

Management Plan for Hill's Pondweed (*Potamogeton hillii*) in Canada

Hill's Pondweed



2014



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RECOMMENDATION AND APPROVAL STATEMENT

The Parks Canada Agency led the development of this federal management strategy, working together with the other competent minister for this species under the Species at Risk Act. The Chief Executive Officer, upon recommendation of the relevant Park Superintendent and Field Unit Superintendent, hereby approves this document indicating that Species at Risk Act requirements related to management plan development 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

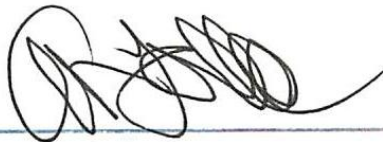
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Approved by:



Alan Latourelle

Chief Executive Officer, Parks Canada Agency

PREFACE

Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of management plans for listed species of special concern and are required to report on progress within five years. The federal, provincial, and territorial government signatories under the [Accord for the Protection of Species at Risk \(1996\)](#) agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada.

The Minister of the Environment and the Minister responsible for the Parks Canada Agency is the competent minister for the recovery of the Hill's Pondweed and has prepared this management plan, as per section 37 of SARA. It has been prepared in cooperation with the Ontario Ministry of Natural Resources, including Ontario Parks, First Nations, local government and non-government organizations, and independent experts.

Success in the management of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Parks Canada Agency and Environment Canada, or any other jurisdiction, alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Hill's Pondweed and Canadian society as a whole.

Implementation of this strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

ACKNOWLEDGMENTS

The original draft of this management plan was prepared by Judith Jones, Winter Spider Eco-Consulting, and Jarmo Jalava, Consulting Ecologist. The draft was updated by Gary Allen and Stephen McCanny (Parks Canada, Ontario Service Centre), with reviews and advice provided during the internal review of the document by Jeff Truscott and Cavan Harpur at Bruce Peninsula National Park, and by Kara Vlasman at Parks Canada National Office. Thanks are also due to the following individuals whose review comments and suggestions served to improve the scientific accuracy and utility of this document in preparation for posting: Anthony Chegahno (Chippewas of Nawash First Nation), Amelia Argue and Eric Snyder (Ontario Ministry of Natural Resources SAR Branch), Meghan Gerson, Rachel deCatanzaro, Tania Morais, and Elizabeth Rezek (Environment Canada, Canadian Wildlife Service – Ontario), and Jarmo Jalava. During the 60-day public comment period, Holly Bickerton alerted Parks Canada to a new population in eastern Ontario, far beyond the previously known Canadian range. Eleanor Thomson, who discovered this significant outlier, graciously provided the detailed notes from her 2008 and 2013 field visits, and accompanied Parks Canada staff to the first population in 2012. Access to element occurrence data at the Natural Heritage Information Centre (NHIC) was facilitated by Martina Furrer and Jim Mackenzie.

EXECUTIVE SUMMARY

The Committee on the Status of Endangered Wildlife in Canada designated Hill's Pondweed (*Potamogeton hillii*) as Special Concern in 1986 and confirmed this status in 2005. The species is listed as Special Concern on the federal *Species at Risk Act* (SARA). In Ontario, it is listed as Special Concern on the Species at Risk in Ontario (SARO) List under the Endangered Species Act, 2007 (ESA 2007). The global rank of Hill's Pondweed is vulnerable, and it is identified as rare in all nine U.S. states in which it occurs.

Hill's Pondweed is a slender, entirely submerged aquatic plant, with linear leaves. Linear-leaved pondweeds are difficult to identify without fruit present, and Hill's Pondweed may easily be confused with other species when sterile.

The Canadian range of the species is restricted to Ontario, where it occurs from Manitoulin Island in the north, south through the Bruce Peninsula; with a few sites in southwestern Ontario, and two sites in eastern Ontario. The total number of sites may be as many as 35 if all sites are found to be extant, or as few as 28 if sites where Hill's Pondweed was not found in 2003-2008 are in fact extirpated. However, it is most likely that Hill's Pondweed will be found at some of these sites with further field study. With eight of the 28 known extant Canadian populations of Hill's Pondweed within Bruce Peninsula National Park, Parks Canada has a high responsibility for the management of this species.

Hill's Pondweed occurs in cold, clear, alkaline water, such as in channels in wetlands, small streams, ponds, muddy substrate, and where water collects. Rarely is it found in turbid or polluted waters, or in open lakes, or in water deeper than 1.5 metres.

Intrinsic factors may limit Hill's Pondweed including: low levels of beaver activity, low pollination success, and natural changes in water clarity or water level. There is little information on threats affecting Hill's Pondweed. Documented threats include: invasive species, road construction and maintenance, and changes in water chemistry or flow.

The management objective for Hill's Pondweed is to maintain populations and habitat at their current distribution and number of occurrences for the next ten years, or until reassessed as Not at Risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and that assessment is accepted by the Minister. As the species tends to occupy successional habitats, management should be directed at the watershed level, with the goal of retaining high quality, pollution-free aquatic systems. The objectives will be met by: working with agencies that have responsibility for wetlands; direct actions on invasive species; increased public awareness of the species and communicating best management practices; working with landowners on stewardship; monitoring trends; and reconfirming known sites and surveying potential habitat. Additional survey work is recommended because, as a rather inconspicuous aquatic plant, it is very likely that the species has often been overlooked and may be more widespread than is known. Specific conservation measures and an implementation schedule for these measures, are provided.

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1. COSEWIC SPECIES ASSESSMENT INFORMATION

Date of Assessment: May, 2005

Common Name (population): Hill's Pondweed

Scientific Name: *Potamogeton hillii*

COSEWIC Status: Special Concern

Reason for Designation: An inconspicuous, rooted, aquatic plant currently known from fewer than 20 Canadian populations and occupying a very small total area of habitat. No imminent limiting factors have been identified that would have significant impacts on this globally rare species, but invasive exotic plants may be impacting some populations.

Canadian Occurrence: Ontario

COSEWIC Status History: Designated Special Concern in April 1986. Status re-examined and confirmed in May 2005. Last assessment based on an update status report.

2. SPECIES STATUS INFORMATION

Hill's Pondweed is present in nine U.S. states and in Ontario (Figure 2). The species is rare in all jurisdictions where it is found. It is globally ranked G3, nationally ranked N3 in the U.S., and N2 in Canada. In Canada, the species is listed as Special Concern under both the federal *Species at Risk Act* (2002) and Ontario's *Endangered Species Act, 2007*. Table 1 summarizes the conservation status ranks for the species.

Table 1. List and Description of Various Conservation Status Ranks for Hill's Pondweed (NatureServe 2012).

	Global (G) Rank	National (N) Rank	Sub-national (S) Rank	COSEWIC/ COSSARO Status	Legislated Status
Hill's Pondweed (<i>Potamogeton hillii</i>)	G3 (vulnerable)	Canada – N2 (imperilled) USA - N3 (vulnerable)	Connecticut (S1), Ohio (S1), Pennsylvania (S1), Virginia (S1), Wisconsin (S1) Michigan (S2), New York (S2), Ontario (S2) Massachusetts (S3), Vermont (S3)	SC (COSEWIC) SC (COSSARO)	Endangered: Connecticut, Ohio, Pennsylvania Threatened: Michigan, New York Special Concern: Ontario, Massachusetts, Wisconsin Not listed: Vermont, Virginia.

G = Global conservation status; N = National conservation status; S = state or provincial conservation status; 1—critically imperilled, 2—imperilled, 3—vulnerable, 4—apparently secure, and 5—secure.

3. SPECIES INFORMATION

3.1 Species Description

Hill's Pondweed (Figure 1) is a slender, submerged aquatic plant, green to olive-green in colour, with stems generally 30-60 cm long and 0.5-1.0 mm wide. The leaves are linear, 2-6 cm long and 1-2.5 mm wide (4 mm maximum), with 3 parallel veins, a tiny bristle (mucro) at the tip, and 1-2 rows of transparent air cells (lacunae) along the midvein. This species does not produce wide, floating leaves. The stipules (leaf-like tissue where the leaf stalk meets the stem) are delicate, 7-16 mm long, not fused to the leaf stalk, and only slightly shredding at the tip. In July, flowers are borne in small, nearly globose clusters (spikes) 4-7 mm long, which are held just above the water surface on short, recurved stalks 1.0-1.5 cm long. The seed-like fruits are 2-4 mm long with 3 low ridges or keels and are usually present in August and September. Reproduction is largely vegetative, often by stem fragmentation or by winter buds (turions) that detach from the plant (Hellquist 1984).

Linear-leaved pondweeds are difficult to identify when fruit are not present. Given this, a conclusive identification of pondweeds should not be expected without the fertile parts of the plant. Hill's Pondweed is easily confused with *Potamogeton pusillus*, *P. foliosus*, *P. friesii*, *P. strictifolius*, or *P. ogdenii*. Hill's Pondweed is characterized by fruit clusters on short stalks which arise from the leaf axils, and fruits with 3 low keels or ridges. The fruits of *P. hillii* are larger than those of the closely related *P. foliosus*. As well, the bristle on the leaf tip of *P. hillii* separates it from sterile *P. foliosus*, where the leaf tips are merely acute. *P. strictifolius* may also form bristle-tipped leaves, but has a bold leaf margin formed from prominent veins and distinct nodal glands (Hellquist 1984).

Hill's Pondweed can be separated from other species of pondweed by these characters (See especially Hellquist 1984, Cronquist 1991, or Voss 1972):

- Leaves narrow, linear, 3-veined
- Leaves bristle-tipped with rows of air cells along the mid-vein
- Fruit cluster small, few-flowered, sub-globose,
- Fruits, with 3 low keels or ridges
- Fruit stalk (peduncle) short, arising from leaf axils
- Stipules free from the leaf stalk
- Stipules only slightly shredding at the tips.



Figure 1. Hill's Pondweed (centre, submerged) — general aspect (J. Jalava 2008).



Figure 2. Hill's Pondweed on the Shield in eastern Ontario at Calabogie (In this late summer image, taken when the pond level has begun to drop, the Hill's Pondweed is exposed at the surface, and dominates the scene, appearing golden in the evening sunshine. The short spikes protruding from the water within the mass of Hill's Pondweed are Whorled Water Milfoil (*Myriophyllum verticillatum*) (E. R. Thomson 2008)).

3.2 Populations and Distribution

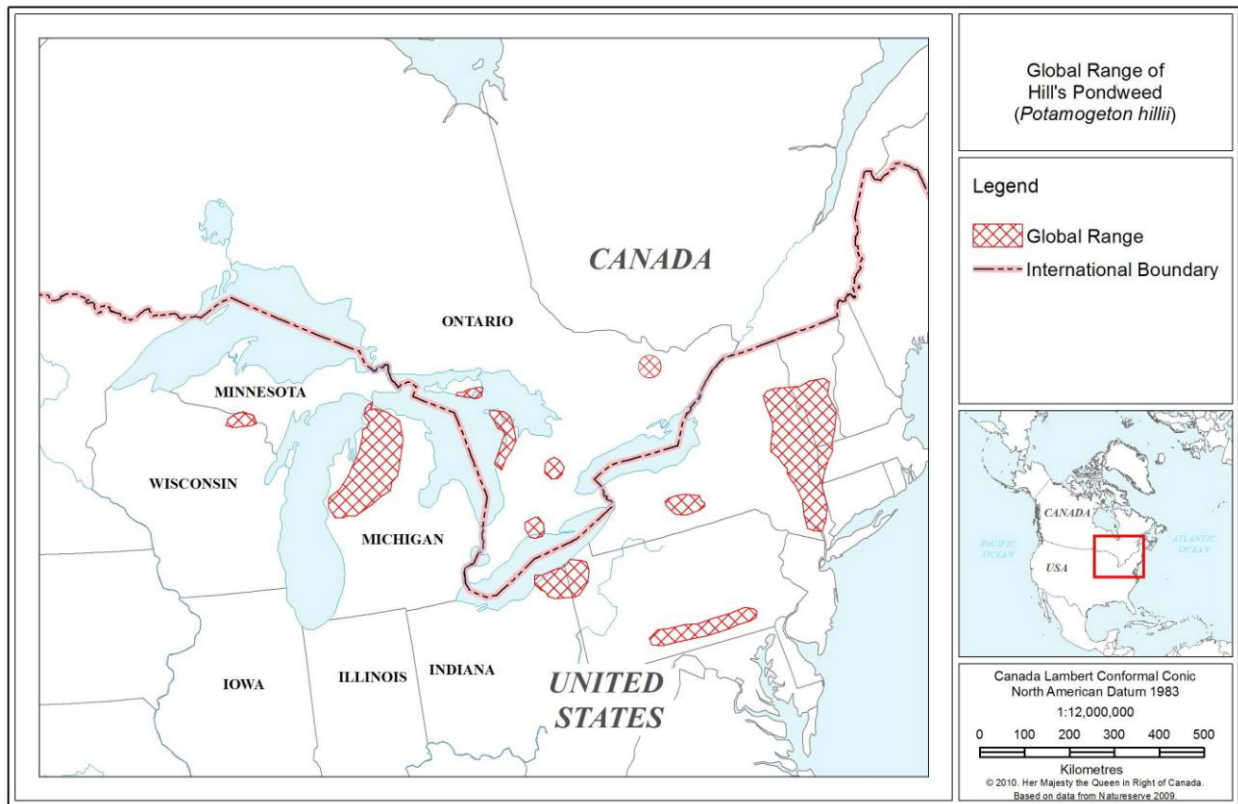


Figure 3. Global range of Hill's Pondweed (stippled areas show generalized regions). No information was available on locations in Virginia.

According to NatureServe (2012), there are 87 documented element occurrences (EOs), and likely over 100 actual occurrences range-wide. Given the difficulties of identifying the species and accessing its submerged wetland habitat, it is likely that the species is often overlooked and may be more widespread than is known.

In Ontario, Hill's Pondweed occurs from Manitoulin Island in the north, south through the Bruce Peninsula; with a few sites in southwestern Ontario, and two sites in eastern Ontario (Figure 3).

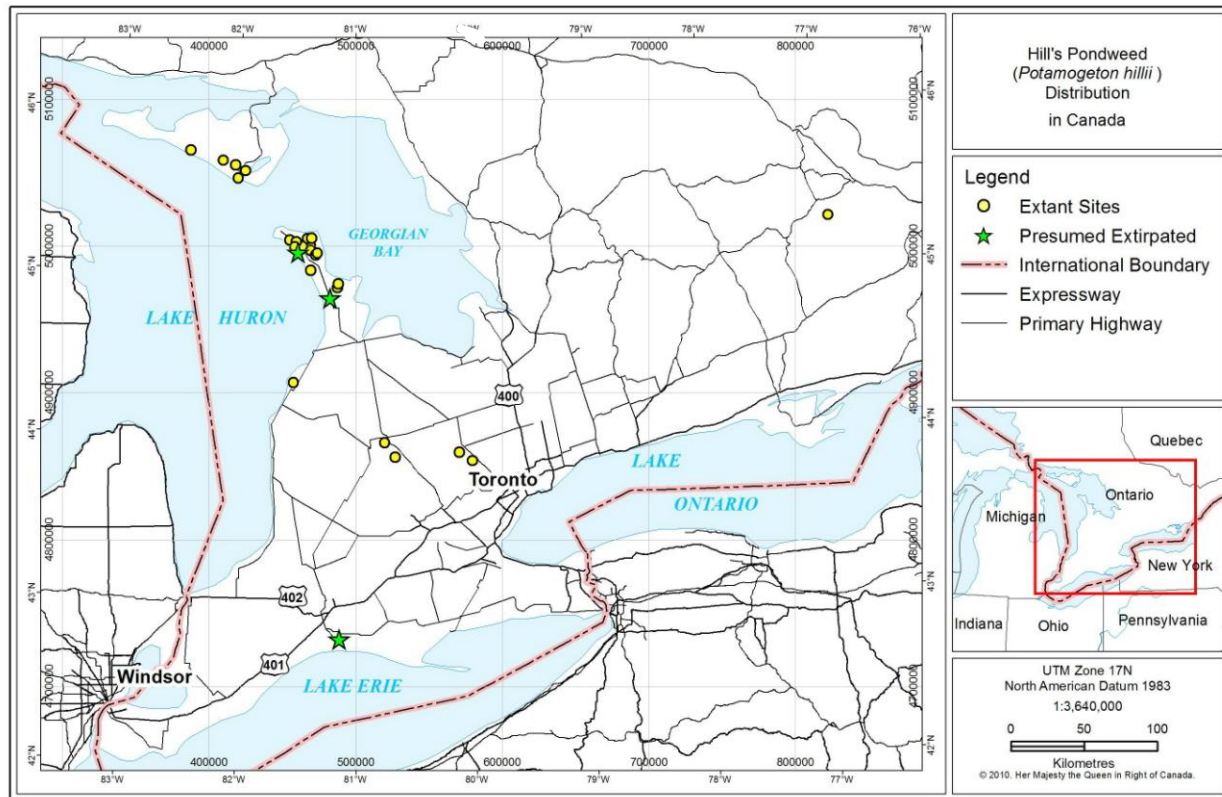


Figure 4. Canadian distribution of Hill's Pondweed.

Habitat for Hill's Pondweed is associated with dolostone (Hellquist, 1984), so potential habitat may be found in Ontario wetlands along the Niagara Escarpment and Precambrian contact line (Brownell 1986). However, with the recent discovery of the species in Renfrew County near Calabogie, in eastern Ontario, potential habitat also exists on the Canadian Shield.

This species has never been known to be common in Ontario. COSEWIC (2005) reports a total of 22 element occurrences (EOs) of Hill's Pondweed, but the status of many of these sites remains uncertain. Prior to 2003, there were 19 records for extant sites, although many had not been revisited for a long time. Between 2003 and 2008, 13 of those sites were reconfirmed to be extant, three are now presumed extirpated (St. Thomas in Elgin County, and two sites on the Bruce Peninsula: Little Eagle Harbour and Albermarle Brook/Hope Bay), and seven others have inconclusive field work or need further surveys to confirm species presence or extirpation¹ (five of these sites are now considered historical, as there have been no observations in 20 years). As well, three new sites were found in 2002-2003, and 11 new sites were found in 2006-2008. The total number of sites may be as many as 35 if all known sites are found to be extant, or as few as 28 if sites where Hill's Pondweed was not found in 2003-2008 are in fact extirpated. However, it is most likely that Hill's Pondweed will be found at some of these sites, with further work.

¹ Sites are not usually considered extirpated until they have been searched on at least 2 separate occasions in different years and/or the habitat has significantly changed.

A list of all known sites showing ownership, most recent observation, available abundance data, and individual population status, is provided in Appendix B². Abundance is very difficult to quantify for this species. Individual stems are hard to count since the plants are submerged and can be growing in large, dense, clonal patches, sometimes mixed with other linear-leaved pondweeds. Although this is a perennial species, numbers of plants at any one site may vary considerably from year to year depending on conditions (COSEWIC 2005; Brownell 1986). Makkay (COSEWIC 2005) estimated numbers of plants to the nearest 100, but an estimate of occupied area in square metres (Jalava pers. comm. 2012) is easier to make and sometimes may be more useful. The most recent COSEWIC status update report (COSEWIC 2005), estimated the Ontario population at 119,600 individuals, but this total uses data from only 12 sites. Therefore, it is entirely possible that the actual size of the population of Hill's Pondweed in Ontario may be more than double this number (with the caveat that the population totals would include a clonal component).

3.3 Needs of the Hill's Pondweed

3.3.1 Habitat and Biological Needs

Hill's Pondweed occurs in cold, clear, alkaline water. It can be found in channels in open wetlands; in small slow-moving streams, ponds, and beaver ponds with muddy substrate; around springs and small inlets in ponds or marshes; and where water collects, such as above beaver dams and road culverts. It can be found in beaver draw-downs (in the shallow pools left on the upstream side after a dam has broken). Rarely is it found in turbid or polluted waters, or in open lakes, or in water deeper than 1.5 m (Hellquist 1984). Fieldwork for this species on the Bruce Peninsula (Brinker 2007; Jalava 2009) often located Hill's Pondweed habitat within dynamic wetland systems with natural disturbance from beaver activity. Wetlands subjected to beaver activity undergo various phases of development and successional stages; thus it has been suggested that Hill's Pondweed does not appear to persist in one locality over a long period (Mitchell and Sheviak 1981 cited in Brownell 1986; NatureServe 2012). However, field work in Ontario shows that some populations have persisted at the same site for at least 30 years. It is not known if particular water levels or successional stages are required for germination or reproduction of the species.

The alkalinity of the water is an extremely important factor in the distribution of Hill's Pondweed. Hellquist (1980) examined the levels of dissolved calcium carbonate (CaCO_3) in water at 35 sites and found Hill's Pondweed occurs where dissolved CaCO_3 ranged from 53.0 to 290.0 mg per litre with a mean of 124.1 mg per litre. As well, 79% of Hill's Pondweed sites coincided with dolomitic limestone bedrock, which is presumed to be the source of the alkalinity. At one of the two populations in Ontario on the Precambrian bedrock, the pH still measured as slightly alkaline at 7.6 (Parks Canada 2012), so presumably buffering of the water is occurring, within the beaver pond habitat.

² The locational information for four of these extant sites on the northern Bruce Peninsula is considered confidential, and these sites are thus not included in Appendix B.

Brinker (2007) noted that the majority of populations were in wetlands with fairly recent disturbance histories, often with natural disturbance dynamics from beaver activity, and with little to moderate amounts of shrub or tree cover. All had dead standing woody snags, suggesting altered flood dynamics, and a high incidence of graminoid cover. Scattered tree cover was often less than 10%. Virtually all sites found during fieldwork on the Bruce Peninsula in 2008 (Jalava 2009) had frequent standing dead snags, fallen dead trees, marshy areas and, usually, very slowly flowing water of a stream or brook. Occasional populations were in motionless pools.

The population discovered in eastern Ontario in 2008 occurs in a small (30 meters by 40 meters), shallow (0.6 to 1.2 metres deep) beaver pond, where the Hill's Pondweed is dominant and very dense; in association with the alga *Chara vulgaris* (also very dense), Whorled Water Milfoil, Small Bladderwort, Common Pondweed, and Grass-leaved Pondweed. This has been a beaver pond for many years, no standing dead trees or fallen dead trees are present, and with its location on a small creek system, slow flows continue in the pond. The second eastern Ontario site was discovered in 2013, approximately 7.5kms southeast of that above. It occurs as a small, but dense population in a marshy bay (previously a beaver pond) of Wabun Lake, in association with Floating Pondweed, Leafy Pondweed, Berchtold's Pondweed, Flat-stemmed Pondweed, Slender Naiad, Water Knotweed, Small Bladderwort, and Greater Bladderwort. Exposed granitic boulders are present along the shorelines at both populations, and the sites are located on the shallow till and rock ridges of the Precambrian bedrock, within the Algonquin Highlands physiographic region (Chapman & Putnam 1984

Details on typical associate species, and examples of where habitat occurs, are presented in Appendix C, to assist future workers in recognizing and searching suitable habitat.

3.3.2 Ecological Role

Hill's Pondweed sometimes forms dense colonies, and thus may provide cover and surface area for small aquatic organisms (insects, snails, etc.), amphibians, and possibly fishes. These species in turn provide food for larger animals. Vegetative parts, and especially seeds of pondweeds in general, are a very significant food source for waterfowl, muskrats, and other vegetarian animals (Martin and Uhler 1939 cited in COSEWIC 1986).

Seeds of Hill's Pondweed are probably dispersed by waterfowl, as well as by the mechanical movements of the plants from wind and water. According to Haynes (1978), waterfowl eat pondweed seeds but digest only the outermost and middle layers of the seed, leaving the inner layer surrounding the seed intact. A high percentage of germination was shown for seeds that have passed through waterfowl gut (Brownell 1986).

Little is known about pollination in this species. Flower spikes in Hill's Pondweed are held at or below the water surface, so presumably pollen is transferred by wind or water. According to Haynes (1978), dragonflies have been observed to land on some the flower spikes of some species of pondweeds, but there is little evidence that pollen transfer is actually accomplished by any insect.

If wetlands where Hill's Pondweed occurs are found to have successional dynamics, it could be speculated that Hill's Pondweed may be a colonizer of early successional areas (e.g., open water or muck), and that its growth and eventual density may play a role in helping other species become established. Dense populations may play a minor role in reducing water flow in brooks, streams, and wetlands channels.

3.3.3 Limiting Factors

A number of intrinsic factors may limit Hill's Pondweed, but so far none have been studied. A list of possible factors could include: a lack of (or changes in) beaver activity, low pollination success with low levels of out-crossing leading to low fruit production, and natural changes in water clarity or water level.

As well, if habitat for Hill's Pondweed is within early successional stages that eventually become unsuitable from increased vegetation, then the species must be able to disperse seed to new, early successional habitats in order to remain present within the landscape. Such long-distance dispersal could be a limiting factor, but again this has not been studied. The ability to produce sufficient seed to attract dispersal agents (possibly waterfowl) could also be a limitation. These potential limiting factors require study to determine their impact on this species.

4. THREATS

4.1 Threat Assessment

Threats are defined as the proximate (human) activities or processes that have caused, are causing, or may cause the destruction, degradation, and/or impairment, of biodiversity and natural processes. Threats can be past (historical), ongoing, or likely to occur in the future. Threats do not include intrinsic biological features of the species or populations such as inbreeding depression, small population size, or genetic isolation, which are considered limiting factors.

There is very little specific information on what threats may be affecting individual populations or how severe the effects might be. Most information on threats reported in the literature or from recent field work is merely speculative. At this point, it is not possible to assess anything more than whether or not a threat has been reported to be present (Table 2). The listed threats may be potential threats to any Hill's Pondweed population.

Table 2. Threats Assessment.

Threat	Bruce Peninsula	Manitoulin Island	SW Ontario
Road construction and maintenance	present	potential	potential
Changes in water quality or flow	present	present	present
Invasive species	present	potential	present
Removal of beaver dams	potential	potential	potential
Filling in or drainage of wetlands	potential	potential	potential

4.2 Description of Threats

Trends

Little information on threats was presented in either the 1986 COSEWIC report (Brownell 1986) or the 2005 COSEWIC report, due to the dearth of systematic monitoring; other than references to change over time, e.g. degradation by cattle at one site (Black Creek, Manitoulin Island), or ascendance of the exotic Curly Pondweed (*Potamogeton crispus*), and competition with Hill's Pondweed at another site (Bethel Creek, Wellington County). Other potential threats were listed generally as draining of ponds or wetlands, and loss of water quality from chemical or thermal pollution.

Bruce Peninsula

Jalava (2009) noted that the major threat to Hill's Pondweed on the Bruce Peninsula was road maintenance and widening, and this threat appeared to have severely impacted or possibly extirpated Hill's Pondweed from one site. Winter road salt, pesticide use for road maintenance, erosion, deposition of dust, and contamination of water from livestock and septic systems, are additional potential threats to water quality associated with roads. On the other hand, Jalava (2009) noted road building may occasionally create habitat, since road embankments often impound water in a manner similar to beaver dams. Removal of beaver dams could result in loss of habitat for the species. As long as natural processes within watersheds are not significantly interfered with, and water quality remains intact, the species will likely persist. No impacts directly from water pollution were observed in 2008 on the Bruce Peninsula (Jalava 2009).

Southwestern Ontario

In the Credit Valley watershed, many factors may be affecting water quality in Hill's Pondweed habitat. The lakes that support Hill's Pondweed are surrounded by cottages, and nutrients from septic systems may be entering the lake, and may possibly be the cause of algal blooms. As well, an aggregates operation and dredging of the outflow channel on one lake may be affecting water levels (Lynn pers. comm. 2009). It is not yet known how this has affected Hill's Pondweed populations.

At the Bethel Creek site (Wellington County), it was suggested that the abundance of Curly Pondweed (*P. crispus*), a widespread, exotic, may have been instrumental, in part, in replacing

Hill's Pondweed, as the species was present in 1978 but could not be refound during a 2003 survey (COSEWIC 2005).

Eastern Ontario

No threats have been detected for these populations, on private property, in the well forested and relatively undisturbed Shield landscape near Calabogie.

Manitoulin Island

On Manitoulin Island, one population has probably become extirpated due to a change in water quality when the site became the outlet for the sewage treatment system for the town of Mindemoya.

According to Brownell (1986), wetland sites were protected due to their zoning as hazard lands; however, filling in and altering of wetlands continues to be a threat since private landowners may fill in or alter wetlands on their property without scrutiny if no re-zoning or building permit is required for a project.

5. MANAGEMENT OBJECTIVE

The objective of this management plan is to maintain Hill's Pondweed populations and habitat at current distribution and number of occurrences for the next ten years, or until reassessed as Not at Risk by COSEWIC, and that assessment is accepted by the Minister.

Rationale: In the 2005 COSEWIC assessment, Hill's Pondweed was designated as Special Concern due to its low number of populations (fewer than 20) and its restriction to a very small total area of habitat. There are currently between 28 and 35 extant populations of the species, and it is believed that three populations are extirpated, with another two considered as possibly extirpated. There is no evidence to suggest that the species was historically more abundant, and there is a good likelihood of additional populations being identified, evidenced by 15 'new' populations having been discovered in the past ten years. With success in additional targeted field surveys, including searches on the Precambrian bedrock landscape of southern Ontario, the species is a candidate for reassessment as Not at Risk by COSEWIC.

As the species appears to be particularly sensitive to degradation of its aquatic habitat, the long term objective to maintain populations and habitat at the current distribution and number of occurrences is set to prevent further decline in the number of known populations, or deterioration of the species' status. The objective is specifically set to not focus on maintaining the species through 'freezing' habitat at particular sites, as the species tends to occupy successional habitats, and may not remain at a given site for long periods of time. Rather management should be directed at those watersheds within which the species occurs, with the goal of retaining or enhancing high quality, pollution-free aquatic systems (NatureServe 2012).

6. BROAD STRATEGIES AND CONSERVATION MEASURES

6.1 Actions Already Completed or Underway

1. From 2006 through 2008, Hill's Pondweed was one of the secondary target species of extensive surveys for species at risk (SAR) occurring in hydro-riparian habitats within the Bruce Peninsula National Park / Fathom Five National Marine Park Greater Ecosystem (Brinker 2007; Jalava 2009). As a result of that study, 10 new sites for Hill's Pondweed on the Bruce Peninsula were discovered, 5 known sites were reconfirmed, and 2 known sites were not relocated. Managing for SAR is part of the Bruce Peninsula National Park Management Plan (Parks Canada 1998), monitoring programs are being established for all SAR, including Hill's Pondweed (Kirk *et al.* 2011), and Parks Canada is responsible for regular reporting on the status of SAR within their properties.
2. From 2007 to 2011, SAR inventories and community presentations have been undertaken of the Chippewas of Nawash First Nation and the Saugeen First Nation reserve lands and traditional territories on the Bruce Peninsula. As a result of these studies, community awareness regarding this species has been increased.
3. A conservation plan has been done for Green Lake, which supports Hill's Pondweed, by the Credit Valley Conservation Authority. Although this plan does not deal directly with species at risk, the conservation plan recognizes the importance of maintaining the natural features of the area, which may help to maintain water quality.

6.2 Broad Strategies

The broad strategies for Hill's Pondweed are:

1. Work with partners to develop and implement conservation and management measures, to protect habitat.
2. Conduct population surveys and monitoring to fill knowledge gaps on the species, including beaver pond systems on the Precambrian bedrock of southern Ontario.
3. Increase public awareness of the species and its habitat.
4. Reconfirm known sites and survey potential habitat.

Specific steps in achieving the above, and the rationale behind them, are discussed in the following section.

Hill's Pondweed is one of many SAR found in the Bruce Peninsula and Manitoulin Island region. It is recommended that recovery of Hill's Pondweed be coordinated with recovery activities being undertaken for other SAR in the region. This will enable the best use of resources and

personnel and will be very important in keeping the public engaged and informed on target species. Recovery efforts for Hill's Pondweed in the Bruce Peninsula and Manitoulin Island region will be achieved by cooperative efforts amongst those that have direct responsibility for wetlands, including Bruce County, the member municipalities, conservation authorities, Ontario Ministry of Natural Resources, planning boards, Ontario Parks, First Nations, Bruce County Stewardship Council, private landowners, and Parks Canada. Threats to Hill's Pondweed should be addressed by these partners via management planning, by adoption and communication of best management practices, e.g. for maintenance of roads through sensitive wetland systems, and through judicious control of beavers as one of the drivers in healthy, aquatic ecosystems.

In southwestern Ontario, threats to Hill's Pondweed should be addressed by the appropriate planning agencies, e.g. Credit Valley Conservation Authority, in their watershed management and site-specific conservation plans, and the municipalities in their respective plans, as well as by communicating best management practices for development and activities adjacent to or in water.

6.3 Conservation Measures

Table 3. Conservation Measures and Implementation Schedule.

Broad Strategies	Conservation Measures	Priority ³	Threats or concerns addressed	Timeline
1. Work with partners to develop and implement conservation and management measures, to protect habitat.	1. Identify planning and conservation agencies that work in the area of known populations.	High	Any or all	Complete by 2016
1. Work with partners to develop and implement conservation and management measures, to protect habitat.	2. Assess presence of invasive species at Hill's Pondweed sites.	Medium	Invasive species	Complete by 2019
2. Conduct population surveys and monitoring to fill knowledge gaps on the species.	3. Conduct surveys to verify the presence of Hill's Pondweed at locations which need reconfirmation or additional field work.	High	Low number of populations; declining trends	Complete by 2017
3. Increase public awareness of the species and its habitat.	4. Identify key private landowners; depending on the number of people involved, plan and implement appropriate contact and communication.	High	Any or all	Begin by 2016
3. Increase public awareness of the species and its habitat.	5. Include information on Hill's Pondweed in the nature-oriented sections of the websites of the Credit Valley CA and the Town of Caledon.	Low	Any or all	Complete by 2017
4. Reconfirm known sites and survey potential habitat.	6. For selected element occurrences in and intersecting with the Bruce Peninsula National Park, assess the presence of the species and potential habitat every five years, per the monitoring protocol developed in 2011 (Kirk <i>et al.</i>).	High	Low number of populations; declining trends	Begin by 2015

³ Priority reflects the degree to which the action contributes directly to the conservation of the species or is an essential precursor to an action that contributes to the conservation of the species.

6.4 Narrative to Support Implementation Schedule

6.4.1 Work with partners to develop and implement conservation and management measures to protect habitat

Conservation Measure #1: Identify planning and conservation agencies that work in the area of known populations (e.g., Niagara Escarpment Commission, Town of Caledon, Tehkummah Township, Saugeen First Nation, Chippewas of Nawash First Nation, Township of Northern Bruce Peninsula, Township of Southern Bruce Peninsula, Bruce County, etc.). Make Hill's Pondweed sites known to these agencies and discuss management and protection steps with them.

Performance measure: Information on Hill's Pondweed is received by at least 5 groups or agencies by 2016.

Conservation Measure #2: Assess presence of invasive species at Hill's Pondweed sites. Focus on the one site where Curly Pondweed (*P. crispus*) is believed to be a threat in possibly extirpating the species (Bethel Creek, Wellington County). Record presence or absence of invasive species at other sites (integrate with field work for Conservation Measure #3).

Rationale: Work is needed to see if or how invasive species are impacting Hill's Pondweed populations (COSEWIC 2005), so that if necessary, management planning can be implemented to improve the situation.

Performance measure: Assessment at one problematic site by 2018. Presence/absence information and an assessment of invasive threat for selected additional sites to be available for 2019.

6.4.2 Conduct surveys and monitoring to fill knowledge gaps on the species

Conservation Measure #3: Conduct surveys to verify the presence of Hill's Pondweed at locations which need reconfirmation or additional field work.

Rationale: In order to plan effective management for this species, a better understanding of its current status and distribution is needed. The species is hard to identify, is inconspicuous, and grows in a habitat that is seldom visited. Therefore, further surveys are needed to see if the species is indeed rare, or rather if it's perceived rarity is the result of a lack of attention in the field. Surveys are especially important because rationale for the Special Concern designation of Hill's Pondweed is few populations occupying a very small total area of habitat (COSEWIC 2005). It is important to verify if this is indeed the case. This may change the conservation outlook for the species.

Survey needs:

Manitoulin Island—4 known sites need reconfirmation; much potential habitat never surveyed;

Eastern Ontario—With the recent discovery of Hill's Pondweed in Renfrew County near Calabogie, and the first on the Shield in Canada, the potential habitat in southern Ontario has greatly increased, and should be acknowledged in surveys for the species.

Performance measure: An evaluation of how many sites exist and whether the species is declining or not will have been made in time for the next COSEWIC review (2015).

6.4.3 Increase public awareness of the species and its habitat

Conservation Measure #4: Identify key private landowners; depending on the number of people involved, plan and implement appropriate contact and communication.

Performance measure: Some communications and outreach products have been developed and landowner contact has begun by 2016.

Conservation Measure #5: Include information on Hill's Pondweed in the nature-oriented sections of the websites of the Credit Valley Conservation Authority and the Town of Caledon.

Performance measure: Accurate information on Hill's Pondweed is readily accessible on the Internet by 2017.

6.4.4 Reconfirm known sites and survey potential habitat

Conservation Measure #6: For selected element occurrences in and intersecting with the Bruce Peninsula National Park, assess the presence of the species and potential habitat every five years, per the monitoring protocol developed in 2011 (Kirk *et al.*). Adopt the census method utilized by Jalava of estimating occupied area of Hill's Pondweed in square metres, rather than attempting individual counts.

Rationale: With eight of the 28 known extant Canadian populations of Hill's Pondweed within Bruce Peninsula National Park, Parks Canada has a high responsibility for the management of this species. The Managed Area Rank is MA2 (Imperilled in the Managed Area because of extreme rarity making it especially vulnerable to extirpation from the Managed Area). The major threat affecting Hill's Pondweed within the National Park and its Greater Park Ecosystem is road widening and road maintenance (Bastick & Darevic DA July 2011).

Performance measure: Application of monitoring protocol initiated in 2015.

Note: Habitat and population restoration is not currently required as there are many sites and ample suitable habitat. If any action of this type were needed, it would be to augment the area of occupancy at some sites. However, this type of action should not be done until threats to water

quality and flow have been assessed, and other management actions to address threats have been undertaken.

7. MEASURING PROGRESS

Every five years, success of this management plan implementation will be measured against the following performance indicator:

- No decline in the abundance and distribution of the Canadian population of Hill's Pondweed.

8. REFERENCES

- Bastick, J. and K. Darevic. 2011. Managed Area Element Status Assessment for Hill's Pondweed at Bruce Peninsula National Park of Canada. Parks Canada. 7pp.
- Brinker, S. 2007. Hydro-riparian Species at Risk Inventory – Bruce Peninsula National Park. Prepared for Parks Canada Agency, Bruce Peninsula National Park, Tobermory Ontario. Prepared by Dougan & Associates Ecological Consulting and Design. 84 pp. + appendices.
- Brownell, V. 1986. COSEWIC status report on the Hill's Pondweed *Potamogeton hillii* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 34 pp.
- Chapman, L.J. and D.F. Putman. 1984. The Physiography of Southern Ontario; Ontario Geological Survey, Special Volume 2. 270pp. Accompanied by Map P.2715 (coloured), scale 1:600,000.
- COSEWIC 2005. COSEWIC assessment and update status report on the Hill's pondweed *Potamogeton hillii* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 19 pp. (www.sararegistry.gc.ca/status/status_e.cfm).
- Cronquist, A. 1991. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada*, 2nd ed. New York Botanical Garden, 910 pp.
- Haynes, R.R. 1978. The Potamogetonaceae in the Southeastern United States. *Journal of the Arnold Arboretum*, 59(2) 170-191.
- Hellquist, C.B. 1984. Observations of *Potamogeton hillii* Morong in North America. *Rhodora* 86: 101-111.
- Hellquist, C.B. 1980. Correlation of alkalinity and the distribution of *Potamogeton* in New England. *Rhodora* 76: 564-649.
- Jalava, J.V. 2009. Hydro-riparian Species at Risk Inventory – Bruce Peninsula National Park, Final Report, January 2009. Prepared for Parks Canada Agency, Bruce Peninsula National Park / Fathom Five National Marine Park, Tobermory Ontario. vi + 152 pp.
- Jalava, J.V. 2012. Personal communication. Consulting Ecologist, Paisley, Ontario.
- Kirk, D.A., J.L. Pearce and H. Bickerton. 2011. Long-term Inventory Program for Species at Risk Reporting for each of the Five Ontario National Parks. Draft report prepared for Parks Canada Agency, Ontario Service Centre. 236pp.
- Lynn, H. 2009. Personal communication. Natural Heritage Ecologist, Credit Valley Conservation Authority.

- Makkay, K. 2004. Confidential locality data for Hill's Pondweed. Unpublished data on file with Committee on the Status of Endangered Wildlife in Canada. Ottawa.
- Martin, A.C. and F.M. Uhler. 1939. Food of game ducks in the United States and Canada. U.S. Department of Agriculture and Technology Bulletin 634. 156 pp.
- Mitchell, R.S. and C. J. Sheviak. 1981. Rare plants of New York State. New York State Museum Bulletin 445. Albany, NY 96 pp.
- NatureServe. 2012. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available <http://www.natureserve.org/explorer>. (Accessed: January 9, 2012).
- Noble, T.W. 1995. Site District 5E2 gap analysis (unapproved draft). Ontario Ministry of Natural Resources, Central Region. Huntsville, ON
- Parks Canada. 1998. Bruce Peninsula National Park Management Plan. Parks Canada, Tobermory, Ontario, 43 pp.
- Parks Canada. 2012. Short Analytical Report Sheet (conducted on sample collected 25 October 2012 from pond supporting *Potamogeton hillii* at Calabogie, Ontario. Analytical Section, Research & Analysis. Ontario Service Centre, Parks Canada. 1 pg.
- Thomson, E.R. 2012-2014. Personal communication with G.M. Allen, including provision of information from original field notes of 27 July 2008 and 5 March 2014 discoveries of the Renfrew County populations of *P. hillii*. Eleanor is a Consulting Biologist.
- USDA, NRCS. 2012. The PLANTS Database (<http://plants.usda.gov>, 9 January 2012). National Plant Data Team, Greensboro, NC 27401-4901 USA.
- Voss, E.G. 1972. *The Michigan Flora* vol. 1. Gymnosperms and Monocots. Cranbrook Institute of Science Bulletin 55, Bloomfield Hills, Michigan. 488 pp.

APPENDIX A: EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*. 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 plans may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the plan itself, but are also summarized below.

Effects on other species are expected to be beneficial, and no negative impacts are predicted. The management of Hill's Pondweed will mostly involve policy and outreach steps. As well, since the goal is to maintain existing sites and populations, there will be very little management in the actual habitat. The primary focus will be work to ensure natural, dynamic wetland processes such as variable water levels, beaver activity, successional changes in vegetation, etc. continue to function naturally. Management activities that maintain wetland integrity and water chemistry will benefit many other species in the same habitat.

This management plan will clearly benefit the environment by promoting the conservation of Hill's Pondweed. The potential for the plan to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this plan will clearly benefit the environment and will not entail any significant adverse effects. The reader should refer to the following sections of the document in particular: Conservation Measures (6.3); Habitat and Biological Needs (3.3.1); and Ecological Role (3.3.2).

APPENDIX B: OCCURRENCES OF HILL'S PONDWEED IN CANADA*

Those sites with a Population Status of “Historical” or “Possibly Extirpated” require further surveys to confirm their status. Sites are not considered extirpated unless they have been unsuccessfully searched more than once in different years, and/or suitable habitat no longer exists at the site. Pop# refers to the number assigned to the known Canadian populations, for tracking purposes within this management plan only.

* The locational information for an additional four extant sites on the northern Bruce Peninsula is considered confidential. These four sites are thus not included in the list below.

NHIC = Natural Heritage Information Centre, Ontario Ministry of Natural Resources; KM = Kristina Makkay (COSEWIC 2005); BPNP = Bruce Peninsula National Park; DAO = Agriculture & Agri-Food Canada National Herbarium, Ottawa; WAT = University of Waterloo Herbarium; n/a = NHIC EO ID # not assigned.

Pop #	NHIC EO ID - COSEWIC pop #	Location	Ownership	Abundance	Last Observation	Previous Observation	Population Status
Bruce Peninsula							
1	13290 KM 019	Cabot Head – Lindsay Twp	Ontario Parks/Private (has ANSI designation)	Not found	Jalava, 2008	1993	Possibly Extirpated
2	3539 KM 009	W of Cameron Lake	Probably private	Not found (possibly extirpated)	Jalava, 2008	~500 plants Makkay 2003; "sparse" Catling & Brownell, 1983	Possibly Extirpated
3	n/a KM020	Crane Lake Road	Probably private	Sparse	Brinker 2006	40,000 Makkay 2003	Extant
4	13287 KM 017	McVicar Swamp & Crane Lake	BPNP/Private	4,000 (Makkay)	Brinker 2006	4,000 Makkay 2003; Johnson, 1991	Extant
5	n/a	Cyprus Lake Road	BPNP	Present; no info on abundance	Brinker 2006	none	Extant
6	92562	Emmett Lake Road	BPNP	Scattered plants	2008	Brinker, 2006	Extant
7	n/a	Halfway Dump Road wetland	BPNP	>100	Jalava 2008	none	Extant
8	13288 KM 018	Hope Bay Forest	Probably private	4m ² patch	Jalava 2008	Larson 1992	Extant

P o p #	NHIC EO ID - COSEW IC pop #	Location	Ownership	Abundance	Last Observa- -tion	Previous Observa- -tion	Popula- -tion Status
9	92559	Johnston Harbour- Pine Tree Point	Probably Crown land	Present; no info on abundance	Brinker 2006	none	Extant
10	21373 KM024	McLander Marsh	BPNP	~16,000	Makkay 2003	Johnson 1991; 1901	Extant
11	KM002	NE of Miller Lake	Private	Not found	Jalava 2008 (habitat altered)	~4000 Makkay 2003;	Extant
12	3532	Miller Lake (Brinkman's Corner Rd)	Municipal	Abundant	Johnson 2002	none	Extant
13	n/a	Sadler Creek	Private	Dense	Wilson 2008	none	Extant
14	92558 KM016	Scott Point	Probably private	10,000	Makkay 2003	none	Extant
15	21372 KM023	Shingle Marsh	BPNP	~2000	Makkay 2003	Johnson, 1991	Extant
16	KM021	Spring Creek	Crown land	Sparse	Jalava 2009	none	
17	92560	Umbrella Lake & vicinity	BPNP	Sparse	Brinker 2006	none	Extant
18	92565	Umbrella Lake Trail	BPNP	No info on abundance	Brinker 2006	NHIC	Extant
19	n/a	Zinkan Island Cove ANSI	Private	Sparse	Jalava 2009	none	
	3531 KM 001	Albermarle Brook / Hope Bay near Adamsville	Probably private	Probably Extirpated due to road impacts or other factors	Not found by Jalava 2008	Not found by Makkay, 2003; Hellquist 1983	Extirpated
	21371 KM022	Little Eagle Harbour	Probably private	Probably Extirpated; vague location data	Not found by Jalava, 2008	Not found by Makkay 2003; 1901	Extirpated
Manitoulin Island							
	n/a	Birch Island	Whitefish River FN	Unknown	Macdona ld 1987	Specimen in WAT; needs verification; (probably not <i>P. hillii</i>)	Unknown
20	3542 KM 012	Black Creek	Private	Not found	Makkay 2003	Occasional Hellquist 1983	Historical

P o p #	NHIC EO ID - COSEW IC pop #	Location	Ownership	Abundance	Last Observa- tion	Previous Observa- tion	Popula- tion Status
21	3535 KM 005	S of Mindemoya (=Mud Lake)	Private	Not found	Makkay 2003	Rare Hellquist 1983	Historical
22	3543 KM 013	N. of Providence Bay Rd (=Governme nt Rd)	Private	Not found	Makkay 2003	Abundant Hellquist 1983	Historical
23	13284 KM 014	Shrigley Bay-Marsh Lake	Private	No info	J.K Morton 2000	Noble, 1995 (=M&V?)	Extant
24	3540 KM 010	South Baymouth	Private	1000	Makkay, 2003	Abundant Hellquist, 1983	Extant
25	3541 KM 011	South Bay at the Leason Bay bridge	Private	6000	Makkay, 2003	Occasional Hellquist, 1983	Extant
Southwestern Ontario							
26	3538 KM 008	Bethel Creek (SSW of Mt Forest)	Probably Private	Not found	Makkay 2003	1978	Historical
27	13285 KM 015	Caledon Lakes Forest ANSI	Private	No info	1986	Near Orangeville	Historical
28	3534 KM004	Green Lake and Caledon Lake	Private and Town of Caledon (gravel pit)	100 (Makkay)	Followes & Varga 2004 Abundant	Oldham, 2003; Makkay, 2003; Abundant Hellquist 1983	Extant
29	3536 KM 005	Smoky Creek/Mallet River (SSW of Mt Forest)	Probably Private	4000	Makkay 2003	1978	Extant
	3533 KM 003	St. Thomas	Probably Private	Extirpated	1951	Not relocated despite several searches	Extirpated
Eastern Ontario							
30	n/a	Calabogie	Private	The dominant underwater plant, very dense	Thomson & Allen 2012	Thomson 2008; specimen in DAO, verified by P.M. Catling	Extant

P o p #	NHIC EO ID - COSEW IC pop #	Location	Ownership	Abundance	Last Observa- -tion	Previous Observa- -tion	Popula- -tion Status
31	n/a	Calabogie	Private	Small, but dense pop'n	Thomson 2013	n/a	Extant

APPENDIX C: DETAILED CHARACTERISTICS OF HILL'S PONDWEED HABITAT

The following are species associated with the habitat of Hill's Pondweed on the dolostone of the Bruce Peninsula:

Scattered trees:

Red Maple (*Acer rubrum*)
American Elm (*Ulmus americana*)
Green Ash (*Fraxinus pennsylvanica*)
Tamarack (*Larix laricina*)
Eastern White Cedar (*Thuja occidentalis*).

Tall shrubs:

Speckled Alder (*Alnus incana* ssp. *rugosa*)
Willow species (*Salix discolor*,
S. eriocephala, *S. petiolaris*, *S. candida*)
Red-osier Dogwood (*Cornus stolonifera*)
Nannyberry (*Viburnum lentago*).

Occasional Low shrubs:

Sweet Gale (*Myrica gale*)
Narrow-leaved Meadow-sweet (*Spiraea alba*).

Graminoids:

Wettest areas--
Green-fruit Bur-reed
(*Sparganium emersum* ssp. *emersum*)
Small's Spikerush (*Eleocharis smallii*)
Cyperus-like Sedge (*Carex pseudo-cyperus*).

Areas with less standing water or only intermittently flooded:

Reed Canary Grass (*Phalaris arundinacea*)
Bluejoint Reedgrass (*Calamagrostis canadensis*)
Tussock Sedge (*Carex stricta*)
Water Horsetail (*Equisetum fluviatile*).

Open water channels and small ponds often have submerged aquatic, floating-leaved aquatic, and free-floating aquatic components. Typical species in these zones include:

Greater Bladderwort (*Utricularia vulgaris*)
 Common Water-milfoil (*Myriophyllum sibiricum*)
 Floating Pondweed (*Potamogeton natans*)
 Common Mare's-tail (*Hippuris vulgaris*)
 Lesser Duckweed (*Lemna minor*)
 The alga *Chara vulgaris*.

According to Hellquist (1984) Hill's Pondweed is associated with *Potamogeton foliosus*, *P. natans*, *P. pusillus*, *P. amplifolius* and *P. gramineus* and rarely found with *P. strictifolius*, *P. friesii*, and *P. pectinatus* which are common in more eutrophic waters. Some examples of places where Hill's Pondweed is found (Jalava, 2009) include:

1. an embayment of a creek surrounded by thicket swamp;
2. open water of a beaver flood, under floating aquatics such as Duckweed (<i>Lemna</i> spp.);
3. a drawn-down beaver-flood after a dam has been let out;
4. in open water of a narrow, slow, stagnant stream surrounded by marsh with numerous snags;
5. a drawn-down beaver-flood, surrounded by Common Cattail (<i>Typha latifolia</i>), and Sweet Gale, with peat hummocks and organic muck substrate;
6. in open water of a stream flowing through a wetland dominated by Canada Blue-joint and Tussock Sedge;
7. in a 10 m x 15 m pool, in water 5-15 cm deep, in a drawn-down beaver-flood, surrounded by marshy thicket swamp with peat hummocks and organic muck substrate;
8. in the open water of a narrow brook, surrounded by thicket swamps and meadow marsh;
9. in open water of a marshy wetland dominated by Common Cattail and Soft-stem Bulrush (<i>Schoenoplectus tabernaemontanae</i>) with Water Smartweed (<i>Polygonum amphibium</i>);
10. in a small pond with abundant snags, with Northern Manna Grass (<i>Glyceria</i> cf. <i>borealis</i>) and Green-fruited Bur-reed (<i>Sparganium</i> cf. <i>emersum</i>), surrounded by scattered patches of Willow species and Common Cattail.

The following are species associated with the habitat of Hill's Pondweed on the Precambrian bedrock of eastern Ontario near Calabogie:

Submergent aquatics:

Whorled Water Milfoil (*Myriophyllum verticillatum*)
 Slender Naiad (*Najas flexilis*)
 Bullhead Lily (*Nuphar variegatum*)
 Water Knotweed (*Polygonum amphibium*)
 Berchtold's Pondweed (*Potamogeton berchtoldii*)
 Leafy Pondweed (*Potamogeton foliosus*)
 Grass-leaved Pondweed (*Potamogeton gramineus*)
 Floating Pondweed (*Potamogeton natans*)
 Flat-stemmed Pondweed (*Potamogeton zosteriformis*)
 Small Bladderwort (*Utricularia minor*)

Greater Bladderwort (*Utricularia vulgaris*)

Emergents:

Narrow-leaved Woolly Sedge (*Carex lasiocarpa*)

Three-way Sedge (*Dulichium arundinaceum*)

Small's Spike Rush (*Eleocharis smallii*)

Water Horsetail (*Equisetum fluviatile*)

Northern Manna Grass (*Glyceria borealis*)

Common Arrowhead (*Sagittaria latifolia*)

Great Bulrush (*Scirpus validus*)

Green-fruit Bur-reed (*Sparganium emersum* ssp. *emersum*)

Least Bur-reed (*Sparganium natans*)

Common Cattail (*Typha latifolia*)

Shrubs:

Speckled Alder (*Alnus rugosa*)

Narrow-leaved Meadow-sweet (*Spiraea alba*)

Steeple-bush (*Spiraea tomentosa*).