage by White-tailed Deer

On Manitoulin Island, stems of Hill's Thistles with the flower heads eaten off have been observed (Jones 1996-2009 unpublished observations). For small populations of Hill's Thistle where only a few individuals may flower, sometimes after a period of many years, loss of flower heads to browsing may be a serious threat. Deer are abundant in the Manitoulin Region and damage to vegetation is frequently observed (Selinger pers. comm. 2010).

1.4.2 Limiting Factors

Low seed viability and low seed germination rates may be limiting factors for this species, and seedlings may be poor competitors for light and space (NatureServe 2010). However, the primary problems affecting Hill's Thistle are threats, not intrinsic limitations (Jones 2004-2009; Jalava 2004a, 2005, 2007, 2008a, b).

1.5 Actions Already Completed or Underway

In order to plan recovery of Hill's Thistle, it is important to see the work that has already been done to avoid duplication of efforts. Much work to protect alvars and increase awareness of their significance pre-dated this recovery strategy. Many of these actions have directly protected or otherwise benefited Hills Thistle populations. Some of the major accomplishments include:

The International Alvar Conservation Initiative (IACI)

This bi-national, range-wide study of alvars produced detailed, standardized field inventories of the majority of significant alvar sites in Ontario, Michigan, New York, and Ohio (Reschke *et al.* 1999). Fieldwork included botanical surveys, vegetation community inventory, classification and mapping, and specific studies on a number of ecological processes including fire history and natural succession (Schaefer 1996, Schaefer and Larson 1997, Jones 2000, Jones and Reschke 2005). Information on Hill's Thistle was collected at many major sites as part of this survey. As well, several major alvar sites that support Hill's Thistle (including Quarry Bay, Belanger Bay, and Burnt Island Harbour) were protected as a result of this project. Stewardship packages were distributed to alvar landowners to raise awareness of the uniqueness of the alvar ecosystem and its rare species (including Hill's Thistle) (Jalava 1998; Jones 1998).

The Ontario Alvar Theme Study

This ecological study of Ontario alvars ranked significant alvars on a regional basis (Brownell and Riley 2000). Presence of Hill's Thistle was one of the special features upon which the ranking was based.

This park has had a monitoring program for Hill's Thistle in place since 1996 (White 2007a, b) and conducted a controlled burn in its habitat in 2004 (Jackson 2004). The results of these efforts will be useful as background information for the design of range-wide monitoring and habitat management plans for Hill's Thistle.

Protected Areas

A number of alvars have been protected in the last 10 years as a result of conservation work for that ecosystem (Parks Canada Agency 2010). Many of these alvar sites support populations of Hill's Thistle. See Section 2.7 Habitat Conservation, for a list of the protected areas which support Hill's Thistle.

Protected Areas Management

At Bruce Peninsula National Park (BPNP), Misery Bay Provincial Nature Reserve, Queen Elizabeth-Queen Mother M'nidoo M'nissing Provincial Park, and private nature reserves such as the Quarry Bay Nature Reserve, management is focusing on maintaining ecological integrity of habitats, including many areas where Hill's Thistle is present.

1.6 Knowledge Gaps

Table 2 summarizes important knowledge gaps for Hill's Thistle in Ontario. Filling these gaps will provide information that can be used to reduce threats or to better manage habitat. As well, a better understanding of species biology may clarify which threats are serious impacts and which are not.

Need to know:	In order to show:	
How controlled burning affects Hill's Thistle	Whether fire can be used to maintain habitat	
The period in which habitat becomes unsuitable due	Whether periodic fire historically maintained habitat	
to natural succession, versus the long-term cycle by	and whether fire is important in naturally	
which new habitat is created	functioning habitat	
Threshold tolerance levels for disturbance	Levels at which some activities may or should	
	continue in critical habitat	
Whether cutting back tree canopy and clearing	Whether this method can maintain suitable habitat	
surrounding shrubs would improve habitat	in the absence of fire	
Whether the presence of weedy species affects	Whether the presence of exotic species contributes	
habitat suitability and accessibility for Hill's Thistle	le to a decline in Hill's Thistle	
Whether Hill's Thistle is self-fertile	Level of threat caused by geographic isolation	
Whether there is less flowering in small populations	Whether small population size is a threat;	
	Whether isolation of small populations creates	
	greater risk	
The amount of genetic diversity in regional meta-	Level of threat due to isolation of habitat patches in	
populations	a landscape that is closing in;	
	Level of threat from genetic isolation	
The length of time seeds are viable	The length of time populations can survive with no	
	flowering individuals;	
	Length of time populations can survive waiting for	
	creation of new habitat	

Table 2. Summary of knowledge gaps.

Need to know:	In order to show:
About seed dispersal mechanisms	How Hill's Thistle moves within and between
	habitat patches;
	What patch size is needed for survival and/or
	recovery;
Ecological role of Hill's Thistle seeds as a food	Whether seed predation limits reproductive capacity
source for animals and insects	

2. RECOVERY

2.1 Population and Distribution Context

NatureServe (2009) reports 141 sites globally, and COSEWIC (2004) listed 64 sites² in Canada (Figures 2 &3), but many more have been discovered since then, with a resulting total of 93 Canadian sites for Hill's Thistle now known (Jones 2004-2009; Jalava 2004a, 2005, 2007, 2008a, b; data on file in NHIC database).



Figure 2. Global Range of Hill's Thistle by Jurisdiction. Red areas: "Critically Imperiled"; Yellow areas: "Vulnerable" (NatureServe 2009).

² "Site" refers to the individuals of Hill's Thistle and the physical place where they are found. It is equivalent to an element occurrence (EO), which may include several groups of plants if all are within 1 km of each other. Population is a general term to discuss clusters of plants without specifically discussing the boundaries of the area.

The Canadian range is restricted to Ontario (Figure 3); populations are located in Simcoe County (1 site), Bruce County (29 sites) and the Manitoulin District (63 sites, of which 20 are on islands other than Manitoulin Island). A complete list of all Canadian Hill's Thistle sites is provided in Appendix B, and a list of sites where Hill's Thistle is considered extirpated is given in Appendix C.



Figure 3. Range of Hill's Thistle in Canada (Environment Canada 2009).

The total number of plants in Canada is estimated to be in excess of 13,000 individuals (Jones 2004-2009; Jalava 2004a, 2005, 2007, 2008a, b; data on file in NHIC database). Several exceptionally large populations and areas of habitat exist (Appendix B), and recently, three populations have been documented that contain >1,000 individuals: Wikwemikong First Nation and Taskerville on Manitoulin Island, and Saugeen First Nation, on the Bruce Peninsula. The size of the Wikwemikong and Saugeen populations were not known at the time of the 2004 COSEWIC report. In addition, four populations are documented as containing >500 individuals.

There are essentially no data showing trends in population size because no long-term monitoring has been done other than at Wasaga Beach Provincial Park. The population there has been stable since 2001; however, it has declined significantly over the entire monitoring period of 1996-2007 (Burke Korol pers. comm. 2007).

The Canadian population as a whole is probably decreasing due to habitat loss from succession (closing-in of forest openings and grasslands), as well as from anthropogenic threats. Loss of habitat is certainly observable. COSEWIC (2004) reports the total area of occupied habitat at 30 km² (Index of Area of Occupancy³ (IAO)) with a presumed decline to these levels over the past 100 years. Indeed, some populations are known to have become extirpated since the 1970s, but with many additional populations recently discovered, some of which are very large, the overall trend or rate of decline is not yet known.

The natural, open grassy areas in which Hill's Thistle is found such as prairies, oak savannas, and alvars, are all vegetation communities deemed to be in decline (ranked "Vulnerable" or less by NHIC 2008). The species can also be found in grassy forest openings, which may be remnants of former larger open habitats.

2.2 Population and Distribution Objectives

The goal of this recovery strategy is to maintain over the long-term, self-sustaining populations of Hill's Thistle in its current range in Canada. Specifically, recovery for Hill's Thistle in Canada is interpreted as a change in the species status from its current Threatened designation to Special Concern, or lower, as assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Based on the information presented above, the population and distribution objectives for Hill's Thistle until 2020 are:

- 1. No continuing decline in total number of mature individuals.
- 2. Populations are maintained in the four core areas the species occupies (Bruce Peninsula; Wasaga Beach, Manitoulin Island, and islands surrounding Manitoulin).

Rationale:

In the 2004 COSEWIC assessment, Hill's Thistle was designated as Threatened because of its "Small and Declining Number of Mature Individuals" and its "Very Small Population". In the first category, the species met the Endangered criteria of <2500 mature individuals, a continuing decline in numbers of mature individuals, and no population totaling >250 flowering plants. In the second category the species met the Threatened criteria of <1,000 mature plants. Hill's Thistle was designated Threatened rather than Endangered because imminent extirpation was unlikely given the occurrence of numerous sites, the presence of about one third of the populations in protected areas, few recent losses, and the fact that not all sites had been completely surveyed (COSEWIC 2004).

As noted in the Population and Distribution Context section, 29 additional populations have been discovered since the 2004 COSEWIC status report (a 45% increase), and the sizes of Hill's Thistle populations have been better documented. The total number of mature individuals was estimated in 2004 to be about 500 flowering plants. Recently, three populations have been documented that contain >1,000 individuals, and another four are >500 individuals. The total

³ Index of area of occupancy is an estimate of the number of 1X1 km grid squares occupied by extant populations (COSEWIC 2009).

2011

Canadian population is now estimated to contain more than 13,000 individuals. The proportion of the total number of plants that are mature in any single year remains largely unknown for the species in Canada, and may vary among populations. However, it is prudent to assume that the current number is close to the threshold of 1,000 mature plants.

Therefore, the expectation under the objectives stated above is that in future evaluations Hill's Thistle could remain in the "Very Small or Restricted Total Population", but would no longer be considered under the "Small and Declining Number of Mature Individuals". COSEWIC uses the term "continuing decline" to mean "a recent, current or projected future decline (which may be smooth, irregular or sporadic), that is liable to continue unless remedial measures are taken." Although it is expected that there will be some "naturally occurring" extirpation of very small populations (e.g. <10 individuals), mostly as a result of habitat becoming unsuitable through the filling in of vegetation, these isolated losses could well be offset over the long term by the growth and expansion of some of the larger populations, especially those in protected areas.

Another key criteria that Hill's Thistle must meet to no longer qualify as Threatened is that the Index of Area of Occupancy be $>20 \text{km}^2$. The IAO captured by the critical habitat as mapped in the recovery strategy is 56 km² (39% of the total 145 km²) and the Extent of Occurrence⁴ captured is 9,150 km² (48% of the approximated total of 18,990 km²). These factors contribute significantly to the recovery objectives.

Maintenance of Hill's Thistle in the four core areas will prevent major contraction of the species' distribution range and potentially preserve the species' genetic diversity and local adaptations.

2.3 Broad Strategies and Approaches to Recovery

Recovery of Hill's Thistle will largely be addressed through ecosystem-based actions for the recovery of alvars or other open habitats, as well as through actions specifically to benefit the species. Broad approaches will primarily be protection and maintenance of existing populations, reduction of threats to habitat, promoting site stewardship through outreach and public education, and using monitoring information and research to guide recovery actions.

Hill's Thistle is one of many species-at-risk (SAR) found in the Bruce Peninsula and Manitoulin Island region. It is crucial that recovery of Hill's Thistle be coordinated with recovery activities being undertaken for other SAR in the same region. This will be the best use of resources and personnel and will be very important in keeping the public engaged and preventing confusion among species. Recovery efforts for Hill's Thistle in the Bruce Peninsula and Manitoulin Island region will be done in coordination with the Pitcher's Thistle - Dune Grasslands Recovery Team, which is also working in the Manitoulin Island - Lake Huron region. There is some overlap in membership between the two teams, as well as in agency staff that are handling both recovery efforts.

⁴ Extent of occurrence is the area included in a polygon without concave angles that encompasses the geographic distribution of all known populations of a wildlife species (COSEWIC 2009).

Also, a great number of Hill's Thistle populations are found on First Nations lands. First Nation communities have maintained local ecosystems for generations through the use of community Traditional Ecological Knowledge. It is important to gather and share Traditional Ecological Knowledge Holders to others as a means for species and ecosystem protection and recovery. Traditional Ecological Knowledge and Science can, together, better inform assessment, monitoring, and recovery of the ecosystems that support specific species at risk.

2.3.1 Protection and maintenance of existing populations

Evaluation of site-appropriate conservation tools is a required approach because Hill's Thistle occurs in many different types of ownership and jurisdiction, so a variety of different protection measures are needed. Recovery in protected areas will be based on management actions such as controlling recreational use (or other threats) to prevent impacts to Hill's Thistle and its habitat, constructing barriers to control access, and establishing appropriate zoning for areas where the species is present. Outside protected areas, some examples of site-appropriate conservation tools may include tax incentive programs, conservation easements, funding for habitat protection such as fencing, etc. Acquisition by conservation partners of high priority sites, if they become available, may also be an approach. Encouraging and enforcing compliance is also a necessary approach, where other management measures fail to protect Hill's Thistle.

2.3.2 Reduction of threats to habitat

Threats reduction will largely be done through protection of existing populations and promoting good stewardship. The actual approaches used to address threats will depend on the threats present at individual sites. Some approaches may include working with land managers on site-appropriate activities such as posting signage and constructing barriers to reduce damage by pedestrians and vehicles, and working with municipalities to ensure Hill's Thistle and its habitat are considered during new development. Enforcement may also be required at some sites.

Addressing the threat of habitat loss from filling in of vegetation may be complex. An important approach is to determine whether controlled burning is a useful tool to reduce this threat. Hand removal of shrub material to open up ground is also a potential tool that needs testing.

2.3.3 Promoting site stewardship

Recovery on municipal lands will require coordinating and sharing habitat information with planning agencies, facilitating discussion of legal and policy approaches, and helping with site-appropriate management planning. Working with the aggregates industry on protection and restoration of alvars during and after extraction will also be an approach. On private and First Nations lands, actions will require working cooperatively with owners and communities on best management practices. The gathering and transfer of Traditional Ecological Knowledge from Knowledge Holders to others, will be encouraged.

Communications to engage the public in valuing and protecting Hill's Thistle and open habitat is vital. A key to encouraging good stewardship is helping landowners and managers understand what they have on their lands. As well, many populations are on municipal shorelines that have

a public right-of-way through them, so educating the public about conscientious use will also be an approach. For populations occurring on First Nations lands, communications and outreach will be needed to gain assistance from the community in protecting Hill's Thistle and its habitat. Cooperating with local partners, such as local stewardship councils, fish and game clubs, etc., to promote awareness and protection of publicly accessible habitat, will also be necessary.

2.3.4 Using monitoring information and research to guide recovery activities

Monitoring information will be essential to recovery because the information gathered will show where recovery efforts are needed most. Monitoring can show if urgent threats need to be addressed, or if protection measures are working. Examples might be tracking visitor foot traffic on trails with Hill's Thistle, or checking for deer browse to see if it is a problem. Monitoring abundance and population trends will also be used to track recovery. Research is one of the primary approaches to recovery of Hill's Thistle, and Section 1.6 Knowledge Gaps, addresses the current important research questions.

Timelines and benchmarks for these strategies are given in Section 2.6 Measuring Progress.

2.4 Critical Habitat

Critical habitat is defined in Section 2(1) of the Species at Risk Act (S.C. 2002, c. 29) as "the habitat that is necessary for the survival or recovery of a listed species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species". In a recovery strategy, critical habitat is identified to the extent possible, using the best available information. Ultimately, sufficient critical habitat will be identified to completely support the population and distribution objectives.

Critical habitat has been identified for Hill's Thistle and the amount of critical habitat identified in this recovery strategy contributes to a substantial portion of the targets outlined in objectives 1 and 2 (Section 2.2), but does not fully meet the objectives. In total, 90 critical habitat polygons are identified at 17 sites in the Manitoulin Region (38), the Bruce Peninsula (40), and Wasaga Beach Provincial Park (12). This mapped critical habitat captures an IAO of 56 km², and an Extent of Occurrence of 9,150 km². Per objective 2, critical habitat is also mapped in each of the four core areas the species occupies. Recent surveys funded by the Species at Risk Program have discovered many additional populations of Hill's Thistle. At this time, we do not have adequate information to determine which of those populations should be identified as critical habitat to achieve the objectives. A schedule of studies, which outlines the work required to complete the identification of critical habitat, is included below. In the meantime, implementation of the broad strategies and approaches, as outlined in Section 2.3, will aid in meeting the population and distribution objectives.

2.4.1 Information Used to Identify Critical Habitat

Critical habitat was identified from current data on habitat occupied by the species. Confirmed records on the Bruce Peninsula, at Wasaga Beach, and in provincial parks, crown lands⁵, and lands owned by environmental non-governmental organizations (ENGOs) in the Manitoulin Region were all used as the basis of the mapping.

Habitat for Hill's Thistle occurs as patches within several types of open non-forested vegetation, or as openings within successional forest (based on field work by many workers including Reschke *et al.* 1999; Brownell and Riley 2000; Jalava 2004-2008; Jones 2004-2008; North-South Environmental 2005; vegetation community data from the aforementioned workers is on file at NHIC). In Canada, critical habitat is found within the following vegetation community types, as per the Ecological Land Classification of Ontario (ELC) (Lee *et al.* 1998):

Bruce Peninsula and Manitoulin Island Region

ALO1-3	Dry-Fresh Little Bluestem Open Alvar Meadow
ALO1-4	Dry-Fresh Poverty Grass Open Alvar Meadow
ALS1-1	Common Juniper Shrub Alvar
ALS1-2	Creeping Juniper-Shrubby Cinquefoil Dwarf Shrub Alvar
ALS1-3	Scrub Conifer-Dwarf Lake Iris Shrub Alvar
ALT1-3	White Cedar-Jack Pine Treed Alvar
ALT1-4	Jack Pine-White Cedar-White Spruce Treed Alvar

Wasaga Beach

TPW1	Dry Black (Red) Oak-White Pine Tallgrass Woodland
TPO1-1	Dry Tallgrass Prairie-Open Sand Barren
FOC1-2	Dry-Fresh White Pine-Red Pine Coniferous Forest
FOM2-1	Dry-Fresh White Pine-Red Oak Mixed Forest
	Cultural Meadow/Dry Tallgrass Prairie

These community types often have a distinct boundary where they change from open (suitable) to forest, wetland, or cultural meadow (all unsuitable). Thus, the general areas in which critical habitat patches occur are fairly easy to distinguish in the field and relatively easy to map (methodology below). All known alvar sites on the Bruce Peninsula and at Wasaga Beach have recently been mapped in detail based on a compilation of more than 15 years of field data and observations of satellite imagery (North-South Environmental Inc. 2005; Jalava 2008a).

2.4.2 Critical Habitat Identification

Critical habitat for the Bruce Peninsula and Wasaga Beach Provincial Park was mapped by Parks Canada in October 2009, and for the Manitoulin Region by Parks Canada in cooperation with staff from Ontario Parks, Ontario Ministry of Natural Resources, Ontario Nature, and the Nature Conservancy Canada in April 2010, based on the following methodology:

⁵ Crown land is land that is held by the Province of Ontario. Acceptable uses of crown land vary depending on the area but may included recreation, hunting, foresty, mining, or other uses, and may require permits or licences in some cases.

Inventory gaps identified by the Recovery Team were surveyed in 2004-2009 to support the identification of critical habitat (Jalava 2004-2008; Jones 2004-2008). All occurrence data for Hill's Thistle for the Bruce Peninsula and Wasaga Beach Provincial Park, and for protected areas in the Manitoulin Region were gathered from all available sources (especially NHIC and BPNP data bases, as well as Wasaga Beach monitoring data). All records were scrutinized and updated in October 2009 and April 2010 by Parks Canada. Only records with coordinates taken on the ground with GPS or localities mapped very precisely in the field on aerial photography were used. Records without GPS coordinates, or not field mapped on air or satellite imagery, or records with only vague locations, were not used to identify critical habitat. In almost all cases newer georeferenced observations were available and supercede these records.

<u>For the Bruce Peninsula and Wasaga Beach:</u> All occurrence data for Hill's Thistle on the Bruce Peninsula (except those on First Nations lands) and at Wasaga Beach Provincial Park were plotted digitally on 2006 ortho photography with 30 cm resolution (South Western Ontario Orthorectification Project 2006). Suitable alvar community polygons as mapped by Jalava (2008a) were superimposed on this. Field data were available for most records to tell if the plants were spread throughout the vegetation community despite having only a single centroid UTM coordinate.

<u>For the Manitoulin Region:</u> All occurrence data from protected areas were superimposed on Quickbird imagery (6 satellite images at 60 cm resolution with a date range of June 2005 – August 2008). As well, field mapping from hard copies (IACI unpublished field notes 1995 and 1996 on file in NHIC database) was scanned and superimposed on satellite imagery to show field-mapped locations. Again, field data were available to tell if the plants represented a single point or were spread throughout.

For the entire Canadian range: The species occupies edges and openings where substrate and other factors are suitable, and fluctuations of some factors may cause population size to wax and wane. Therefore, some radial distance around the plants (to allow for dispersal and expansion of the population and to provide shelter and edge habitat) must be identified as critical habitat. A radial measure of 30 m around the plants was derived in the field by a core group of the Recovery Team as the distance required to prevent impact to extant populations and habitat. Using GIS software, a 30 m circle was plotted around all single point occurrences. In cases where 30 m circles overlapped, they were joined to form one polygon. In cases where 30 m circles where a centroid was provided for a population known to be >50 plants but the locations of individual plants in the habitat were not known, if the suitable habitat patch was larger than a 30 m radius circle, the entire area of suitable habitat was considered critical habitat.

Biophysical attributes of critical habitat for Hill's Thistle in Canada include the following:

- Dry, open ground with little or no immediate canopy cover;
- Trees if present are predominantly coniferous species in a savanna or very open woodland situation;

- Patches of low grasses or sedges, especially Poverty Oat Grass (*Danthonia spicata*) and Richardson's Sedge (*Carex richardsonii*), and reindeer lichens (*Cladina rangiferina* and *C. mitis*), or Bearberry with scattered shrubs;
- Habitat patches are often found on edges and in openings, especially the edges of alvars and in trails;
- Soils are generally shallow and range from sandy near Lake Huron to silty and slightly alkaline on alvars.

In total, 90 polygons of critical habitat, collectively covering 41 hectares at 17 sites, are identified here. Some sites have more than one polygon. The general locations of critical habitat polygons are depicted in Figures 3, 4 and 5 with detailed maps showing the extent of each critical habitat polygon provided in Appendix D. GIS shapefiles of all critical habitat polygons are maintained by the Federal Government.

2.4.3 Activities Likely to Destroy Critical Habitat

Examples of activities that are likely to result in the destruction of Hill's Thistle critical habitat are listed here with the habitat features or properties they are likely to destroy. These activities would be destructive in any part of critical habitat, because they may damage or destroy Hill's Thistle plants, damage or remove the substrate required for growth, introduce competition, or interrupt natural processes that maintain habitat.

Activities that destroy or remove native grassy vegetation:

- Building cottages, houses, and driveways over critical habitat patches
- Building roads across critical habitat
- Limestone/dolostone quarrying or extraction of surface materials such as boulders
- Clearing of ground
- Using critical habitat as landing areas or roads during the logging of adjacent forests

Activities that disturb the extremely shallow soil:

- Driving heavy machinery across critical habitat
- Off-trail ATV or mountain bike use

Activities that reduce native species presence by introducing exotic or potentially invasive species:

- Trucking-in fill dirt and gravel
- Off-trail ATV use as a vector for weeds
- · Seeding lawns or planting non-native species
- Planting trees of any kind
- Grazing of livestock
- · Feeding hay to livestock in critical habitat

Activities that trample and damage vegetation and soil:

- Off-trail use by hikers at a level that tramples or destroys vegetation
- Camping activities such as placing a tent, fire pit, or latrine on top of critical habitat patches

• Off-trail use of critical habitat for group events.

There are several instances where trail use is beneficial to Hill's Thistle because the light disturbance keeps the ground clear of other vegetation. Threshold levels at which trail usage could become harmful rather than beneficial have not been determined. Thus, it is intended here that in general the use of existing trails and roads within critical habitat may continue. The determination of the point at which trail usage may potentially become harmful and protective action needed is more appropriately handled by land managers on a site by site basis.

2.4.4 Schedule of Studies to Identify Critical Habitat

Future identification of critical habitat elsewhere in the range of Hill's Thistle will be undertaken as needed to ensure population and distribution objectives are met, or if the degree of risk affecting the species increases. Table 3 outlines and explains the work required to enable further critical habitat identification and mapping.

Description of Activity	Outcome/Rationale	Timeline
Update occurrence data & mapping for all	Complete and current	2013. Could complement
remaining sites to current CH standards.	occurrence data set & mapping	fieldwork for COSEWIC
	permits creation of accurate CH	Status Report Update due
	polygons for remaining Bruce	in 2014
	Peninsula & Manitoulin Region	
	populations.	
Identify CH parcels to meet the	The amount & distribution of	As required
population & distribution objectives.	critical habitat required to meet	
	recovery objectives is mapped.	

Table 3. Schedule of Studies



Figure 4. General Locations of Critical Habitat Polygons on the Bruce Peninsula.

Recovery Strategy for Hill's Thistle in Canada



Figure 5. General Locations of Critical Habitat Polygons in the Manitoulin Region



Figure 6. General Locations of Critical Habitat Polygons at Wasaga Beach

2.5 Habitat Conservation

Critical habitat is identified for a total of 17 Hill's Thistle sites found wholly or partly within protected areas⁶ (national park, provincial park, or property owned by ENGOs or other federal or provincial lands). There are 9 sites on the Bruce Peninsula, 7 sites in the Manitoulin Region, and 1 site at Wasaga Beach in Simcoe County. Some sites contain several critical habitat polygons. The total amount of Hill's Thistle critical habitat identified in the 90 polygons contained within protected areas is 41 hectares (18 ha for the Bruce Peninsula, 15 ha for the Manitoulin Region, and 8 ha for Wasaga Beach). The sites are listed below, with ownership, according to the four core areas.

Bruce Peninsula:

Brinkman's Corner (Public Works Canada) Bruce Peninsula National Park Clarke Property-Baptist Harbour (Ontario Heritage Foundation; Ontario Heritage Trust) Dorcas Bay Road (Crown Land) Johnston Harbour - Pine Tree Point ANSI (Crown Land) Johnston Harbour - Pine Tree Point Provincial Park (Bruce Peninsula National Park) Lyal Island (Ontario Nature) Rover Property (Nature Conservancy of Canada) Williams Property-Baptist Harbour (Escarpment Biosphere Conservancy)

Manitoulin Island:

Macs Bay Conservation Reserve Misery Bay Provincial Nature Reserve Quarry Bay Nature Reserve (Ontario Nature) Queen Elizabeth-Queen Mother M'nidoo M'nissing Provincial Park

Islands surrounding Manitoulin:

Greene Island (Crown Land) Cockburn Island, Wagosh Bay (Nature Conservancy Canada) Western Duck Island (Crown Land)

Wasaga Beach: Wasaga Beach Provincial Park

2.6 Measuring Progress

Evaluation of the progress toward achieving Hill's Thistle recovery will be reported five years following final posting of this recovery strategy on the Species at Risk Public Registry, and every five years following, as per SARA (s. 46). The success of Hill's Thistle recovery will be evaluated by comparing information from monitoring and inventory with the population and distribution objectives as per Table 4.

⁶ The term "Protected Areas" used in the critical maps has no relation to protection requirements under SARA.

Criterion	Links to Objective #	Evaluation Timeframe (years after final posting of recovery strategy)
Monitoring program implemented for all priority sites.	1, 2	3
Some forms of habitat protection begun to be put in place (protective park management, etc.).	1, 2	5
Threats assessment completed and an evaluation of how to address current threats.	1, 2	3
Threats to habitat begin to be addressed e.g. barriers to prevent ATV use or visitor trampling.	1, 2	2
A multi-species communications strategy developed for the Bruce Peninsula and Manitoulin Region, with information distributed to private landowners about stewardship practices.	1, 2	5 (CS) 5+ (outreach info.)
A dialogue begun with First Nations, municipalities, and corporate quarry owners, about stewardship possibilities.	1, 2	3
No continuing decline in total number of mature individuals	1	Measured over 10 years or 3 generations*
Populations are maintained in each of the 4 core areas	2	Measured over 10 years or 3 generations

Table 4. Performance measures for progress of Hill's Thistle recovery

* This time frame is adopted from the COSEWIC assessment criteria, to account for anomalies within a shorter time frame.

2.7 Statement on Action Plans

One or more action plans will be completed by December 2015.

3. **REFERENCES**

Brownell, V.R. and J.L. Riley. 2000. The Alvars of Ontario: Significant Natural Areas in the Ontario Great Lakes Region. Federation of Ontario Naturalists, Don Mills, Ontario. 269 pp.

Bruce Peninsula and Manitoulin Island Alvar Recovery Team. 2009. Identification of Hill's Thistle critical habitat: justification for boundaries of individual polygons. Unpublished document available from the chairman of the recovery team. Parks Canada, Ottawa. 8 pp and accompanying database and shape files.

Catling, P.M. 1995. The extent of confinement of vascular plants to alvars in Southern Ontario. Canadian Field Naturalist 109:172-181.

COSEWIC. 2004. COSEWIC status report on Hill's Thistle (*Cirsium hillii*). Committee on the Status of Endangered Wildlife in Canada. 40 pp. <u>http://www.cosewic.gc.ca</u>

COSEWIC. 2009. Wildlife Species Assessment. COSEWIC's Assessment Process and Criteria. Government of Canada.

COSEWIC. 2010. COSEWIC Wildlife Species Search – Hill's Thistle. Government of Canada.

Endangered Species Act. 2007. Ontario Ministry of Natural Resources. Online at <u>www.ontario.ca/speciesatrisk</u>

Environment Canada. 2005. Policy on the Feasibility of Recovery <u>in</u> RENEW Recovery Handbook (ROMAN), working draft. Recovery Secretariat, Canadian Wildlife Service, Environment Canada, Ottawa, Ontario.

Environment Canada. 2009. Hill's Thistle page. Accessed November 5, 2009 <u>http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=807</u>

Gaiser, L.D. 1966. A Survey of the Vascular Plants of Lambton County, Ontario. Compiled by Raymond J. Moore. Ottawa: Plant Research Institute, Research Branch, Canada Department of Agriculture. 122pp.

Higman, P.J. and M.R. Penskar. 1999. Special plant abstract for *Cirsium hillii* (Hill's Thistle). Michigan Natural Features Inventory, Lansing, MI. 2 pp. Online at http://web4.msue.msu.edu/mnfi/abstracts/botany/Cirsium_hillii.pdf

Hill, E.J. 1910. The pasture-thistles, east and west. Rhodora 12:211-214.

Hilty, J. 2008. Insect visitors of prairie wildflowers in Illinois. Online at <u>http://www.shout.net-~jhilty/</u>

International Alvar Conservation Initiative. 1996. Conserving Great Lakes Alvars. Final Technical Report of the International Alvar Conservation Initiative. The Nature Conservancy, Chicago, Illinois.

Jackson, J. 2004. Wasaga Beach Provincial Park. Prescribed burn report 2004. Ontario Parks, Ministry of Natural Resources. Unpaginated.

Jalava, J.V. 1998. Alvar stewardship packages. Ontario Natural Heritage Information Centre Newsletter 4(2):14.

Jalava, J.V. 2004. Biological Surveys of Bruce Peninsula Alvars. Prepared for NatureServe Canada, Ontario Natural Heritage Information Centre and Parks Canada. iii + 21 pp.

Jalava, J.V. 2005. Biological surveys of Bruce Peninsula Alvars, summary report. Unpublished report, Prepared for Bruce Peninsula National Park, Parks Canada. iii + 80 pp.

Jalava, J.V. 2007. Species at Risk Inventory: Hill's Thistle (*Cirsium hillii*). Prepared for Parks Canada Agency, Bruce Peninsula National Park / Fathom Five National Marine Park, Tobermory, Ontario. 15 pp.

Jalava, J.V. 2008a. Alvars of the Bruce Peninsula: A Consolidated Summary of Ecological Surveys. Prepared for Parks Canada, Bruce Peninsula National Park, Tobermory, Ontario. iv + 350 pp + appendices.

Jalava, J.V. 2008b. Summary of Updated Hill's Thistle (*Cirsium hillii*) Occurrence Data in Bruce County. Unpublished report to Bruce Peninsula National Park, Parks Canada, Tobermory. 2 pp.

Janke, K., C. Homuth and M. Lake. 2006. Hill's Thistle (*Cirsium hillii*) monitoring, Wasaga Beach Provincial Park, 2006. Ontario Parks, Ministry of Natural Resources. Unpaginated.

Jones, J. 1995. International Alvar Conservation Initiative field data form for Evansville Shrub Alvar, on file at the Natural Heritage Information Centre, Peterborough, Ontario.

Jones, J. 1995-2009. Field data forms (1995-1998 from the International Alvar Conservation Initiative) on file at the Natural Heritage Information Centre, Peterborough, Ontario.

Jones, J.A. 1998. Manitoulin's Flat Rock Country: a landowner's guide to a special habitat. Federation of Ontario Naturalists, Don Mills, Ontario. 17 pp.

Jones, J.A. 2000. Fire history of the bur oak savannas of Sheguiandah Township, Manitoulin Island. *Michigan Botanist* 39(1): 3-15.
Jones, J.A. 2004. Alvars of the North Channel Islands. Report to NatureServe Canada, Ottawa, Ontario.

Jones, J.A. 2005. More alvars of the North Channel Islands and the Manitoulin Region: Report prepared for Ontario Ministry of Natural Resources, Espanola Office.

Jones, J.A. 2006a. Report from field work on *Iris lacustris* and *Cirsium hillii* in the Manitoulin Region in 2006. Report prepared for Parks Canada, Species at Risk Section, Peterborough, Ontario.

Jones, J.A. 2007. Report from the 2007 Species-At-Risk surveys on the Wikwemikong Reserve. Unpublished report to the Wikwemikong Unceded Indian Reserve on file with the Wikwemikong Lands Office.

Jones, J.A. 2008. Report from field work on Hill's Thistle in Manitoulin and Algoma Regions in 2008. Unpublished report to Parks Canada, Ottawa. 6 pp.

Parks Canada Agency. 2010. Recovery Strategy for Lakeside Daisy (*Hymenoxys acaulis*) in Canada. *Species at Risk Act* Recovery Strategy Series. Parks Canada Agency, Ottawa. 71 pp.

Jones, J.A. and C. Reschke. 2005. The role of fire in Great Lakes alvar landscapes. *The Michigan Botanist* (44) 1: 13-27.

Kell, David J. 2006. *Cirsium*. In: Flora of North America North of Mexico. Vol. 19. Oxford University Press.

Lee, H.T., W.D. Bakowsky, J. Riley, J. Bowles, M. Puddister, P. Uhlig, and S. McMurray. 1998. Ecological Land Classification for Southern Ontario: First Approximation and Its Application. Ontario Ministry of Natural Resources, Southcentral Sciences Section, Science Development and Transfer Branch. SCSS Field Guide FG-02.

Ministry of Municipal Affairs & Housing. 2005. Provincial Policy Statement. Issued under Section 3 of the Planning Act. 37 pp.

Moore, R.J. and C. Frankton. 1974. The Thistles of Canada. Monograph No. 10, Canada Department of Agriculture, Research Branch, Ottawa. 111 pp.

Morton, J.K. and J.M. Venn. 2000. *The Flora of Manitoulin Island*, 3rd ed. University of Waterloo Biology Series Number 40. Waterloo, Ontario.

Natural Heritage Information Centre (NHIC). 2009. Element occurrence, natural areas, vegetation communities and species databases and species lists. Natural Heritage Information Centre, Ontario Ministry of Natural Resources, Peterborough, Ontario. Online electronic databases.

NatureServe. 2009. On line Explorer. http://www.natureserve.org Accessed November, 2009.

NatureServe. 2010. On line Explorer. http://www.natureserve.org Accessed June, 2010.

North-South Environmental Inc. 2005. Detailed life science inventory of Wasaga Beach Provincial Park. Prepared for Ontario Parks Central Zone, Ontario Ministry of Natural Resources, Huntsville, Ontario. 77 pp.

Penskar, M.R. 2001. Rangewide status assessment of Hill's Thistle (*Cirsium hillii* Canby) Fern.). U.S. Fish and Wildlife Service, Region 3. East Lansing Field Office, East Lansing, Michigan. 11 pp.

Reschke, C., R. Reid, J. Jones, T. Feeney and H. Potter. 1999. Conserving Great Lakes Alvars: Final Technical Report of the International Alvar Conservation Initiative. The Nature Conservancy, Chicago, Illinois. 230 pp.

Schaefer, C.A. 1995-1996. International Alvar Conservation Initiative field data forms on file at the Natural Heritage Information Centre, Peterborough, Ontario.

Schaefer, C.A. 1996. Comments on the role of fire in Bruce Peninsula alvars. Prepared for the Federation of Ontario Naturalists, Don Mills, Ontario. 6 pp.

Schaefer, C.A. and D.W. Larson. 1997. Vegetation, environmental characteristics and ideas on maintenance of alvars on the Bruce Peninsula, Canada. Journal of Vegetation Science 8:797-810.

South Western Ontario Orthorectification Project (SWOOP). 2006. Satellite imagery for Southern Ontario.

The Nature Conservancy. 1990. Element Stewardship Abstract for *Cirsium hillii* – Hill's Thistle. The Nature Conservancy Midwest Regional Office, Minneapolis, MN. 15 pp.

Voss, E.G. 1996. Michigan Flora: Vol. 3. Cranbrook Institute of Science, Ann Arbor, Michigan. 622 pp.

White, D. 2007a. Hill's Thistle (*Cirsium hillii*) at Wasaga Beach Provincial Park: a monitoring protocol. Unpublished report to Ontario Parks, Central Zone, Huntsville, Ontario. 18 pp.

White, D. 2007b. Hill's Thistle at Wasaga Beach Provincial Park: Implementation and monitoring protocol and field manual. Unpublished report to Ontario Parks, Central Zone, Huntsville, Ontario. 50 pp.

Woodliffe, P.A. and G.M. Allen. 1990. A Life Science Inventory and Ranking of 30 Natural Areas of Walpole Island Indian Reserve. In: Conserving Carolinian Canada,

Conservation Biology in the Deciduous Forest Region. G.M. Allen, P.F.J. Eagles and S.D. Price (Eds). World Wildlife Fund, Canada. University of Waterloo Press. 346 pp.

Personal Communication Sources:

Jarmo Jalava. Consulting Ecologist, Paisley, Ontario. <jjalava@yahoo.com>

Burke Korol. Ecologist, Ontario Parks, Central Zone, Huntsville, Ontario. burke.korol@ontario.ca

Wayne Selinger. 2010. District Biologist, Manitoulin District, Ontario Ministry of Natural Resources. <u>wayne.selinger@ontario.ca</u>

Joan Venn. Herbarium Curator, Dept. of Biology, University of Waterloo. jvenn@sciborg.uwaterloo.ca

4. RECOVERY TEAM MEMBERS

- Chair: Gary Allen, Species at Risk Specialist, Parks Canada
- Wasyl Bakowsky, Community Ecologist, Natural Heritage Information Centre, Peterborough
- Vivian Brownell, Consulting Biologist, Metcalfe
- Frank Burrows, Superintendent, Bruce Peninsula National Park, Tobermory
- Anthony Chegahno, Chippewas of Nawash First Nation
- Jarmo Jalava, Consulting Ecologist, Paisley
- Judith Jones, Consulting Biologist, Sheguiandah
- Dan Kraus, Conservation Science Manager, Ontario Region Nature Conservancy of Canada, Guelph
- April Mathes, Stewardship Coordinator Nature Reserves, Ontario Nature, Toronto
- Angela McConnell, Species at Risk Biologist, Canadian Wildlife Service, Downsview
- Ethan Meleg, Outreach Coordinator, Bruce Peninsula National Park, Tobermory
- Dr. J.K. Morton, Professor Emeritus, Dept. of Biology, University of Waterloo, Waterloo
- Roxanne St Martin, Species at Risk Biologist, Ontario Ministry of Natural Resources Southern Region, Peterborough

Recovery Team Advisors

- Dr. Paul M. Catling, Research Scientist and Curator, National Program on Environmental Health, Agriculture and Agri-food Canada, Ottawa
- Eric Cobb, Species at Risk Specialist, Ontario Ministry of Natural Resources, Sudbury
- John Grant, Nature Conservancy of Canada, Guelph
- Will Kershaw, Management Planner, Ontario Parks Northeast Zone, Sudbury

- Dr. Douglas Larson, Department of Botany, University of Guelph, Guelph
- Dr. Steve Marshall, Department of Environmental Biology, University of Guelph, Guelph
- Ed Morris, Parks Ecologist, Ontario Parks Northeast Zone, Sudbury
- Mike Oldham, Botantist/Herpetologist, Ontario Ministry of Natural Resources Natural Heritage Information Centre, Peterborough
- Scott Parker, Park Ecologist, Fathom Five National Marine Park, Tobermory
- Chris Risley, Species at Risk Regulation, Listing Biologist, Ontario Ministry of Natural Resources Ontario Parks, Peterborough

APPENDIX A: EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

Recovery efforts for Hill's Thistle are not expected to have adverse effects on other species; however, the use of controlled burns as a habitat improvement tool must be studied before any potential effects of this can be fully determined. As discussed in Section 1.3.2, burning may be needed to create suitable habitat but could also destroy Hill's Thistle (where it already exists) and possibly other species, particularly invertebrates. Whether burning is necessary is a knowledge gap.

Mechanical removal of shrubbery, if found to be useful, might have a local, adverse effect on common early successional species such as Common Juniper, Balsam Poplar (*Populus balsamifera*), Staghorn Sumac (*Rhus typhina*), or Green Ash (*Fraxinus pennsylvanica*) if these species were removed. However, the loss of individuals of these widespread, generalist species from a small area of habitat is not considered a long-term adverse effect.

On the other hand, maintenance of open grassland through mechanical or other methods is expected to have a beneficial effect on many other species that are restricted to open grassland habitat. While many of these species are not yet at risk, they are much less common than the shrubs mentioned above, and they face the same problem of habitat loss from succession that Hill's Thistle faces. Therefore, although there may be some local loss of individuals of common woody species, the overall benefit to more uncommon species requiring open habitats is considered to outweigh the loss.

In addition, the open grassland vegetation type is itself considered rare. Naturally open habitats with good quality native vegetation, such as alvars, prairies and sand barrens, are dwindling both due to lack of wild fire (or other ecological processes) and due to conversion of these places to human uses. The overall natural landscape of Southern Ontario is forested, and naturally open habitats are the exception to the norm. Thus, maintaining open grassland will benefit less common elements of Ontario's biodiversity.

All other recovery steps are likely to help other species as they mostly deal with protecting habitat and outreach to landowners.

APPENDIX B: LIST OF HILL'S THISTLE SITES

(includes ownership, most recent observation, estimated # of plants, & # of critical habitat polygons identified in this report). Details on recent observations are available in the databases of Bruce Peninsula National Park and the Natural Heritage Information Centre, Polygons are shown below in figures 7 to 53.

Site Name	Ownership	Most recent observation	Estimated # of Plants	# CH polygons
		N.1.1. 2007		10
Wasaga Beach	Provincial Park	White 2007	bl 8 in 28 plots	12
Total Simcoe County: 1 site	~700 individuals;	12 critica	al habitat polyge	ons
	BRUCE PENINS	JLA		
Baptist Harbour/Cape-Hurd ANSI	Private/NGO	Jalava & Chegahno 2008; Jalava 2003	~50	3
Barney Lake Alvar	Private	Schaefer 1996	60	
Black Creek Provincial Park	Provincial Park	Johnson 2003	43	
Bradley Harbour	Private/County Forest	Johnson & Goodban 2001	75	
Brinkman's Creek Uplands	National Park	Brinker 2006 Jalava 2004	8	1
Bruce Alvar Preserve	NGO	Wilson 2007	8	
Brinkman's Corners				
Corisande Bay	Municipal/	Jalava 2007	223	3
Trail N of Scugog Lake	National Park/	Wilson 2007		
Rover Property	Private			
Johnson's Harbour Rd	Private/Crown	Jalava 2007	~30	
Crane River Townline	managed by BPNP	Wilson 2007		
Dorcas Bay – Singing Sands	National Park	Jalava, Jones	556	3
Dorcas Bay Road North		& Allen 2009		
Eagle Road at Eagle Harbour	Municipal/	Jalava &	~97 in	4
William Henry Marsh	National Park	2008; Jalava 2007	several subpop- ulations	
Garden Island	Private	Jalava 2005	83	

Stokes Bay				
Hay Bay Road	Municipal/ claimed by F.N.	Jalava 2009	28	
Johnson Harbour – Pine Tree Point	Private/ Provincial Park	Jalava 2007 Brinker 2006	>50	6
Ladyslipper Bay	Private	Wilson 2007	No info	4
Unnamed Lake				
Pine Tree Point Trail				
Little Eagle Harbour	Private/	Brinker 2006	~60	4
	Municipal	Jalava 2005		
Lyal Island	NGO	Jalava 2006	183	1
Oliphant South	Private	Johnson 1985	19	No location data
Pendall Lake Alvar	National Park	Brinker 2006	6	1
Pike Bay Alvar	Private	Allen 2002	31	
Whiskey Harbour Road		Schaefer 1995		
Saugeen First Nation EO #1	First Nation	Jalava & Root 2008	196	
		Schaefer 1996		
Saugeen First Nation EO #2	First Nation	Jalava & Root 2008	2017	
Sauble Beach	Conservation Authority	Jalava 2008	20	
Walker's Woods	Autionity			
Scugog Lake Alvar	National Park	Jalava 2007	3	2
		Brinker 2006		
		Schaefer 1996		
Sideroad Creek Alvar	National Park	Jalava 2007		8
Dorcas Bay Road South and East		Brinker 2006		
Sucker Creek	Private/	Jalava 2006	62	
St. Jean's Point	Authority	Johnson 2003		

Zinkan Island Cove	Private/ Municipal	Jalava & Chegabro	~20	
Little Pine Tree Harbour	wunicipai	2008;		
Harkins Harbour		Jones 2008		
Total Bruce Peninsula: 29 sites	>4100 individuals	s; 40 critica	al habitat polyge	ons
ISLANDS SUR	ROUNDING MAN	NITOULIN ISLA	ND	
Amedroz Island	Crown /	Jones 2008	85	
	First Nation			
Cockburn Island	Private/ Municipal	Morton &	No info	
North of Hershell Island	Municipai	venn 1977		
Cockburn Island	Crown	Crins 2008	55	2
Wagosh Bay				
Darch Island	Crown /	Jones 2008	2	
	First Nation	Jones 2004		
Fitzwilliam Island	Municipal	Jones 2008	5	
Indian Harbour				
Fitzwilliam Island	Municipal	Jones 2008	2	
Phoebe Point				
Fitzwilliam Island	Municipal/	Morton &	No info	
Wild Bight	Private	Venn 1975		
Great Cloche Island	Corporate	Allen 2002	37	
Bell Rocks		Jones 1996		
Great Cloche Island	Corporate	Jones 1996	Info	
NW of Lewis Lake			missing	
Great Cloche Island	Corporate	Jones 1996	No info	
West end track				
Greene Island	Crown	Jones 2005	52	2
Innes Island	Crown/ First Nation	Jones 2004	39	
La Cloche Peninsula	First Nation	Morton &	No info	
Dreamer's Rock		venii 19/8		
Little La Cloche Island	Corporate	Allen 2002	157	

Vidal Island	Crown/	Jones 2005	12	
	First Nation			
West Rous Island	Crown/	Jones 2004	36	
	First Nation			
Western Duck Island	Crown	Jones 2009	10	2
Wikwemikong	Crown/	Jones and	408	
Island #1	First Nation	ikong Crew 2008		
Wikwemikong	Crown/	Jones and	455	
Island #2	First Nation	ikong Crew 2008		
Total Islands: 20 sites >13	80 individuals	6 critic	al habitat polyg	gons
Λ	IANITOULIN ISL	AND		
Belanger Bay	Provincial Park	Jones & Hall 2009	96	8
Big Bay, east side	Municipal	Jones 2008	~62	
Birch Point	Private	Jones 2006	5	
Burnt Island Harbour	Provincial Park	Jones 2007	30	5
Carroll Wood Bay	Private	Jones 2004	92	
Christina Bay/	Provincial Park Crown	Jones 2009	24	2
Burnt Island Road	Faik, Clowii	Allen 2002		
Evansville Shrub Alvar	Private	Jones 1996	70	
North of Fisher Bay	Private	Jones 2005	88	
Leask Point	Private	Jones 2000	13	
West of Lynn Point	Corporate	Jones & Hall 1995	57	
Mac's Bay Alvar	Private/ Crown	Jones 2000	121	2
Marsh Lake Alvar	Private	Jones 2003	10	
Michael's Bay	Private	Jones 2006	35	
Hammond Point		Oldham 1994		
Michael's Bay	Private	Jones 2009	38	
E of Manitou River		Jones 2008		

Blue Jay Creek mouth				
Michael's Peninsula	Municipal	Jones 2008	642	
Misery Bay East	Provincial Park	Jones 2000	504	7
Misery Bay West	Provincial	Jones 2000	>100	1
	Park/		(40 in park)	
	Private			
Murphy Point	Private	Jones 2008	No info	
Portage Bay west side	Private	Jones 2005	11	
Portage Lake Dunes	Private	Ringius 1976	No info	
Providence Bay	Private	Morton & Venn 1982	No info	
Quarry Bay	Provincial Park/ NGO	Jones 2000	107	6
Sand Bay	Private	Allen 2002	12	
NW of Shrigley Bay	Private	Jones 2005	68	
SW of Silver Lake	Provincial Park	Jones 2005	114	1
NW of South Baymouth	Private	Morton 1997	No info	
West of South Baymouth Alvar	Private	Jones 2008	76	
Table Rock Flatlands	Private	Jones 2003	61	
		Noble 1995		
Taskerville	Private	Jones 2009	>1000	
		Jones 1996		
Wikwemikong EO #1	First Nation	Jones &	175	
		2007		
Wikwemikong EO #2	First Nation	Jones &	308	
		Wiky Crew 2007		
Wikwemikong EO #3	First Nation	Jones &	169	
		Wiky Crew 2007		
Wikwemikong EO #4	First Nation	Jones & Wiky Crew	261	
		2007		
Wikwemikong EO #5	First Nation	Jones & Wiky Crew	20?	

		2007	
Wikwemikong EO #6	First Nation	Jones & Wiky Crew 2007	78
Wikwemikong EO #7	First Nation	Jones & Wiky Crew 2007	31
Wikwemikong EO #8	First Nation	Jones & Wiky Crew 2007	147
Wikwemikong EO #9	First Nation	Jones & Wiky Crew 2007	>2000
Wikwemikong EO #10	First Nation	Jones & Wiky Crew 2007	1
Wikwemikong EO #11	First Nation	Jones & Wiky Crew 2007	20
Wikwemikong EO #12	First Nation	Jones & Wiky Crew 2007	69
Wikwemikong EO #13	First Nation	Jones & Wiky Crew 2007	41
Wikwemikong EO #14	First Nation	Jones & Wiky Crew 2007	7
Total Manitoulin Island:43 sites>6800 individuals32 critical habitat polygons			
TOTAL CANADIAN RANGE: 93 sites>13,000 individuals90 critical habitat polygons			

APPENDIX C: SITES WHERE HILL'S THISTLE IS CONSIDERED EXTIRPATED

Jones (2006) revisited several sites on Manitoulin Island that had historic records for Hill's Thistle that had not been reconfirmed for 10-30 years. She found five sites no longer supported the species. In Michigan, Voss (1996) noted that although there were a number of old records from the southern part of the state, Hill's Thistle might now be extirpated in that area.

COSEWIC (2004) lists six historically known populations, which were considered probably extirpated and several that were considered erroneous. However, some of these populations were investigated and recently relocated (Jalava 2005, 2007, 2008b, pers. comm.). Based on the most recent survey work, sites where Hill's Thistle is in fact no longer present, or has not been found in more than 20 years, are listed below.

Site Name	Last Observer*	Recent Search	Comments
Barrie Island:	Ringius &Wilson,	Not found by Jones,	Habitat is overgrown with
Beer Point	1976;	2006	small cedars
Bear's Rump Island	Morton and Venn,	Not found by Jalava,	
	1987	2007 or Schaefer, 1996	
Cape Croker/Nawash	Varga 1995 referring	Not found by Jalava &	Extirpated or erroneous
FN	to a 'pre-1949 record'	Chegano, 2008	record
Clapperton Island:	Morton and Venn,	Not found by Jones,	Habitat present; species
Beattie Bay	1976	2005, 2006	not found
Clapperton Island:	Morton and Venn,	Not found by Jones	Habitat present; species
Logan Bay	1976	2005, 2006	not found
Driftwood Cove	Schaefer, 1996	Not found by Jalava,	Extirpated or erroneous
Alvar		2007	record
Foxy Prairie: Gore	J.K. Morton, 2005	Not found by Jones	Habitat very degraded
Bay Airport		2005, 2006	
Roberts Bay	Morton and Venn,	Not found by Jones,	Habitat destroyed by new
	1981	2006	roads
Sauble Beach South	J. Johnson, 1980s	General area visited by	Area is subdivided with
		Jalava, 2008b	cottages; no habitat found
Vidal Bay: Creasor	Ringius and Wilson,	Not found by Jones	Very little habitat present;
Bight	1976	1997, 2005	mostly overgrown
Walpole Island F.N.:	Dodge, 1914	Not found by Gaiser,	
Squirrel Island		1966; or Woodliffe	
		and Allen, 1988	
Wasaga Beach:	A.A. Reznicek 1970s		Believed extirpated by
Nottawasaga Bay			recreational development
Shore			(COSEWIC, 2004)

*Information from Morton and Venn, 2000; COSEWIC, 2004; Jalava, 2008a,b; and Joan Venn, pers. comm.



APPENDIX D: Maps of Critical Habitat

Figure 7: Fine-scale map of Hill's Thistle critical habitat parcels 1-3 on the northern Bruce Peninsula.

* Note: The term "Protected Area" used in the critical habitat maps has no relation to protection requirements under SARA.



Figure 8: Fine-scale map of Hill's Thistle critical habitat parcels 4-11 on the northern Bruce Peninsula.



Figure 9: Fine-scale map of Hill's Thistle critical habitat parcels 12-14 on the northern Bruce Peninsula.



Figure 10: Fine-scale map of Hill's Thistle critical habitat parcel 15 on the northern Bruce Peninsula.



Figure 11: Fine-scale map of Hill's Thistle critical habitat parcel 16 on the northern Bruce Peninsula.



Figure 12: Fine-scale map of Hill's Thistle critical habitat parcels 17-18 on the northern Bruce Peninsula.



Figure 13: Fine-scale map of Hill's Thistle critical habitat parcel 19 on the northern Bruce Peninsula.



Figure 14: Fine-scale map of Hill's Thistle critical habitat parcel 20 on the northern Bruce Peninsula.



Figure 15: Fine-scale map of Hill's Thistle critical habitat parcels 21-22 on the northern Bruce Peninsula.



Figure 16: Fine-scale map of Hill's Thistle critical habitat parcel 23 on the northern Bruce Peninsula.



Figure 17: Fine-scale map of Hill's Thistle critical habitat parcel 24 on the northern Bruce Peninsula.



Figure 18: Fine-scale map of Hill's Thistle critical habitat parcel 25 on the northern Bruce Peninsula.



Figure 19: Fine-scale map of Hill's Thistle critical habitat parcel 26 on the northern Bruce Peninsula.



Figure 20: Fine-scale map of Hill's Thistle critical habitat parcel 27 on the northern Bruce Peninsula.



Figure 21: Fine-scale map of Hill's Thistle critical habitat parcels 28-29 on the northern Bruce Peninsula.



Figure 22: Fine-scale map of Hill's Thistle critical habitat parcel 30 on the Bruce Peninsula.



Figure 23: Fine-scale map of Hill's Thistle critical habitat parcel 31 on the northern Bruce Peninsula.



Figure 24: Fine-scale map of Hill's Thistle critical habitat parcel 32 on the northern Bruce Peninsula.



Figure 25: Fine-scale map of Hill's Thistle critical habitat parcels 33-34 on the northern Bruce Peninsula.



Figure 26: Fine-scale map of Hill's Thistle critical habitat parcels 35-36 on the northern Bruce Peninsula.



Figure 27: Fine-scale map of Hill's Thistle critical habitat parcel 37 on the northern Bruce Peninsula.



Figure 28: Fine-scale map of Hill's Thistle critical habitat parcel 38 on the northern Bruce Peninsula.



Figure 29: Fine-scale map of Hill's Thistle critical habitat parcel 39 at Wasaga Beach.



Figure 30: Fine-scale map of Hill's Thistle critical habitat parcels 40-44 at Wasaga Beach.


Figure 31: Fine-scale map of Hill's Thistle critical habitat parcels 45-46 at Wasaga Beach.



Figure 32: Fine-scale map of Hill's Thistle critical habitat parcels 47-49 at Wasaga Beach.



Figure 33: Fine-scale map of Hill's Thistle critical habitat parcel 50 at Wasaga Beach.



Figure 34: Fine-scale map of Hill's Thistle critical habitat parcel 51 on the northern Bruce Peninsula.



Figure 35: Fine-scale map of Hill's Thistle critical habitat parcel 52 on the northern Bruce Peninsula.



Figure 36: Fine-scale map of Hill's Thistle critical habitat parcels 53-55 on Manitoulin Island.



Figure 37: Fine-scale map of Hill's Thistle critical habitat parcels 56-58 on Manitoulin Island.



Figure 38: Fine-scale map of Hill's Thistle critical habitat parcels 59, 62 and 63 on Manitoulin Island.



Figure 39: Fine-scale map of Hill's Thistle critical habitat parcel 61 on Manitoulin Island.



Figure 40: Fine-scale map of Hill's Thistle critical habitat parcels 64-65 on Manitoulin Island.



Figure 41: Fine-scale map of Hill's Thistle critical habitat parcel 66 on Manitoulin Island.



Figure 42: Fine-scale map of Hill's Thistle critical habitat parcel 67 on Manitoulin Island.



Figure 43: Fine-scale map of Hill's Thistle critical habitat parcels 68-71 on Manitoulin Island.



Figure 44: Fine-scale map of Hill's Thistle critical habitat parcel 72 on Manitoulin Island.



Figure 45: Fine-scale map of Hill's Thistle critical habitat parcel 73 on Manitoulin Island.



Figure 46: Fine-scale map of Hill's Thistle critical habitat parcel 74 on Manitoulin Island.



Figure 47: Fine-scale map of Hill's Thistle critical habitat parcel 75 on Manitoulin Island.



Figure 48: Fine-scale map of Hill's Thistle critical habitat parcels 76-81 on Manitoulin Island.



Figure 49: Fine-scale map of Hill's Thistle critical habitat parcel 82 on Manitoulin Island.



Figure 50: Fine-scale map of Hill's Thistle critical habitat parcels 83-84 on Manitoulin Island.



Figure 51: Fine-scale map of Hill's Thistle critical habitat parcels 85-86 on Greene Island.



Figure 52: Fine-scale map of Hill's Thistle critical habitat parcels 87-88 on Western Duck Island.



Figure 53: Fine-scale map of Hill's Thistle critical habitat parcels 89-90 on Cockburn Island.