COSEWIC
Assessment and Status Report

on the

Dwarf Lake Iris
Iris lacustris

in Canada

SPECIAL CONCERN
2010

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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

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COSEWIC
Assessment Summary

Assessment Summary – November 2010

Common name
Dwarf Lake Iris

Scientific name
Iris lacustris

Status
Special Concern

Reason for designation
This globally vulnerable Great Lakes endemic is a small clonal perennial iris restricted in Canada to areas near the shore of Lake Huron in Ontario. Of 40 extant Canadian populations consisting of over 50 million stems, two thirds occur outside of protected areas and are susceptible to shoreline development. This species is also sensitive to road construction, trampling, and fire suppression. However, recent survey efforts, which greatly increased the known number of populations and number of plants, have reduced the level of risk for this species.

Occurrence
Ontario

Status history
Designated Threatened in November 2004. Status re-examined and designated Special Concern in November 2010.

COSEWIC
Executive Summary

Dwarf Lake Iris
Iris lacustris

Species information

Dwarf Lake Iris is a small perennial plant with flat, strap-shaped leaves that grow all in one plane. The plants spread by rhizomes, often forming large colonies of shoots. Flowers sit directly on the ground, not on a stalk, and have showy blue or purple petals with orange, bearded crests. When not in flower, Dwarf Lake Iris can be confused with Sticky False Asphodel, which grows in many of the same habitats.

Distribution

Dwarf Lake Iris is endemic to the Great Lakes basin and restricted to the northern shores of Lakes Michigan and Huron. There are 40 extant populations in Canada (all in Ontario), as well as 80 sites in Michigan and 15 in Wisconsin. The current Canadian range runs from southern Bruce County north to Tobermory and along the south shore of Manitoulin Island from the Owen Channel to the Carter Bay area, with a disjunct population at Belanger Bay.

Habitat

In Canada, Dwarf Lake Iris grows on alvars, dolostone bedrock shorelines, sand or gravel beach ridges, and in openings in coniferous woodlands. The majority of populations are within 500 m of the shore of Lake Huron, but the largest ones occur up to several kilometres from the lake. Wildfire has likely played an important role in creating habitat. In the absence of fire, natural succession eventually causes conditions to become unsuitable for Dwarf Lake Iris. This process may take anywhere from 50 to several hundred years. Shoreline development has completely removed or destroyed habitat in some locations, while at others it has improved habitat by opening the canopy and creating new open ground. Roughly 37% of the Canadian population is on land in protected areas.

Biology

Dwarf Lake Iris blooms from mid-May to early June. Plants are self-compatible, but natural fruit set and seed set are low. Age of maturity (from seedling to first flowering) is estimated to be at least seven years. Average age of individuals and generation time are unknown, but given the size of some colonies, it can be speculated that some plants live for decades. Seeds of Dwarf Lake Iris have an oily appendage that is attractive to ants, but dispersal distances are probably relatively small compared to the size of colonies. The species has very low genetic diversity. The total population is not considered to be severely fragmented.

Population sizes and trends

Several colonies documented in recent surveys are on the order of hectares, square kilometres, or in linear strips many kilometres in length. Currently, the total Canadian population totals over 50 million ramets, at least 50 times more than previously reported. This estimate includes extensive newly discovered populations, more comprehensive surveys of previously known sites, and a re-evaluation of existing data. There is little information on trends because most populations have had only one observation or had no previous abundance data. Eight populations of <10 m^2 or <1000 ramets are presumed to be in decline due to succession and shoreline development, and portions of a few extant sites are known to have been lost.

Limiting factors and threats

Threats resulting from human activity and natural or inherent limiting factors currently affect the survival of Dwarf Lake Iris. The threats are: shoreline development and road construction, loss of habitat from fire suppression, and trampling from ATVs, heavy machinery, pedestrians, and bicycles. The limiting factors include: inability to grow in shade; lack of insect pollinators; low genetic diversity; and low dispersal ability. Cottage development and trail use by ATVs or foot traffic may be either a threat or a benefit, depending on the degree or intensity of the activity. There are situations in which Dwarf Lake Iris can thrive with human activities.

Special significance of the species

Dwarf Lake Iris is endemic to the Great Lakes region, and populations in Ontario, Michigan, and Wisconsin comprise the entire global range. The species has no specific cultural use to humans and no medicinal or cultural use is known among local Aboriginal groups. However, the plant is conspicuous and showy when in flower and became the state wildflower of Michigan in 1998.

Existing protection

Dwarf Lake Iris is listed as threatened on Schedule 1 of the federal *Species at Risk Act* (SARA). The species is also listed as a threatened, transition species on Schedule 4 of the Ontario *Endangered Species Act (2007)* (ESA). Habitat for this species has not been regulated anywhere.

Part of the Dwarf Lake Iris population on the Wikwemikong Reserve is protected in an area that has been a protected wilderness since the mid-1980s (designated by a band council resolution). In this area, no logging, residential development, or hunting is allowed. Two national parks and several provincial parks and nature reserves also afford some protection to a number of populations.

The Global NatureServe rank for Dwarf Lake Iris is vulnerable (G3), nationally the NatureServe rank is vulnerable (N3) in Canada, and the Natural Heritage Information Centre ranks it as vulnerable (S3) in Ontario.

TECHNICAL SUMMARY

Iris lacustris
Dwarf Lake Iris Iris lacustre
Range of occurrence in Canada (province/territory/ocean): Ontario

Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated) *About 7 yrs from seedling to first flowering; however, most individuals are in long-lived asexually reproducing colonies.*	7+
Is there an observed, inferred, or projected continuing decline in number of mature individuals? This is a colonial, rhizomatous plant with tens of millions of ramets (shoots). Estimating number of mature individuals can be difficult in large colonies; areal extant is probably a better measure, Most populations have had only one observation where abundance or areal extant was recorded so trends are unknown. Most reproduction is clonal. With >50 million ramets in the total population and only one observation for most populations, it is difficult to detect or even infer a decline	Unknown
Estimated percent of continuing decline in total number of mature individuals within 5 years or 2 generations.	Unknown
Observed, estimated, inferred, or suspected percent reduction (or increase) in total number of mature individuals over the last 10 years, or 3 generations.	Unknown
Projected or suspected percent reduction (or increase) in total number of mature individuals over the next 10 years, or 3 generations.	Unknown
Observed, estimated, inferred, or suspected percent reduction (or increase) in total number of mature individuals over any 10 year or 3 generation period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible and understood and ceased?	Threats are known but not easily reversible
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence A polygon with no concave sides was drawn around all populations using Google Earth Pro. The area of the polygon was calculated by the software.	8,232 km²
Index of area of occupancy (IAO) Based on the total number of 2x2 km squares of the UTM grid that are occupied by the species on total range mapping.	348 km² 2x2 grid
Is the total population severely fragmented?	No
Number of "locations∗" Some populations are > 1 km^2 in extent; therefore number of locations may be several for a single population depending on type of threat. There are 40 extant populations separated by 1 km or more. The number of locations is not defined but is greater than 10 (a threshold number for COSEWIC's B criterion).	>10
Is there an observed, inferred, or projected continuing decline in extent of occurrence?	No

∗ See definition of location.

Is there an observed, inferred, or projected continuing decline in index of area of occupancy? Since the 1890s there has been a slight decline of 5% and future declines are expected if cottage and housing development continues to occur in the occupied areas.	Yes
Is there an observed continuing decline in number of populations? 5 additional populations were lost earlier	Slight decline loss of 2 populations since 1989
Is there an inferred continuing decline in number of locations?	No
Is there an observed continuing decline in area, extent and/or quality of habitat? Slow loss of habitat over 50-100+ years from succession; some habitat lost to development; some habitat improved (opened up) by human activities;	Net trend is a moderate reduction and a long-term decline in quality
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations∗?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each population)

Population	**N Mature Individuals**
Listed in Table 1 at the end of document. There are 40 populations.	*>50 million ramets*
This is a colonial, rhizomatous plant with tens of millions of ramets (shoots).	
Total	*>50 million ramets*

Quantitative Analysis

Probability of extinction in the wild?	None available

Threats (actual or imminent, to populations or habitats)

Threats include:
1. Shoreline development and road construction;
2. Trampling from ATVs, heavy machinery, pedestrians, or bicycles;
3. Fire suppression;

Limiting factors include:
1. Lack of insect pollinators;
2. Low dispersal ability;
3. Genetic isolation and low diversity;
4. Susceptibility to succession.

Threats #1 and #2 may be deleterious or beneficial depending on degree of human activity. #3 is serious but slow-acting (over 50-100+ years).

Rescue Effect (immigration from outside Canada)

Status of outside population(s)?	U.S.: threatened
Is immigration known or possible?	No
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Yes
Is rescue from outside populations likely?	Unlikely

Current Status

COSEWIC: Special Concern (November 2010)

Status and Reasons for Designation

Status: Special Concern	**Alpha-numeric code:** Not applicable
Reasons for designation: This globally vulnerable Great Lakes endemic is a small clonal perennial iris restricted in Canada to areas near the shore of Lake Huron in Ontario. Of 40 extant Canadian populations consisting of over 50 million stems, two thirds occur outside of protected areas and are susceptible to shoreline development. This species is also sensitive to road construction, trampling, and fire suppression. However, recent survey efforts, which greatly increased the known number of populations and number of plants, have reduced the level of risk for this species.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable.
Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable
Criterion D (Very Small Population or Restricted Distribution): Not applicable
Criterion E (Quantitative Analysis): Insufficient information

PREFACE

A great deal of new information has been gathered for Dwarf Lake Iris since the last status report. The extent of occurrence for this species has increased from 382 km^2 to a current 8232 km^2. Many new populations have been discovered, and some populations previously reported as only a few square metres in size have been found to cover many square kilometres. The largest population covers >14 km^2 and the second largest is >7 km^2. There are at least 40 extant populations and an estimated population size of >50 million ramets. Although trend data are still lacking (most populations have had only one observation where abundance or areal extent was recorded), the species is certainly at a much lower level of risk than previously thought.

COSEWIC HISTORY

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

COSEWIC MANDATE

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

COSEWIC MEMBERSHIP

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

DEFINITIONS (2010)

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

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

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

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

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

COSEWIC Status Report

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Dwarf Lake Iris

Iris lacustris

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2010

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SPECIES DESCRIPTION AND SIGNIFICANCE

Name and classification

Scientific Name: *Iris lacustris* Nutt.

Common Name: Dwarf Lake Iris, Iris lacustre

Family: Iridaceae (iris family)

Major plant group: Monocot flowering plant

Synonyms: *Iris cristata* Ait. ssp. *lacustris* (Nutt.) Iltis
Iris cristata Ait. var. *lacustris* (Nutt.) Dykes

Dwarf Lake Iris was considered a subspecies and a variety of Crested Iris (*Iris cristata*) (Dykes 1913; Mason and Iltis 1965) but is currently recognized as a distinct species based on morphology, habitat, range, and chromosome configuration and number (Foster 1937; Scoggan 1978; Henderson 2003). In the Flora of North America (Henderson 2003), Dwarf Lake Iris is separated from Crested Iris based on the former's smaller size, funnelform floral tubes, and sharply keeled spathes (a leaf-like covering over the ovary).

Crested Iris is found in rich woods in the southeastern United States (Cronquist 1991). It is not found anywhere in the range of Dwarf Lake Iris, so the two species are not found growing together. However, genetic evidence shows that at one time, both were part of a single species. A study of isozyme diversity (Hannan and Orick 2000) found that Dwarf Lake Iris probably had a relatively recent origin from a limited Crested Iris gene pool (see **Population genetic structure and variability**, below).

Morphological description

Dwarf Lake Iris is a perennial, small in stature (up to 20 cm in height), with flat, strap-shaped leaves (0.5-1.0 cm wide and 6-18 cm long) that grow all in one plane, spreading somewhat like a fan (Figure 1). The plants spread by rhizomes (underground stems), often forming colonies of ramets (individual shoots) that may cover large patches of ground, from a few square metres to several square kilometres (Figure 2). Flowers lack stalks and are enveloped at the base of the leaves (unlike the common Northern Blue Flag (*Iris versicolor*) where the flowers are on tall stalks). Flowers are 3-5 cm wide with three petal-like sepals and three showy petals with orange, bearded crests lying partly beneath small petal-like style branches. Flowers grow to a height of 10 cm and are usually blue to purple, but forma *albiflora* has white flowers (Cruise and Catling 1972). The fruit is a dry capsule.

Figure 1. Dwarf Lake Iris in flower (photo: Judith Jones).

Figure 2. A large colony of Dwarf Lake Iris ramets carpeting the ground (photo: Jarmo Jalava).

When not in flower, Dwarf Lake Iris can be confused with Sticky False Asphodel (*Triantha glutinosa*), which grows in many of the same habitats. Like Dwarf Lake Iris, Sticky False Asphodel has flat, strap-shaped leaves, and can form large colonies. The leaves of Sticky False Asphodel, however, tend to be narrower, fleshier, and darker green than those of Dwarf Lake Iris. These are not infallible characters and there is variation from plant to plant. Therefore, for a definitive identification, it is recommended to survey either in early June when the iris is in flower, or in mid-July to mid-August when the vertical, sticky stems and white flowers or reddish fruits of Sticky False Asphodel are present.

Population genetic structure and variability

Crested Iris has long been presumed to be the nearest relative of Dwarf Lake Iris as it is the only other iris with crested petals in eastern North America. Both species are polyploid (Pringle 1976) yet Crested Iris has a reported chromosome number of 2n=24, 32 and Dwarf Lake Iris 2n=32, 42 (Henderson, 2003). Hannan and Orick (2000) found genetic evidence for a geologically recent origin of Dwarf Lake Iris from a single, genetically depauperate Crested Iris gene pool. There is no detectable isozyme variation at any Dwarf Lake Iris locus, and nearly all isozymes found in Dwarf Lake Iris exhibited identical electrophoretic mobilities to Crested Iris.

The genetic data suggests a recent evolutionary origin for Dwarf Lake Iris. Populations on current lakeshore sites cannot be older than the glacial retreat 11,000 years ago (Karrow 1987) and are likely much younger because current lakeshore sites were inundated during the Nipissing period (9,000-6,000 years ago) (Morton and Venn 2000). The species as a whole is genetically depauperate, perhaps due to founder effects resulting from repeated population extinction and recolonization events. Also, the strong tendency of Dwarf Lake Iris to reproduce vegetatively, with new plants being established from rhizomes rather than from out-crossing, results in large colonies with numerous genetically identical individuals, perpetuating the low overall genetic diversity.

Designatable units

A single designatable unit is here recognized because of the restricted geographical range that is found within the Great Lakes Plains Ecological Area recognized by COSEWIC, the similarity of habitat across its range and the species low genetic diversity.

Special significance

Dwarf Lake Iris is endemic to the Great Lakes region. The populations in Ontario, Michigan, and Wisconsin comprise the entire global population. The plant is conspicuous and showy when in flower and became the Michigan state wildflower in 1998 (Michigan Natural History Magazine 2002). The species has no specific cultural use to humans. No medicinal or cultural use of this plant is known among local Aboriginal groups (King pers. comm. 1997; Chegahno pers. comm. 2009; Flamand pers. comm. 2009); however, the closely related Crested Iris was used for digestive ailments (Hamel and Chiltosky 1975).

DISTRIBUTION

Global range

Dwarf Lake Iris is endemic to the Great Lakes basin and is restricted to the northern shores of Lake Michigan and Lake Huron (Figure 3). In the United States, there are currently 80 sites known in Michigan (MNFI 2007) and 15 in Wisconsin (U.S. Fish and Wildlife Service 1988). Historically, the species was collected as far south as Milwaukee, Wisconsin and Windsor, Ontario, but these were considered historic populations before the early 1960s (Guire and Voss 1963).

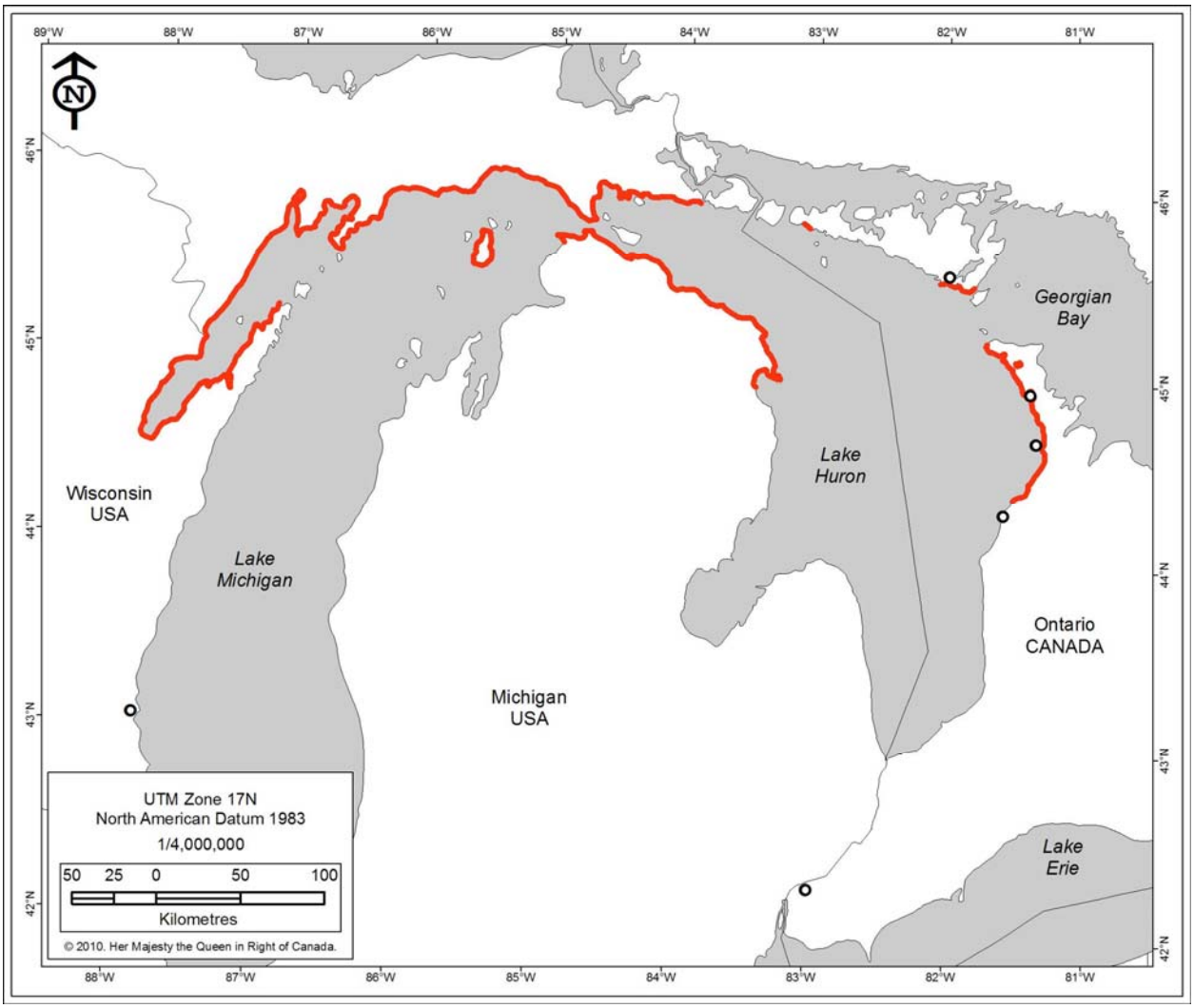

Figure 3. Global range of Dwarf Lake Iris. Width of range is slightly exaggerated: actual range is usually only within a few kilometres from the lakeshore, with a few exceptions. Open circles represent historic populations. Please note the distribution is not continuous as depicted on this map.

Canadian range

In Canada, Dwarf Lake Iris is only found in Ontario (Figure 4). With a few exceptions, it is almost always found along the Lake Huron shore or within a few kilometres of the shore. The current range extends along the Lake Huron coast in a 160 km strip from near Inverhuron in southern Bruce County north to Tobermory, and then west along the south shore of Manitoulin Island for roughly 30 km from the Owen Channel to the Carter Bay area. A disjunct population occurs 70 km west near Belanger Bay at the western end of Manitoulin Island. This population is closer to Michigan populations on Drummond Island than to the rest of the Canadian range. Approximately 40 populations are present in Canada, ranging in size from small patches of a few ramets to colonies of many square kilometres (Table 1).

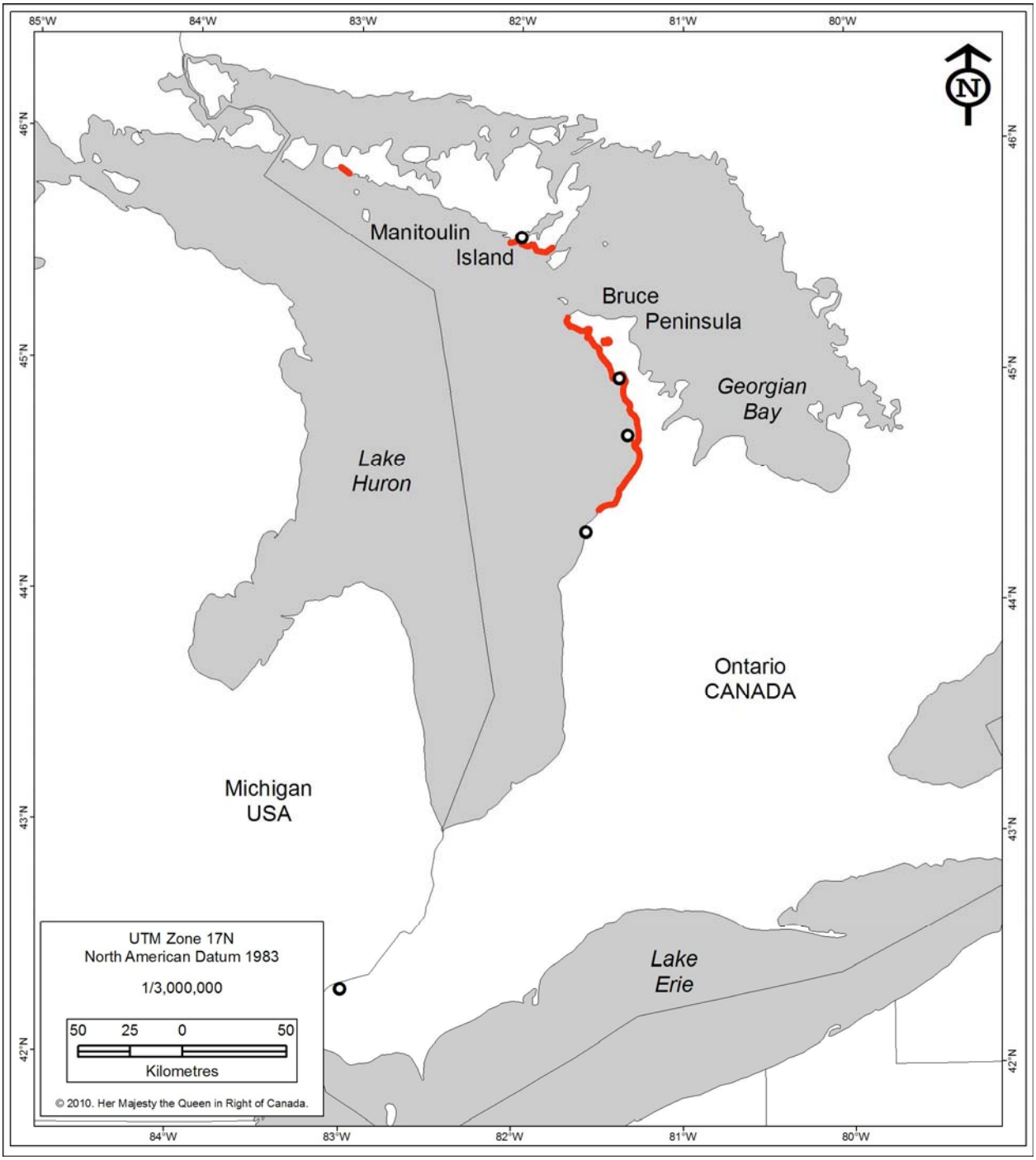

Figure 4. Canadian range of Dwarf Lake Iris (dark shading). Open circles represent historic populations. Width of range is slightly exaggerated: actual range is usually only within a few kilometres from the lakeshore, with a few exceptions. Please note the distribution is not continuous as depicted on this map.

Table 1. Extant, potential, and status unknown populations of Dwarf Lake Iris, showing previous and most recent observations and abundance.

Populations in italics have not been seen in more than 20 years and may be extirpated. They are listed at the end with potential sites because additional searching may still be needed. Observer key: JVJ—Jarmo Jalava; J2—Judith Jones; KM—Kristina Makkay; JKM—J.K. Morton; M&V—Morton and Venn; MJO—Michael Oldham. NHIC EO IDs with strike-through indicate site belongs to a different existing EO number or should be considered its own EO and requires a new number.

Site #	COSEWIC ID#	NHIC EO ID#	Ownership	COSEWIC Report Population Size (Makkay 2004)	Updated Population Size or Areal Extent (source: J2 or JVJ field work unless specified)	Last Observation	Comments	IAO 2x2
				MANITOULIN ISLAND				
1	042 034	7834 3160	Ontario Parks / OMNR shoreline	not visited	patches cover 10 ha	MJO 2004; J2 2000	034 / 3160 record is erroneous	4
2		??	Ontario Parks / OMNR shoreline	not visited	patches cover 2 ha	J2 2000		8
3	031	3157	Private / Municipal	not found	~10,000 ramets	J2 2006		4
4	NEW	NEW	Municipal	not reported	2 patches; <1,000 ramets	J2 2008		4
5	NEW	064 applied correct-ly	Municipal / private	not reported	Discontinuous over ~5.5 km of shoreline-- >1,000,000 ramets	J2 2006		12
6	032	3158	Private / Municipal	Main patch 40 m^2, ~ 730 shoots, 115 flowers. Patch 7.5 m^2, ~200 shoots, 50 flowers. Patch 1 m^2, 100 shoots, 35 flowers.	Discontinuously present over ~5 km of shoreline 1,000,000s of ramets	J2 2006		12
7	033	3159	Private	not found; ranked H	>10,000 ramets	J2 2007		4
8	NEW	NEW	First Nation	not reported	~75,000 ramets (Jones 2007, 2008a)	J2 & FN staff 2007		20
9	NEW	NEW	First Nation	not reported	> 7.5 km^2; 1,000,000s of ramets	J2 & FN staff 2007		44
10	030	3156	First Nation	not visited	>10,000 ramets	J2 & FN staff 2007		4
11	NEW	NEW	First Nation	not reported	>30,000 ramets	J2 & FN staff 2007		4
				BRUCE PENINSULA				
12		91764	private	2 small patches, 6m^2, ~1,000 ramets, 200 flowers + 1 m^2 patch		KM 2003 JKM 1973		8
13	023	3150	private / NGO nature reserves	not found	40,000 to 80,000 ramets	JVJ 2004		8
14	022	3149	private	Patch of 30 plants + patch 4m sq, ~1000 shoots, 1 flower	~11,000 ramets (2,148 ramets found in partial survey in 2007) (Jalava 2007)	JVJ 2007		12
15	017	3148	Bruce Peninsula National Park	~275,600 ramets in 24 patches covering ~464 m^2		KM 2003		16
			Bruce Peninsula National Park	not reported	265,000 to 280,000 ramets in 4 v. large patches on S of road; + approx. 3,600 ramets in 3 patches	JVJ 2007		
16			Bruce Peninsula National Park	not reported	no population data in 1991 report; not found in 2007 (Jalava 2007)	JVJ 2007		4
17			Bruce Peninsula National Park	not reported	~21,200 ramets (Jalava 2008a)	JVJ 2006		4
18			First Nation	not reported	Johnson, 1991	1991		8
19	038	5931	Bruce Peninsula National Park / Nature Conservancy of Canada	Coverage 53 m^2, in 3 patches, ~8600 shoots.	50,000 to 100,000 ramets in Corisande Bay ANSI; 95,361 ramets in 6 patches on trail to Rover Property; ~100 ramets at Rover Property	JVJ 2005		36
	53	64287	Provincial Nature Reserve	6,500 ramets over 50 m^2, + >500 ramets		JVJ 2006		

Site #	COSEWIC ID#	NHIC EO ID#	Ownership	COSEWIC Report Population Size (Makkay 2004)	Updated Population Size or Areal Extent (source: J2 or JVJ field work unless specified)	Last Observation	Comments	IAO 2x2
20	016	91788 91763 84794 3147	OMNR / NGO nature reserve / Private – Krug Forest	~630 m^2 cover in 5 patches, ~97,200 shoots in area of ~2ha + area of 3 small patches comprising 4.5 m^2 with ~1800 shoots.	~45,280,000 ramets estimated in a 14.5 km^2 area (Jalava 2007) + 430 ramets	JVJ 2007	Large area; contains 4 populations previously considered to be separate	20
21	015		Crown / Federal / private	~26,000 ramets covering 240 m^2	836 ramets found in two separate patches during partial survey (Jalava 2007)	JVJ 2007		16
22		3162	private	not reported (EO #36)	~12,000+ ramets Johnson 2004	JVJ 2006		4
23			private	not reported	"Several patches of several hundred plants"	Ecoplans 1999		4
24	041	5934	NGO Nature Reserve	not visited; ranked H	>1,500 ramets (Jalava 2008a)	JVJ 2006		4
25	013	3144	Private	1.5 m^2 patch, ~1,000 ramets; ~ 2200 reported by Schaefer, 1996	>3000 ramets	KM 2003	Makkay location is in different alvar from Schaefer's.	4
26	NEW	NEW	Private	not reported	>5,000 ramets	J2 2006		4
27		~~3142~~	Probably Private	not reported	1 m^2 patch; D. Sutherland & C. Jones	Sutherland 2004	> 1 km from EO 3142	4
28	010	3142	Private and Sauble Valley CA (Agreement Forest)	1 m^2 patch	~25,000 ramets in several patches (Jalava 2008c)	JVJ 2006		4
29	037	3163	NGO Nature Reserve	not found	<100 ramets in 2004 (NHIC 2008)	Maher 2004		4
30	011	64288	Private	~400 shoots		KM 2003		4
31	59	~~64288~~	Private	~4000 shoots/ 27 m^2		KM 2003	>1 km from EO 64288	8
32	"New site"	3140	Private	300,000 shoots	1992: "abundant"; ~2,250 shoots in 2008	JVJ 2008		4
		~~64288~~	Private	not reported	Large numbers	Atkinson, 1992 (in NHIC 2008)	"fen-upland border E end of Lot 39"	
33	040	5933	First Nation	not visited	No info	Schaefer 1996		4
34		18251	First Nation	not reported	No info	Johnson 1991		4
35		~~64288~~	First Nation	not reported	6000-7500 shoots	Johnson 2004	>1 km from 64288	4
36	007	92779	private	not found; possibly extant	~5,300 shoots in 10 patches within Walkers Woods Nature Preserve & 10,000 to 20,000 shoots in adjacent private yard	JVJ 2008		4
37	006	3138	First Nation	0.5 m^2 patch		KM 2003		4
				BRUCE COUNTY				
38	005	3137	private	1 m^2 patch	Not found in 2008 in 1 hour search (Jalava 2008c).	KM 2003		4
39	63, 65 027	3135 5930 3136	Ontario Parks	Abundant throughout park; Main population: 215,400 ramets in a 20 ha area NE end of park: 118 m^2, ~46,000 ramets Campground area; 26 m^2 ,~9000 shoots, + 1 m^2 patch	Areal extent estimated by Toth (pers. comm. 2008) shows a semi-continuous presence over ~10 km. Addition property: 2,200-4,200 ramets (Jalava 2005)	Toth 2008 Jalava 2005; Johnson 2004; Makkay 2003		20
40	002	3134	private / Saugeen Valley CA	not found	220 shoots in private yard in 2008	JVJ 2008	other small populations may persist in this area around private cottages	4

Site #	COSEWIC ID#	NHIC EO ID#	Ownership	COSEWIC Report Population Size (Makkay 2004)	Updated Population Size or Areal Extent (source: J2 or JVJ field work unless specified)	Last Observation	Comments	IAO 2x2
				POTENTIAL SITES OR STATUS UNKNOWN				
	035	3161	Fathom Five National Marine Park	Not visited	Not found in any recent surveys. JVJ found no suitable habitat in 2007 at mapped location; some potential habitat is still unsurveyed	20 plants reported by Bruce Peninsula NP staff in early 1980s	Mentioned in a park report (Brownell 1984)	
		3134	Private	Not reported	Not found by JVJ in 2008; Habitat severely altered	Present in a 1990 wetland evaluation	Other unsurveyed potential habitat still present	
	029	3155	Fathom Five National Marine Park	not visited; collected in 1982 by Morton (2008) "small patch"	not found by Jalava (2007) or Schaefer (1996)	M&V 1982		
		84791	Private	not reported	No population data in 1987 report; not found during 2007 survey, little suitable habitat (Jalava 2007)	M&V 1987		
	039	5932	Provincial Park	not found	not found	MacDonald 1982		

The number of locations is difficult to define for Dwarf Lake Iris, but with 40 extant populations and some that are more than several square kilometres in size, the number is certainly greater than 10 (the threshold for COSEWIC's B criterion). Large populations of Dwarf Lake Iris cannot constitute a single location because it is highly unlikely that a single threatening event could impact the entire area of the population, as required by the IUCN definition. The number of locations within a single large population would depend on the type of potential threat being considered, and the resulting number of locations at that population may be different for different threats. Furthermore, the 40 extant populations are all separated from each other by at least one km. Finally, the main threats are general or broad-acting, such as fire suppression and shoreline development that may act too slowly to be useful for the definition of location. Dwarf Lake Iris is currently estimated to have a population of more than 50 million ramets and is much more widespread than previously reported. The total population is not severely fragmented.

The Canadian population could make up as much as 30% of the global distribution, based on numbers of populations known globally (40 out of a global total of 135). However, this does not take into consideration the size of each population.

Extent of occurrence and area of occupancy

The extent of occurrence (EO) for this species is 8,232 km^2. Much of the area of this polygon is Lake Huron waters between the Bruce Peninsula and Manitoulin Island. The index of area of occupancy (IAO) based on 2x2 km squares is 348 km^2. The IAO was derived by counting the number of 2x2 km squares of the UTM grid occupied by the species on 1:50,000 scale topographic maps (Table 1).

Historic or extirpated populations

Dwarf Lake Iris was reported in 1874 by Macoun from the Fishing Islands, Bruce County, but has not been seen there since (Table 2). A specimen was collected by Macoun (CAN) in 1901 from Sandwich, Ontario, now the City of Windsor, but there are no subsequent reports, and urbanization has likely destroyed the habitat. A population on the east side of South Baymouth has not been seen since the 1950s. Other historic records include a 1954 report from Stokes Bay on the Bruce Peninsula and a 1989 collection from Inverhuron Provincial Park, neither of which were relocated by Makkay (2003) or by Jalava (2008a). The species has never been reported as common south of Bruce County as no other historic reports south of that area exist (Guire and Voss 1963; COSEWIC 2004).

Table 2. Occurrences of Dwarf Lake Iris presumed extirpated or historic (ranked SH or SX).

COSEWIC ID#	NHIC EO ID#	Location Name	Ownership	COSEWIC Report Population Size (Makkay 2004)	Recent survey work?	Last Observation	Comments
		Wikwemikong #5	FN	Not reported	Not found 2006 or 2007	Jones, 1997	Habitat altered
001	3133	Inverhuron Provincial Park	Ontario Parks	Not found	Not found by JVJ in intensive search in 2008.	1989	Presumed extirpated
047	3159	South Baymouth (E side of town)	Private/municipal	Not found	Not found in 2006	1959	Habitat gone
014	3145	Stokes Bay	Private	Not found		1954	
024	3151	South of Tobermory	unknown	Not found	Not found in 2003	1931	Location data very vague; could be a current population known by a different name.
	3154	Sandwich (Windsor)			Now in City of Windsor; Habitat gone.	1901	
026	3153	Fishing Islands	Mostly Private		Not found by JVJ during ANSI inventory (Jalava 2006c) or in previous studies at these islands.	1874	

Potential populations or status unknown

The species was collected from Bear's Rump Island in 1982 (Brownell 1984: Morton pers. comm. 2009) and Doctor Island in 1987 (NHIC 2008), and was reported from Cove Island (Morton and Venn 1987). These islands are off the northern tip of the Bruce Peninsula. These populations may be extirpated as they have not been relocated in more than 20 years despite recent survey work (Schaefer 1996; Jalava 2008a). A population near Scott Point (Bruce County) documented in a wetland evaluation is presumed extirpated by habitat alteration, but the general area may still contain some populations and is considered a potential site with unsurveyed suitable habitat (Jalava 2008a). Potential or status unknown populations are shown in Table 1.

Erroneous records

Three Manitoulin records for Dwarf Lake Iris in the database of the Natural Heritage Information Centre (NHIC; Ontario Ministry of Natural Resources) are presumed erroneous. First, the species was reported from Fitzwilliam Island by Noble (1995) although never seen there by J.K. Morton and J. Venn (Morton and Venn 2000; Venn pers. comm. 2009). In recent survey work, Jones (2008a) found extensive patches of Sticky False Asphodel filling almost all habitat suitable for Dwarf Lake Iris, and no Dwarf Lake Iris. Second, there is a record from Maiden Island off the south shore of Manitoulin Island near Michael's Bay. The actual location data from Morton and Venn (Venn pers. comm. 2006) say "East of Maiden Island", and refer to a location on the shore of Manitoulin Island. Survey work (Jones 2008a) confirmed there are no Dwarf Lake Iris and no suitable habitat on Maiden Island itself. Third, there is a record for Girouard Point, at the southern part of Belanger Bay. This site was listed in COSEWIC (2004) but not surveyed. The actual location data from the 1969 Winterhalder collection say "1 km north of Girouard Point" and refer to the main population at Belanger Bay (Venn pers. comm. 2006). Jones (2006) surveyed Girouard Point and found no iris in this area and all potential habitat was overgrown.

Two Bruce Peninsula records are also presumed erroneous. A collection by Krotkov in 1933 from "Big Bay", was erroneously treated by Argus *et al.* (1982-1987) as being on the Georgian Bay side of the Bruce Peninsula rather than on the Lake Huron side as mapped by Krotkov (1940) and was referenced in COSEWIC (2004). The collection is believed to have come from Dorcas Bay (NHIC 2008). A record from Cove Island from the early 1980s may also be erroneous. The mapped location was searched (Jalava 2007), and the habitat was relict cobble beach unsuitable for Dwarf Lake Iris. It is still possible that the species occurs elsewhere on this large island, as there is habitat that is potentially suitable. Erroneous and unconfirmed records are shown in Table 3.

Table 3. Erroneous records for Dwarf Lake Iris.

Last observation or record source	COS ID #	EO ID#	Region	Specific Location	Comments
1969 collection by K. Winterhalder		3160	Manitoulin	N of Girouard Point	Data entry error at NHIC; Location is 1 km N of Girouard Pt. and refers to East Belanger Bay population.
1973 collection by J.K. Morton and J. Venn	064	84805	Manitoulin	"Maiden Island" (according to NHIC base data)	Data entry error at NHIC; Location from M&V collection actually says "East of Maiden Island" NOT Maiden Island itself; 2008 survey of Maiden Island found no Iris and no suitable habitat. Record refers to Michael's Peninsula population.
Mentioned in 5E-2 GAP analysis (Noble 1995)	067	84804	Manitoulin	Fitzwilliam Island	A 2008 survey found no Iris present and extensive populations of Sticky False Asphodel filling all suitable habitat.
1933 collection by Krotkov				"Big Bay"	Probably refers to Dorcas Bay, not on Georgian Bay.

HABITAT

Habitat requirements

Dwarf Lake Iris is found on moist sands, gravel, and limestone crevices (Voss 1972). In Canada, it grows on alvars and dolostone bedrock shorelines, on relict sand or gravel beach ridges, and in calcareous soils in openings in coniferous woodlands and along woodland edges. It is sometimes found in moist habitats, such as the fringes of graminoid fens. In the U.S. it also occurs on sandy beaches (Penskar *et al*. 2001). Occasionally it colonizes disturbed sites (Trick and Fewless 1984).

The species is most frequently found at the back of the shore along the treeline, with the majority of locations within 500 m of the shore. However, the largest populations occur at inland locations, up to several kilometres from Lake Huron, in coniferous woodland with numerous gaps in the canopy, or along relict post-glacial shorelines (old beach ridges). One Bruce Peninsula occurrence is more than 10 km from the Lake Huron shore (Jalava 2008a).

Forests containing (or surrounding) habitat are usually dominated by Eastern White Cedar (*Thuja occidentalis*) or Balsam Fir (*Abies balsamea*). The species may also be found under Trembling Aspen (*Populus tremuloides*), Red Pine (*Pinus resinosa*), Jack Pine (*P. banksiana*), White Pine (*P. strobus*) and White Spruce (*Picea glauca*). Common associates of Dwarf Lake Iris include Bearberry (*Arctostaphylos uva-ursi*), Richardson's Sedge (*Carex richardsonii*), Ebony Sedge (*C. eburnea*), and Fringed Polygala (*Polygala paucifolia*). The abundance of Dwarf Lake Iris in open woodlands of Jack Pine and Red Pine (both largely fire-dependent species) and in areas of Manitoulin Island known to have burned (Jones 2007, 2008 unpublished data; Flamand 2007 unpublished data), suggests that wildfire has played a role in creating habitat.

Dwarf Lake Iris can tolerate a wide range of microclimates, soil types, and pH but grows and reproduces optimally on shallow, well-drained soils in semi-shade. In Michigan flower and fruit production were highest with intermediate light levels, young soils, and a water table >25 cm below the surface (Van Kley and Wujek 1993). Engelken (2003) found that reproductive success was highest among populations with relatively open tree canopies.

Why Dwarf Lake Iris has such a restricted range and does not grow in apparently suitable habitat elsewhere near Lake Huron and Georgian Bay is not clear. Low dispersal ability and slow colonization after glaciation are possible factors (Jalava 2008b).

The current distribution of habitat for Dwarf Lake Iris is probably based on the post-glacial and climatic history of the area. Evidence from charcoal deposits shows that during the Hypsithermal period (approximately 6500 years ago) extensive fires swept through the region (Morton and Venn 2000), so presumably there was much more open ground available. Current Dwarf Lake Iris range may be the remains of ancient suitable habitat after 6500 years of natural succession and forest development (interrupted periodically by both natural and human-caused fires). Thus, Dwarf Lake Iris may not be restricted to shorelines, but rather shores provide the only remaining suitable habitat.

Habitat trends

In the absence of fire or other ecological processes, the natural, long-term trend in the habitat is for vegetation cover to increase, the canopy to close, and for conditions to become unsuitable for Dwarf Lake Iris. This process may take from 50 to several hundred years, based on comparable rates of change found for alvars (Jones and Reschke 2005). Across the Canadian range of the species, habitat is currently in all the intermediate stages from very open to nearly closed and unsuitable. See **Populations Sizes and Trends** and **Threats and Limiting Factors** sections. No data exist on historic amounts of habitat or on trends in amount of habitat loss from succession.

Shoreline development and subdivision is also changing the habitat of Dwarf Lake Iris. Development has removed or destroyed habitat in some locations, while at others it has improved habitat by opening the canopy and creating new open ground. See **Threats and Limiting Factors** section for a detailed discussion.

BIOLOGY

Life cycle and reproduction

Dwarf Lake Iris blooms from mid-May to early June. The flowers are perfect (containing both stamens and pistils) and usually open for about three days. Age at sexual maturity has been estimated to be at least seven years (from seedling to first flowering) (Planisek 1983). The average age of plants/colonies and generation time are unknown. Average age is difficult to measure even from rhizome nodes because rhizomes fork frequently and criss-cross underground. No data on the age of plants or colonies exist, but from the size of some colonies (on the order of many square metres or even square kilometres) it is likely that at least some plants live for many decades.

Environmental factors influence reproduction in Dwarf Lake Iris. In low light or high moisture situations, flowering, fruit, and shoot density decline (Van Kley and Wujek 1993; Engelkin 2003). In these situations, colonies often persist for many years spreading only by vegetative growth. Plants are self-compatible, but natural fruit set and seed set are still low (Hannan and Orick 2000). Self-pollination is more common than cross-pollination and results in a higher fruit set, but seed set was about half that of available ovules (Planisek 1983). Seeds germinate sporadically after long periods of dormancy (Makholm 1986).

Halictid Bees (*Augochlorella striata*) (Larson 1998), bumble bees (*Bombus* spp.), the Bee Hawk-moth (*Hemaris affinis*), and a species of rove beetle (Engelken 2003) visit Dwarf Lake Iris flowers. The Halictid Bees also visited other flowers, suggesting their relationship to Dwarf Lake Iris is not highly specialized (Larson 1998). Bumble bees are also generalists (Colla and Dumesh 2010). Presence and effectiveness of pollen vectors is likely a limiting factor (Engelken 2003).

Artificial propagation and commercial uses

Dwarf Lake Iris has been successfully propagated at the W.J. Beal Botanical Garden in Michigan although seed set is no more successful than under natural conditions (Chittenden 1995). Dwarf Lake Iris is also a popular rock garden plant with several companies selling seeds commercially (COSEWIC 2004). The source of plants and seed for commercial purposes is unknown. Dwarf Lake Iris transplants from Manitoulin Island were grown and successfully fruited in a private garden in Ottawa, Ontario for a number of years until they were crowded out by grass (Jones, unpublished data). This suggests that microclimate along the shores is not necessarily a requirement for Dwarf Lake Iris.

Physiology and adaptability

Dwarf Lake Iris is a perennial that dies back to its rhizomes and goes dormant in winter. New growth comes from the rhizomes in spring. The locations of past years' shoots can be detected from swollen nodes on the rhizome.

Apparent intolerance to high levels of sunlight may represent sensitivity to drought (COSEWIC 2004). The species tolerates a wide range of soil types including sand, gravel, and loess over limestone, and has been observed growing in soil with pH ranging from 5.4 to 7.5 (Van Kley and Wujek 1993).

With extremely low genetic diversity and a restricted geographic range, the adaptability in Dwarf Lake Iris is low. However, there are situations in which Dwarf Lake Iris can thrive with human activities. Maintaining semi-open conditions near cottages can be favourable to Dwarf Lake Iris, and there are many situations where the species is thriving (see *Anthropogenic threats*). Light use of all terrain vehicles (ATVs) can sometimes benefit Dwarf Lake Iris when it keeps trails open in overgrown habitat. Dwarf Lake Iris thrives along the edges of (and even right in) lightly travelled driveways and trails. This is especially true where the surrounding habitat has become too shaded or overgrown. Dwarf Lake Iris tolerates light mowing and raking near cottages and thrives in some regularly mowed roadside ditches.

Dispersal

Seeds of Dwarf Lake Iris have a white, corkscrew-shaped elaiosome (an oily appendage) which may serve as food to ants (Chittenden and Carrinton 1996). More than one species of ant, as well as a centipede, have been observed moving seeds (Planisek 1983). The distance of dispersal is unknown. Given the colonial habitat of Dwarf Lake Iris and its ability to cover large patches of ground, dispersal by ants would seem to move seeds only a very short distance relative to size of the colonies, some of which are many square kilometres in size. The total population of Dwarf Lake Iris is not considered severely fragmented according to COSEWIC definitions, although there are large geographic distances among most populations, especially in the context of seeds that are ant-dispersed.

Interspecific interactions

Field observations (Jones and Jalava pers. obs. 1996-2009) suggest little evidence of browsing. Insect larvae and chipmunks have been observed consuming the capsules (Makholm 1986).

POPULATION SIZES AND TRENDS

Sampling effort and methods

On Manitoulin Island, nearly all of the south shore of the island has been surveyed as part of more than seven different projects mapping alvars and species at risk (Reschke *et al*. 1999; Jones 2008a,b, 2007-2000; Jones and Jalava 2008; etc.). Since 2004 all known records for Dwarf Lake Iris were searched (see Table 1 for most recent observations). In 2007-2008 the Wikwemikong Unceded Indian Reserve (WUIR) completed an extensive survey for species at risk. All suitable habitat for Dwarf Lake Iris was surveyed (Jones 2007). The populations at Belanger Bay were mapped (Jones 2000).

On the Bruce Peninsula and in southern Bruce County, 31 of approximately 35 previously reported Dwarf Lake Iris occurrences have been inventoried since 2002 (Makkay 2003; Jalava 2008a,b,c, 2007; NHIC 2008). The remaining reported populations either had vague location data or were on lands where permission to survey was not obtained.

Abundance

Abundance is difficult to quantify for Dwarf Lake Iris. The species can be locally common to abundant where it occurs, forming large colonies and dense patches. Several colonies documented in recent surveys cover hectares, square kilometres, or linear strips many kilometres in length (Jalava and Jones 2008). In these situations, the number of ramets may run into the tens of millions. Therefore, the order of magnitude of the number of ramets is probably more important than the actual value. The number of ramets can be estimated by counting the number present in one square metre in a dense patch, in a moderate patch, and in a sparse patch, and then assessing how many square metres of each density are present and multiplying by the number of ramets per square metre of each density.

What constitutes an individual for this rhizomatous, colonial plant depends on how "individual" is defined. COSEWIC (2010) defines a mature individual as follows: "reproducing units within a clone should be counted as individual, except where such units are unable to survive alone." Thus, ramets are considered mature individuals. However, the number of genetic individuals of Dwarf Lake Iris is unknown, and large clusters of ramets may all be part of one genetic individual. If most ramets in very large colonies are clones of one genetic individual, then even with flowering, pollination, and seed set there may be a low potential for outcrossing. However, because most reproduction is vegetative, it is unknown whether a lack of outcrossing or genetic isolation is a limiting factor.

There is a great deal of new information now known about the distribution of Dwarf Lake Iris, which shows the species to be much more extensive and abundant than previously reported. COSEWIC (2004) estimated the total Dwarf Lake Iris population in Ontario to be approximately one million ramets, but none of the populations used to make this calculation were bigger than a few hundred square metres (Makkay 2003). In addition, Makkay did not visit or did not know about 25 of the 40 currently extant populations. Some populations listed in COSEWIC (2004) are actually vastly larger than formerly portrayed. For example, Bruce site #20, listed as ~3 ha in size, actually covers >14 km^2, and the Manitoulin site around South Baymouth (#032 in COSEWIC 2004), listed as a few square metres, is in fact two populations that stretch along the shore for more than 10 km (Manitoulin sites #6 and #7).

With the discovery of new populations, more comprehensive surveys of previously known sites, and a re-evaluation of existing data, the abundance estimate is now much higher. Currently, the Canadian population probably totals > 50 million ramets; this new estimate is at least 50 times greater than COSEWIC (2004). This increase is due to new discoveries and better surveying and not the result of growth by the species.

Jones (2008) estimated the actual areal extent of Dwarf Lake Iris in the Manitoulin District to be 9 to 10 km^2. Jalava (2008a) estimated the areal extent on the northern Bruce Peninsula to be ~15.5 km^2 and that Southern Bruce County populations probably cover no more than 0.5 km^2. Thus the overall areal extent in Canada is ~25 km^2.

Fluctuations and trends

Fluctuations and trends are difficult to judge because most populations have only been surveyed once or had previous observations with no abundance data recorded.

Although no trends have been documented for Dwarf Lake Iris populations, there are eight populations that are <10 m^2 in size or <1000 ramets (sites 3, 12, 24, 27, 29, 30, 37, and 38: Table 1). These are in areas where the canopy is closing due to succession or where habitat has been altered or destroyed by human activity. Their small size suggests that these populations are declining.

Portions of some populations have been lost making these populations smaller than they were 15 years ago. Unknown amounts of Sites #3 and #7 have been lost to cottage development and access road construction, but small populations still remain around some cottages (Jalava 2008a).

On the other hand, 10,000-20,000 ramets “appeared” at Site #36 in a private yard after duff was removed by the landowner (Jalava 2008a). Adjacent lots with duff cover did not appear to have any plants present.

Rescue effect

Because there are some disjunct populations of Dwarf Lake Iris (e.g., Belanger Bay) and populations on islands, the species probably is capable of occasional long-distance dispersal. The movement of rhizome fragments by water (e.g., after flooding, ice scour, or storms) would seem to be a potential long-distance dispersal mechanism. Seeds are dispersed locally mainly by ants. However, it is highly unlikely Canadian populations could be rescued by U.S. populations. Populations in Michigan in Alpena and Presque Isle Counties are separated from the main Canadian population by hundreds of kilometres and by Lake Huron. Even the most western populations at Belanger Bay on Manitoulin Island are >50 km from the nearest populations on Drummond Island, with barriers of open water, and unsuitable habitat on Cockburn Island intervening.

THREATS AND LIMITING FACTORS

Three threats resulting from human activity and four natural or inherent limiting factors currently affect the survival of Dwarf Lake Iris. There are also some potential threats. The anthropogenic threats are:

1. Shoreline development and road construction;
2. Trampling from ATVs, heavy machinery, pedestrians, or bicycles;
3. Fire suppression.

The limiting factors are:

1. Species-specific habitat requirements making it susceptible to the threat of loss of habitat from succession exacerbated by fire suppression;
2. Lack of insect pollinators;
3. Low dispersal ability;
4. Low genetic diversity.

Anthropogenic threats

Residential development and road construction along the Lake Huron shoreline impact Dwarf Lake Iris and its habitat. Clearing of land and construction of buildings, driveways, and roads directly damages plants, dislodges shallow soils, and can completely destroy habitat. Planting of lawns also causes removal of vegetation, sometimes with the addition of fill and top soil which may bring weeds into the habitat. These threats have been especially severe in Bruce County and in the Carter Bay and South Baymouth areas of Manitoulin Island, where the shoreline is being subdivided and habitat is being lost to cottages and second homes.

On the other hand, many cottagers leave their lots in a relatively natural state, and some clearing of trees can create canopy gaps that improve Dwarf Lake Iris habitat (Jones and Jalava pers. obs. 1996-2008; COSEWIC 2004). Therefore, cottage development may be either a threat or a benefit depending on the intensity of the activity, and based on the observations of Jones and Jalava (pers. obs. 1996-2008), there certainly are situations in which Dwarf Lake Iris can thrive with human activities.

Use of heavy machinery or ATVs in Dwarf Lake Iris habitat destroys individual plants, displaces shallow soils, causes rutting, and introduces weed species. The difficulty of controlling ATV use makes it a serious concern, even though there may be some localized benefits (see next). Heavy machinery use is a moderate threat to some of the Manitoulin Island First Nation populations, and ATV use is a threat to those populations as well as to some non-park Bruce Peninsula populations.

Light use of ATVs can sometimes be a benefit to Dwarf Lake Iris when it keeps trails open in overgrown habitat (see **Physiology and adaptability**). Therefore, as with cottage development, trail use may be either a threat or a benefit, depending on the degree or intensity of the activity.

Natural limitations

Loss of habitat through succession is a limiting factor to Dwarf Lake Iris (Jalava 2008a; Jones and Jalava pers. obs. 1996-2008), which is exacerbated by fire suppression. Low light levels result in fewer flowers and fruit. Succession to closed-canopy forest reduces reproductive success. At many sites Jones and Jalava (pers. obs. 1996-2008) have observed sterile colonies of ramets under full canopy with no flowers present. At many sites only a few ramets or small patches of ramets are left because habitat has closed in or become overgrown. Habitat change through succession is widespread and is present at almost all small colonies making it one of the main factors limiting colony size.

Open woodland habitat was more common 100 to 150 years ago after wildfires (Jones and Reschke 2005). The largest known populations of Dwarf Lake Iris occur in these historic burned areas. Wildfire on the scale that was historically present may never occur again. Therefore, human suppression of wildfire now limits the species.

Availability and effectiveness of insect pollinators may be an inherent limiting factor for Dwarf Lake Iris. Planisek (1983) found that while 13% of growing tips produced flowers, only 3% produced fruit. This is in spite of the fact that Dwarf Lake Iris is self-compatible and self-pollination does occur (Larson 1998). Engelken (2003) examined reproductive success in Dwarf Lake Iris in three different habitat types on the Bruce Peninsula. He found hand-pollinated flowers showed fruit set 15 to 25% greater than control flowers left open to natural insect pollination. In all three habitats, control flowers had less than 5% fruit set. The study concluded that sexual reproduction is highly limited by pollen dispersal and by a lack of adequate pollen vectors. It also suggested that Dwarf Lake Iris is not attractive to potential pollinators and that the amount of fruit set may be linked to the types and numbers of pollinators that are present.

Bumble bees are believed to be a pollinator of Dwarf Lake Iris, and recent studies (e.g., CSPNA 2006) document declines in native bees and other insect pollinators. It is unknown whether this limiting factor could be affecting populations of Dwarf Lake Iris. Dwarf Lake Iris mostly spreads by vegetative reproduction, so a lack of sexual outcrossing may not be a serious problem for the species. The lack of insect pollinators is presented here as a potential limitation that may prevent the species from possibly being more widespread or more resistant to habitat damage.

Low dispersal ability may also be an inherent limitation, but this has not been studied.

Low genetic diversity increases the potential for loss of individual populations due to disease. It also reduces the ability for the species as a whole to adapt to long-term environmental change. This limiting factor probably applies to the entire Canadian population and especially to the smallest subpopulations.

Other potential threats

Herbicides and road salt are listed as threats to U,S, populations of Dwarf Lake Iris (NatureServe 2009). The majority of Canadian Dwarf Lake Iris populations are situated away from major roads and therefore are not subject to these impacts. At present, impacts from collecting appear low or negligible. Jalava (2008b) listed lack of public awareness as a potential threat, explaining that landowners might inadvertently destroy sterile Dwarf Lake Iris plants and habitat.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

Legal protection and status

Dwarf Lake Iris is listed as threatened on Schedule 1 of the federal *Species at Risk Act* (SARA). SARA provides protection for plants of Dwarf Lake Iris on federal lands (National Parks, Department of Defence lands, First Nations, etc.). The recovery strategy (Jalava 2008b) has been posted on the SARA Public Registry, which identifies critical habitat.

Dwarf Lake Iris is listed as a threatened, transition species on Schedule 4 of the Ontario *Endangered Species Act (2007)* (ESA). The ESA legally protects plants of Dwarf Lake Iris on all lands in Ontario. The ESA will also protect the regulated habitat of the species in Ontario by June 2013 if its status remains as threatened. Habitat for this species has not yet been regulated anywhere. The Ontario *Provincial Parks and Conservation Reserves Act (2006)* mandates parks and conservation reserves to manage lands to maintain the ecological integrity of habitats for native species including species at risk.

In the United States, Dwarf Lake Iris has been designated threatened and legally listed as such under the U.S. *Endangered Species Act* since 1988.

Non-legal status and ranks

In Canada, Dwarf Lake Iris has a national NatureServe rank of vulnerable (N3). In Ontario, Dwarf Lake Iris is also ranked vulnerable (S3) (Oldham and Brinker 2009).

In the United States the species is ranked nationally as vulnerable (N3), as well as vulnerable (S3) in both Michigan and Wisconsin. The most recent review of the American status of the species was initiated in 2007 (USFWS 2009). The species is ranked vulnerable globally (G3) (NatureServe 2009).

Habitat protection/ownership

Of the 40 populations in Canada:

- 13 are entirely on privately owned land
- 9 are entirely within provincial or national parks or private nature reserves
- 5 are partly on private land and partly in Provincial or National parks, Conservation Authority land, private nature reserves, or Crown or federal land
- 9 are entirely on First Nations lands
- 3 are partly on private land and partly on municipal land
- 1 is entirely on municipal land

Roughly 37% of the Canadian population occurs on lands under some type of protective ownership which does not include populations on private land within Areas of Natural and Scientific Interest (ANSIs).

Part of the Dwarf Lake Iris population on the Wikwemikong Reserve is in an area that has been a protected wilderness since the mid-1980s (designated by a band council resolution). In this area, no logging, residential development, or hunting is allowed.

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Judith Jones B.S., M.S., has been an independent biological consultant since 1995. Her work covers a broad range, including alvar ecology, inventories of natural areas, the sustainable harvest of Canada Yew (*Taxus canadensis*), environmental impact studies of proposed developments in Southern Ontario, and recovery of species at risk. She is the author of several COSEWIC status reports and recovery strategies and sits on a number of recovery teams. She has been working on Dwarf Lake Iris since 1996.

Jarmo Jalava is a consulting ecologist who has been involved in species at risk (SAR) and conservation planning work in Ontario since 1978. He has authored or co-authored more than 100 ecological reports, papers, and articles, and has inventoried hundreds of natural areas in southern and central Ontario. He is the author or coauthor of many SAR recovery strategies and a COSEWIC status report.

COLLECTIONS EXAMINED

No collections were examined for this updated report. Almost every recorded location has been visited within the last 10 years.